SRINIVAS INSTITUTE OF MANAGEMENT STUDIES

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MANAGEMENT INFORMATION SYSTEMS
&
COMPUTER APPLICATIONS

MBA II Semester

SRINIVAS GROUP
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1. INTRODUCTION :

1.1 Organization

Organizations are formal social units devoted to the attainment of specific goals. Organizations use certain resources to produce outputs and thus meet their goals. For example, a business firm that produces semiconductor memory chips consumes certain resources (money, materials, labor, machinery, and information) and aims to meet certain financial objectives. A nonprofit hospital applies its resources to provide health care to its target population.

Although the type of organization would largely depend on the size and nature of the enterprise, yet there are 4 common forms of organizational structure, namely

(a) line organization
(b) functional organization
(c) line and staff organization
(d) committee organization

(a) **Line organization** : This is one of the oldest and simplest form of organizational structures and is also known as scalar organization, military organization, vertical organization or departmental organization. Under this organization structure, the line of authority flows vertically from the top most executive to the lowest subordinate. The authority concentrates in the hands of the topmost executive who delegates it to his subordinates, the subordinates delegate to their subordinates and so on. Thus the authority reduces at each successive level down the organization. The line organization is thus based on the superior – subordinate relationship.

(b) **Functional organization** : As the name suggests, under this type of organizational structure, all activities in the organization are grouped together according to basic functions like production, marketing, finance, human resource etc. Each function is put under the charge of a specialist who is fully responsible for carrying out the function for the entire enterprise. The authority flows functionally to the divisional heads. The divisional heads report to one specialist with reference to one function and to another, for another function

(c) **Line and staff Organization** : This type of organization has been evolved to achieve the advantages of the two forms of the organizational structures mentioned above. While the line organization insists too much on the unity of command, the functional organizational emphasizes too much on the decentralization of control. In order to strike a balance, line and staff organizational structure has been evolved. In this form of organization, the structure is basically that of the line organization but functional experts are provided to advise line authorities in the performance of their duties

(d) **Committee organization** : In today's complex business world, each activity taken out by any department affects the work of other departments. A slight change in production policy will affect the sales department. Similarly, change in the sales policy or a new sales policy, cannot be followed by the sales managers, without consulting the finance department or the production department.

It should therefore be well understood that important policy decisions, which affect other departments should not be taken by the in-charge of the department alone, but they should be referred to a committee consisting of the managers of the affecting departments. It ensures co-operation and better co-ordination. Thus committee

organization is extensively used to solve the multifaceted problems of large and complex business units. Committee is a group of individuals especially designated to take the decision in matters referred to it through free interchange of ideas among its members.

1.2 Management

Management can be seen as a function, a process, a profession or a class of people. And along with material, capital and labour, management is considered as a resource. It refers to the kind of tasks and activities that are performed by managers. The specific natures of activities are determined by such managerial functions as planning, organizing, directing and controlling. In fact, management is a process of achieving an organization's goals and objectives by making the fullest use of available resources like men, materials, machines, money, methods etc.

1.3 Functions of Management :-

The various functions of management are briefly defined as follows :

(a) **Planning** : It is the process of deciding in advance the courses of action to be followed, when and also, how to undertake these actions. Planning involves selecting missions and objectives and the actions to achieve them; it requires decision making, that is, choosing future courses of action from among alternatives. There are various types of plans, ranging from overall purposes and objectives to the most detailed actions to be taken, such as ordering a special stainless steel bolt for an instrument or hiring and training workers for an assembly line. No real plan exists until a decision — a commitment of human or material resources or reputation — has been made. Before a decision is made, all that exists is a planning study, analysis, or a proposal; there is no real plan.

(b) **Organising** : It refers to the grouping of people and activities in order to facilitate the achievement of the organizational objective. People working together in groups achieve some goal must have roles to play, much like the parts actors fill in a drama, whether these roles are ones they develop themselves, are accidental or are defined and structured by someone who wants to make sure that people contribute in a specific way to group effort. The concept of a "role" implies that what people do have a definite purpose or objective; they know how their job objective fits into group effort, and they have the necessary authority, tools, and information to accomplish the task.

Organizing, is that part of managing that involves establishing an intentional structure of roles for people to fill in an organization. It is intentional in the sense of making sure that all the tasks necessary to accomplish goals are assigned and, it is hoped, assigned to people who can do them best.

The purpose of an organization structure is to help in creating an environment for human performance. It is, then, a management tool and not an end in and of itself. Although the structure must define the tasks to be done, the roles so established must also be designed in the light of the abilities and motivations of the people available.

Designing an effective organization structure is not an easy managerial task. Many problems are encountered in making structures fit situations, including both defining the kind of jobs that must be done and finding the people to do them.

(c) **Controlling** : Control is the mode of checking the progress of plans and also, correcting any deviations that may occur along the way. **Controlling** is the measuring and correcting of activities of subordinates to ensure that events conform to plans. It

measures performance against goal and plans, shows where negative deviations exist, and, by putting in motion actions to correct deviations, helps ensure accomplishment of plans. Although planning must precede controlling, plans are not self-achieving. Plans guide managers in the use of resources to accomplish specific goals; then activities are checked to determine whether they conform to the plans.

Control activities generally relate to the measurement of achievement. Some means of controlling, like the budget for expense, inspection records, and the record of labor-hours lost, are generally familiar. Each measures and each shows whether plans are working out. If deviations persist, correction is indicated. But what is corrected? Nothing can *be* done about reducing scrap, for example, Activities through persons or buying according to specifications, or handling sales returns unless one knows who is responsible for these functions. Compelling events to conform to plans means locating the persons who are responsible for results that differ from planned action and then taking the necessary steps to improve performance. Thus, outcomes are controlled, by controlling what people do.

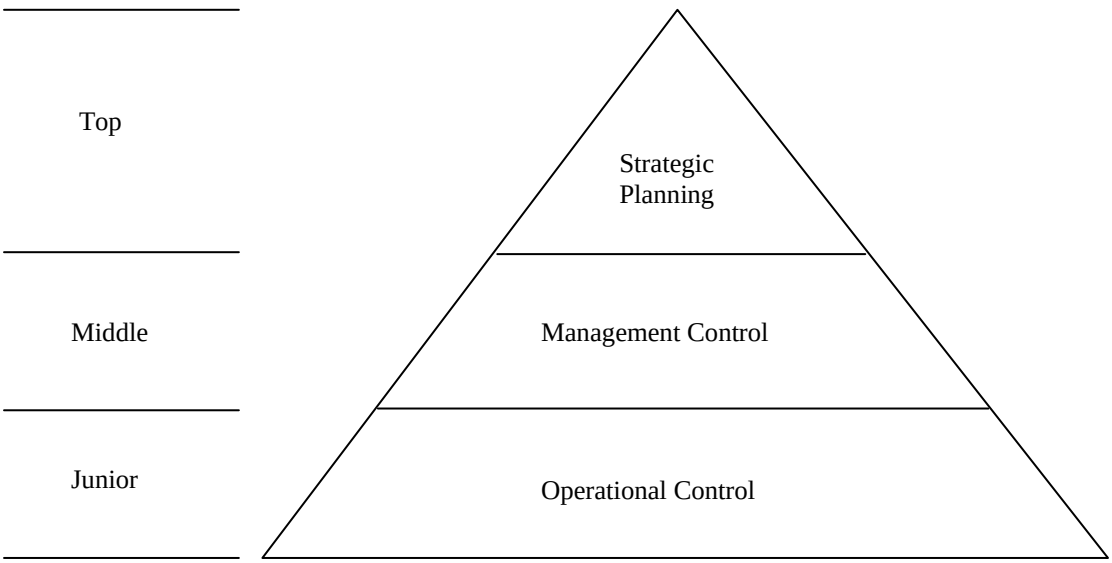
(d) **Directing** : It is the process of activating the plans, structure and group efforts in the desired direction. It is needed for implementation of plans by providing the desired leadership, motivation and proper communication. This includes staffing and leading. **Staffing** involves filling, and keeping filled, the positions in the organization structure. This is done by identifying work-force requirements; inventorying the people available; and recruiting, selecting, placing, promoting, appraising, planning the careers of, compensating, and training or otherwise developing both candidates and current job holders to accomplish their tasks effectively and efficiently.
Leading is the influencing of people so that they will contribute to organization and group goals; it has to do predominantly with the interpersonal aspect of managing. All managers would agree that their most important problems arise from people — their desires and attitudes, their behavior as individuals and in groups — and that effective managers also need to be effective leaders. Since leadership implies followership and people tend to follow those who offer a means of satisfying their own needs, wishes, and desires. It is understandable that leading involves motivation, leadership styles and approaches, and communication.

Management can be grouped into three hierarchical levels - top, middle and junior management levels.
Top (or strategic) management establishes the policies, plans and objectives of the organization as well as a budget framework under which various departments will operate.
Middle (or tactical) management has the responsibility of implementing the policy and overall plans of the top management.
Junior (or operational) management has the responsibility of implementing day-to-day operations and decisions of the middle management to produce goods and services to meet the revenue, profit and other goals, which in turn will enable the organization to achieve its overall plans and objectives.

1.4 Levels Of Management :-

Each organization is made up of several levels. These could be classified broadly into three categories : top, middle and junior management levels.

The top management performs strategic planning and the other two levels provide support in the form of processed information. The middle management level performs tactical planning and control, and needs information to discharge these managerial functions. The junior level is involved in day-to-day operational control and needs information for its working.



(a) **Strategic Planning** : This level develops the strategy for deciding the objectives of the organization, planning resources to be used in order to attain those objectives, formulating policies to govern, use and disposition of the resources

(b) **Management Control** : It is required by managers of various departments to measure performance, decide on control actions, formulate new decision rules and also allocate resources.

(c) **Knowledge and Data Management :** It is required by managers of various departments to support the organizations knowledge and data workers, to integrates new knowledge into the business. Knowledge systems especially in the form of workstations and office systems are among the most widely used office systems.

(d) **Operational control** : It is the process of ensuring that operational activities are carried out to achieve optimum use of resources. It makes use of pre-established procedures and decision rules.

Sector	Operations	Tactics	Strategy
Production	• Machine settings • Worker schedules • Maintenance sch.	• Rearrange work area • Schedule new products • Change inventory method	• New factory • New products • New industry
Accounting	• Categorize assets • Assign expenses • Produce reports	• Inventory valuation • Depreciation method • Finance short/long term	• Debt vs. equity • International taxes
Marketing	• Reward salespeople • Survey customers • Monitor promotions	• Determine pricing • Promotional campaigns • Select marketing media	• Monitor competitors • New products • New markets

Decision Level	Description	Example	Type of Information
Strategic	Competitive advantage, become a market leader. Long-term outlook.	New product that will change the industry.	External events, rivals, sales, costs quality, trends.
Tactical	Improving operations without restructuring the company.	New tools to cut costs or improve efficiency.	Expenses, schedules, sales, models, forecasts.
Operations	Day-to-day actions to keep the company functioning.	Scheduling employees, ordering supplies.	Transactions, accounting, human resource management, inventory.

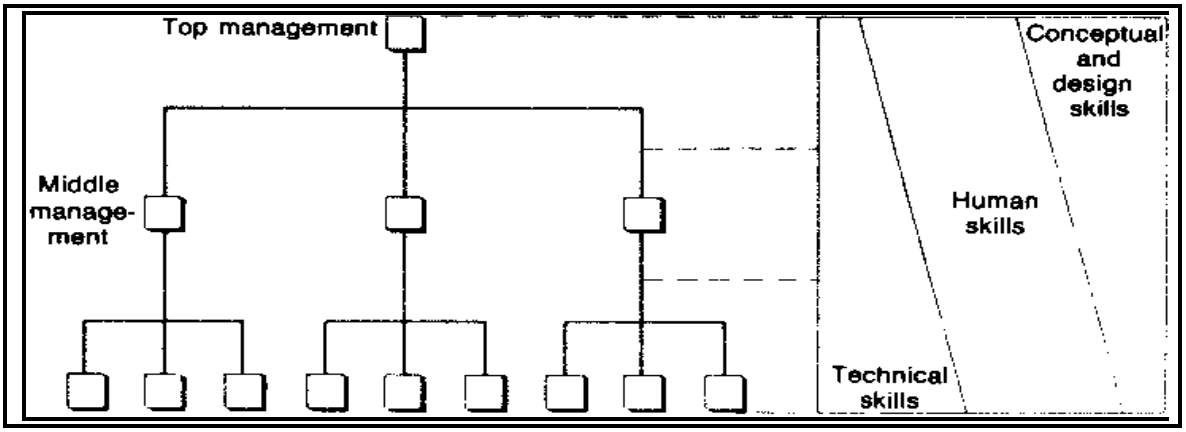
1.5 Managerial skills and the organizational hierarchy :

The four kinds of skills required for manager or administrators are :

1. **Technical skill** is knowledge *of* and proficiency in activities involving methods, processes, and procedures. Thus, it involves working with tools and specific techniques. For example, mechanics work with tools, and their supervisors should have the ability to teach them how to use these tools. Similarly, accountants apply specific techniques in doing their job.
2. **Human skill** is the ability to work with people; it is co-operative effort; it is teamwork; it is the creation of an environment in which people feel secure and free to express their opinions.
3. **Conceptual skill** is the ability to see the “big picture," to recognize significant elements in a situation, and to understand the relationships among the elements.
4. **Design skill** is the ability to solve problems in ways that will benefit the enterprise. To be effective, particularly at upper organizational levels, managers must be able to do more than see a problem. They must have, in addition, the skill of a good design engineer in working out a practical solution to a problem. If managers merely see the problem and become "problem watchers," they will fail. Managers must also have

that valuable skill of being able to design a workable solution to the problem in the light of the realities they face.

The relative importance of these skills may differ at various levels in the organization hierarchy. The technical skills are of greatest importance at the supervisory level. Human skills are also helpful in the frequent interactions with subordinates. Conceptual skills, on the other hand, are usually not critical for
lower-level supervisors. At the middle-management level, the need for technical skills decreases; human skills are still essential; the conceptual skills gain in importance. At the top management level, conceptual and design abilities and human skills are especially valuable, but there is relatively little need for technical abilities. It is assumed, especially in large companies, that chief executives can utilize the technical abilities of their subordinates. In smaller firms, however, technical experience may still be quite important.



1.6 The Goal of All Managers :-

Managers must establish an environment in which people can accomplish group goals with the least amount of time, money, materials, and personal dissatisfaction or in which they can achieve as much as possible of a desired goal with available resources. In a non-business enterprise such as a police department, as well as in units of a business (such as an accounting, department) that are not responsible for total business profits, managers still have goals and should strive to accomplish them with the minimum of resources or to accomplish as much as possible with available resources.

Productivity, Effectiveness, and Efficiency :

Another way to view the aim of all managers is to say that they must be productive.

Definition of productivity : Successful companies create a surplus through productive operations. Although there is not complete agreement on the true meaning of **productivity,** we can define it as the output-input ratio *within a time period with due consideration for quality.* It can be expressed as follows:

Productivity = [outputs / input] (within a time period, quality considered)

The formula indicates that productivity can be improved (1) by increasing outputs with the same inputs, (2) by decreasing inputs but maintaining the same outputs, or (3) by increasing outputs and decreasing inputs to change the ratio favorably. Companies use several kinds of inputs, such as labor, materials, and capital. "The greatest opportunity for increasing productivity is surely to be found in knowledge work itself, and especially in management.""

Definitions of effectiveness and efficiency Productivity implies effectiveness and efficiency in individual and organizational performance. **Effectiveness** is the achievement of objectives. **Efficiency** is the achievement of the ends with the least amount of resources. Managers cannot know whether they are productive unless they first know their goals and those of the organization.

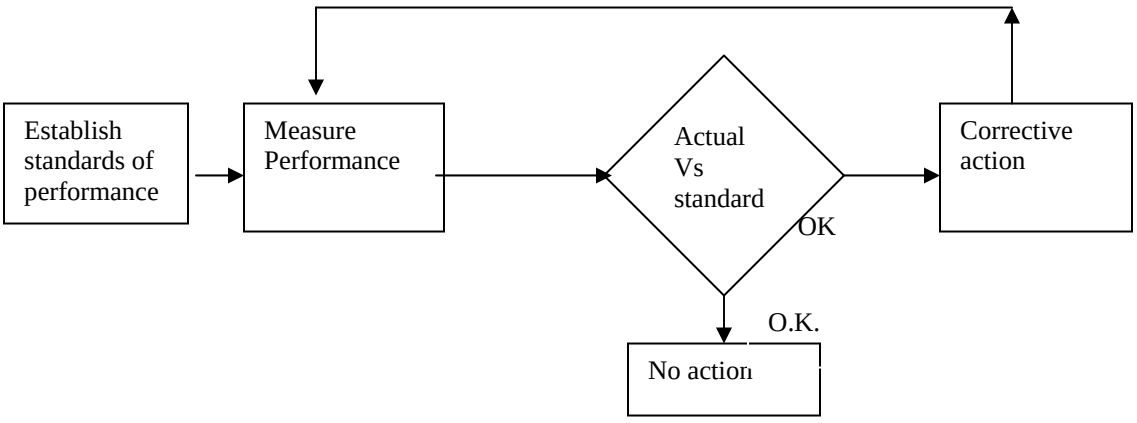
Management as a control system :-

Planning, organizing, directing and controlling are the various steps in the management process. All steps prior to a control are necessary but are not necessarily self assuring the results unless it is followed by a strong control mechanism. Management experts have viewed these steps as management control system.

A definition of control is the process through which managers assure that actual activities conform to the planned activities, leading to the achievement of the started common goals.

The control process measures a progress towards those goals, and enables the manager to detect the deviations from the original plan in time to take corrective actions before it is too late.

The basic steps of the control process :



1. **Early warning mechanism** : Predicting the possibility of achieving the goals and standards before it is too late and allowing the manager to take corrective actions.

2. Performance Standard : The performance standard must be measurable and acceptable to all the organizations. The system should have meaningful standards relating to the work areas, responsibility, managerial functions and so on.

3. **Strategic controls** : Critical success factors. The system should recognize & control them.

4. **Feedback** : The control system would be effective, if it continuously monitors the performance and sends the information to the control center for action. It should not only highlight the progress but also the deviations.

5. Accurately and timely : The feedback should be accurate in terms of results and should be communicated on time for corrective action.

6. Realistic : The system should be realistic so that the cost of control is far less than the benefits. The standards are realistic and are believed as achievable. Sufficient incentive and rewards are to be provided to motivate the people.

7. Information flow : The system should have the information flow aligned with the organisation structure and the decision makers should ensure that the right people get the right information for action and decision making.

8. Exception principle : The system should selectively approve some significant deviations from the performance standards on the principle of management by exception.

What is Data ?

Data is a series of non-random symbols, numbers, values or words, a series of facts obtained by observation or research, a collection of non-random facts, the record of an event or fact.

Examples of Data :

Today's date, Measurements taken on a production line, Records of business transactions.

What is Information ?

Data that has been processed so that they are meaningful. Data that has been processed for a purpose. Data that has been interpreted and understood by the recipient.

Examples of Information

A bank statement, A sales forecast, A telephone directory.

Information involves transforming data using a defined process, Involves placing data in some form of meaningful context, Is produced in response to an information need and hence serves a specific purpose, Helps to reduce uncertainty, thereby improving decision behaviour.

Data Transformation Process involves Classification, Rearranging / sorting, Aggregating, Performing calculations, Selection.

Value of Information :

1. Tangible Value

Can be measured directly, usually in monetary terms.

Tangible value = Benefit of Information – Cost of gathering it.

2. Intangible Value

Difficult to measure or impossible to quantify.

Intangible Value = Improvement of decision behaviour – Cost of gathering it.

Qualities of Information :

1. Time dimension
2. Content dimension
3. Form dimension
4. Additional characteristics

Attributes of Information Quality :

Time	Content	Form	Additional Characteristics
Timeliness Currency Frequency Time period	Accuracy Relevance Completeness Conciseness Scope	Clarity Detail Order Presentation Media	Confidence in source Reliability Appropriate Received by correct person Sent by correct channels

What is a System ?

It is a collection of interrelated components that works together towards a collective goal. Its function is to receive inputs and transform them into outputs.

System Components

1. Input 2. Process 3. Output 4. Feedback 5. Control mechanism.

What is Information System ?

An organized combination of People, Hardware, Software, Communication networks, and Data resources, that collects, transforms and disseminates information in an organization.

FUNCTIONS OF INFORMATION SYSTEM :

The information systems function represents :

1. It is a major functional area of a business as like accounting, finance, operations management, marketing, marketing, and HRM.
2. It is an important contributor to operational efficiency, employee productivity and morale, and customer service and satisfaction.
3. It is a major source of information and support needed to promote effective decision making by managers.
4. It is an important ingredient in developing competitive products and services that give an organization a strategic advantage in the global marketplace.
5. It is a major part of the resources of an enterprise and its cost of doing business, thus posing a major resource management challenge.
6. A vital, dynamic, and challenging career opportunity for millions of men and women.

2. Evolution of MIS :-

Earliest use of Information System was recorded during third millennium BC in a Sumerian Temple. They used clay tablets for recording receipts and issues of grains to the individual workers. The industrial revolution and growth in business industry along with development of accounting systems, organization size, and development of

computing technology have ensured the fast growth of information systems during the last few centuries.

As business grows (from sole trading firms to global corporations), it is found impossible to a manager to visit all his organizations facilities, plants and warehouses. It was the information system that kept informed of this organizations activities. A full fledged information system requires in an organization to collect data at source measured with precision, process it immediately and keep all its file updated to feed the managers, with most current, highly accurate information

Data is used in the form of raw material and must be subjected to manipulation or processing to produce useful information. An information system produces information using data.

If information system produces information, which is useful for managers in planning, organizing, directing and controlling of the organization, then such system is called "Management Information System".

The information provided by MIS supports the manager to take structured (or programmed) decisions which are those that are based on predictable patterns of activity.

Definition of MIS :

MIS can be defined as a system that

(a) provides information to support managerial functions like planning, organizing, directing, controlling.
(b) collects information in a systematic and a routine manner which is in accordance with a well defined set of rules.
(c) includes files, hardware, software and operations research models of processing, storing, retrieving and transmitting information to the users.

Objectives of MIS :

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

Components of MIS :

As predicted by McLeod, in 1986, a typical MIS is based on four major components. They are :

(a) **Data gathering** – data required to the operations of the organization have to be gathered from both internal and external sources.

(b) **Data entry** – stored in databases.
(c) **Data transformation** – in to useful information by means of computer programs and judgments made by technical staff and other system users.
(d) **Information utilization** – applied to decision making process related to organizations operation.

Functions of MIS :

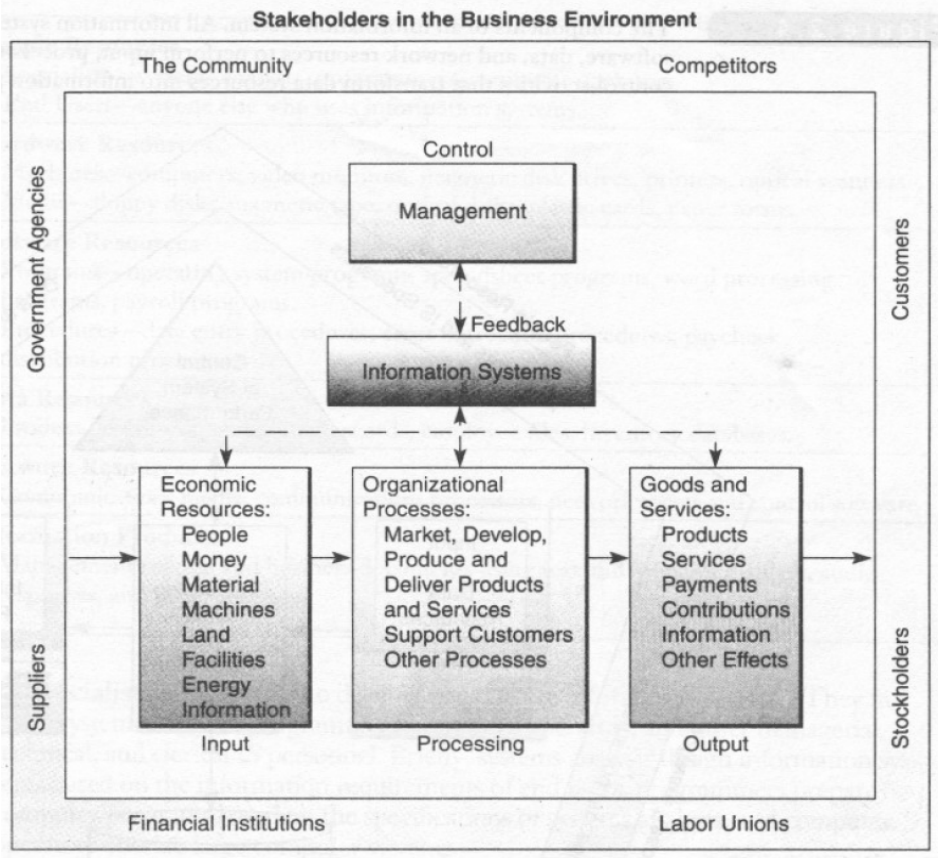
(a) **Collect data** – Internal data can be collected from company records or reports, marketing data, financial data, production data, personnel data and information compiled by manager themselves. External sources include trade publications, customers and consultants, government data, technology data, social change data, Economic data etc..
(b) **Store and process data** – using computers.
(c) **Present information to Managers** – for their use.

Resources of MIS :

People, hardware, software, data, and networks are the five basic resources of information systems.

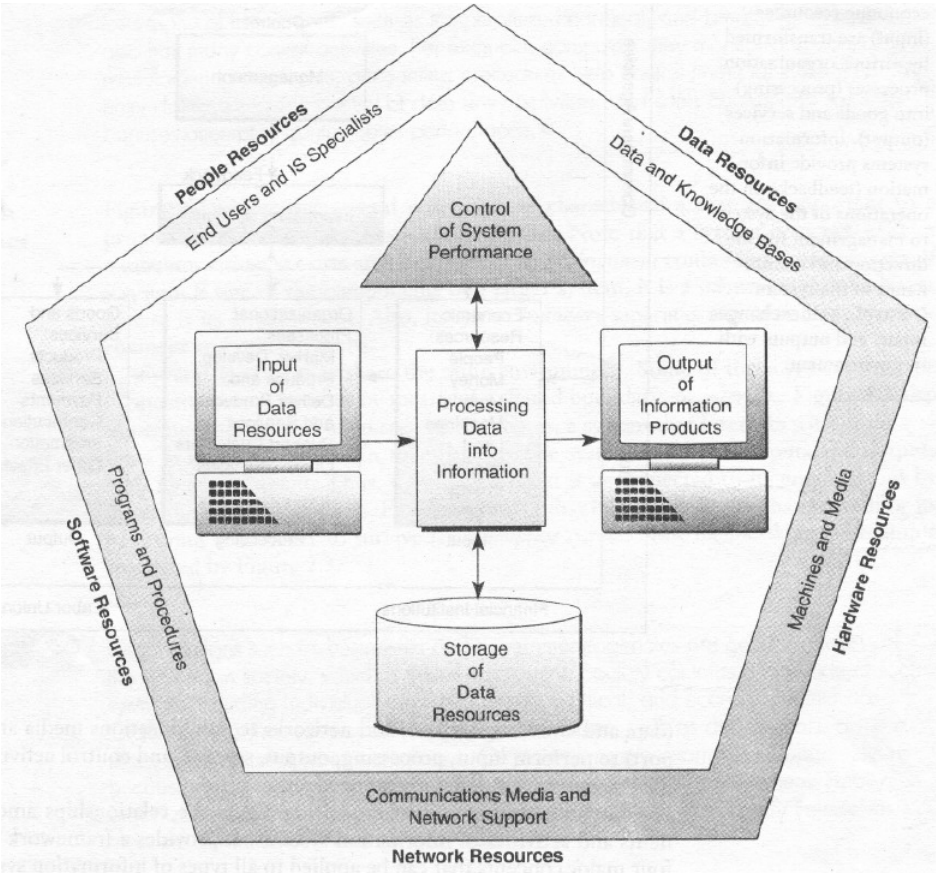
1. People resources include end users and IS specialists, hardware resources consist of machines and media, software resources include both programs and procedures, data resources can include data and knowledge bases, and network resources include communications media and networks.

2. Data resources are transformed by information processing activities into a variety of information products for end users.



3. Information processing consists of input, processing, output, storage, and control activities.

People Resources Specialists—systems analysts, programmers, computer operators. End Users—anyone else who uses information systems.
Hardware Resources Machines—computers, video monitors, magnetic disk drives, printers, optical scanners. Media—floppy disks, magnetic tape, optical disks, plastic cards, paper forms.
Software Resources Programs—operating system programs, spreadsheet programs, word processing programs, payroll programs. Procedures—data entry procedures, error correction procedures, paycheck distribution procedures.
Data Resources Product descriptions, customer records, employee files, inventory databases.
Network Resources Communications media, communications processors, network access and control software.
Information Products Management reports and business documents using text and graphics displays, audio responses, and paper forms.



Characteristic of MIS :

(a) Management oriented :

* The system is designed from the top to work downwards. It does not mean that the system is designed to provide information directly to the top management.

* Other levels of management are also provided with relevant information.

(b) Management directed :

* Because of management orientation of MIS, it is necessary that management should actively direct the system development efforts.

* In order to ensure the effectiveness of system designed, management should continuously make reviews.

For example, in the marketing information system, the management must determine what sales information is necessary to improve its control over marketing operations.

(c) Integrated :

The word 'integration' means that the system has to cover all the functional areas of an organization.

It has to consider various sub systems, their objectives, information needs, and recognize the interdependence, that these sub-systems have amongst themselves, so that common areas of information are identified and processed without repetition and overlapping.

For example, in the development of an effective production scheduling system, a proper balance amongst the following factors is desired :

(i) set up costs
(ii) manpower
(iii) over time
(iv) production capacity
(v) inventory level
(vi) money available
(vii) Customer service.

(d) **Common data flows** :

Because of the integration concept of MIS, common data flow concept avoids repetition and overlapping in data collection and storage, combining similar functions, and simplifying operations wherever possible.

For example, in the marketing operations, orders received for goods become the basis of billing of goods ordered, setting up of the accounts receivable, initiating production activity , sales analysis and forecasting, etc.

(e) **Heavy planning element** :

A management information system cannot be established overnight. It takes almost 2 to 4 years to establish it successfully in an organization. Hence, long-term planning is

required for MIS development in order to fulfill the future needs and objectives of the organization.
The designer of an information system should therefore ensure that it will not become obsolete before it actually gets into operation.
An example of such a feature of MIS may be seen in a transportation system where a highway is designed not to handle today's traffic requirements but to handle the traffic requirements five to ten years.

(f) **Flexibility and ease of use** :

* While building an MIS system all types of possible means which may occur in future are added to make it flexible.

* A feature that often goes with flexibility is the ease of use.

* The MIS should be able to incorporate all those features that make it readily accessible to a wide range of users with easy usability.

Role of MIS : (Information needs at different levels of Management) :

The role of MIS in an organization can be compared to the role of the heart.
MIS = Heart
Data = Impure blood
Information = Pure blood

* The system is expected to fulfill the information needs of an individual, group of individuals, managers etc.

MIS satisfies diverse needs through a variety of systems such as :
query systems,
analysis systems,
modeling systems,
decision support systems etc.

Bottom Level :

* MIS helps operational management by providing operational data for planning, scheduling, controlling and also helps them further in decision making at the operational level to correct an out of control situation.

* Operational information pertains to the day-to-day activities of the organization and helps to assure that specific tasks are performed efficiently and effectively.

* It include the production of routine and necessary information, such as financial accounting, payrolls, personal rosters, equipment inventories, and logistics.

* Operation level require information for the purpose of conversion of inputs into outputs. Also it supplies routine and other information to tactical tier in summarized form.

Middle Level :

* MIS helps middle level management in short term planning, target setting and controlling the business functions.

* The tactical decisions are directed towards developing divisional plans, structuring workflow, establishing distribution channels, acquisition of resources such as men, materials and money.

* The tactical information helps managers to see that the resources are being used efficiently and effectively to meet the strategic objectives of the organization.

Such information include productivity measurement (output per man-hour or per machine-hour), budgetary control, or variance analysis reports, cash flow forecasts, manning levels and profit results within a particular department of the organization, labour turn-over statistics within a department, short-term purchasing requirements etc.

A large proportion of this information will be generated within the organization using feedback between different departments. Tactical information is usually prepared regularly – perhaps weekly, or monthly and is used for decision making referred to as management control.

Top Level :

MIS helps top management in goal setting, strategic planning and also evolving the business plans in addition to their implementation.

Strategic planning depends heavily upon information external to the organization.

When this is combined with internal data, management can make estimates of expected results. The specifics of this information are often unique and tailor made to particular strategic problems.

MIS in-fact plays the role of information generation, communication, problem identification and helps in the process of decision making.

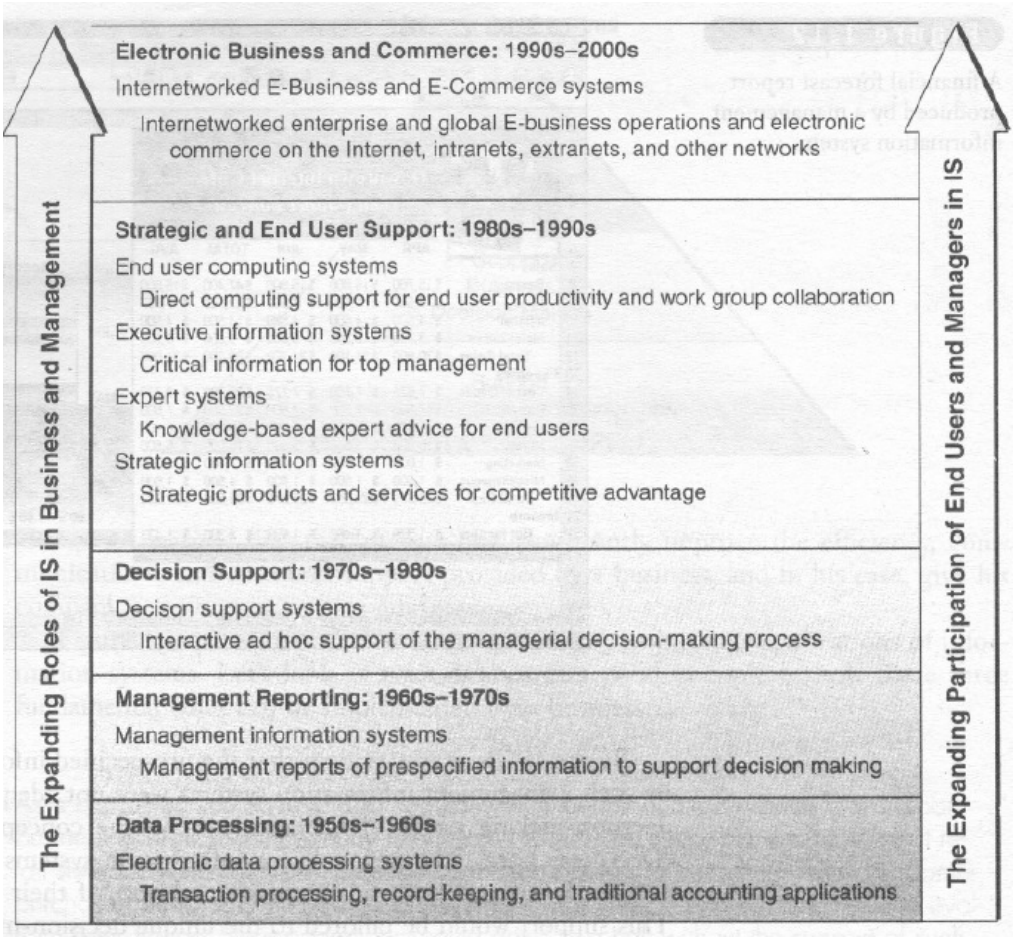
Impact of MIS :

* The manager is kept alert by providing certain information indicating the probable trends in the various aspects of business.

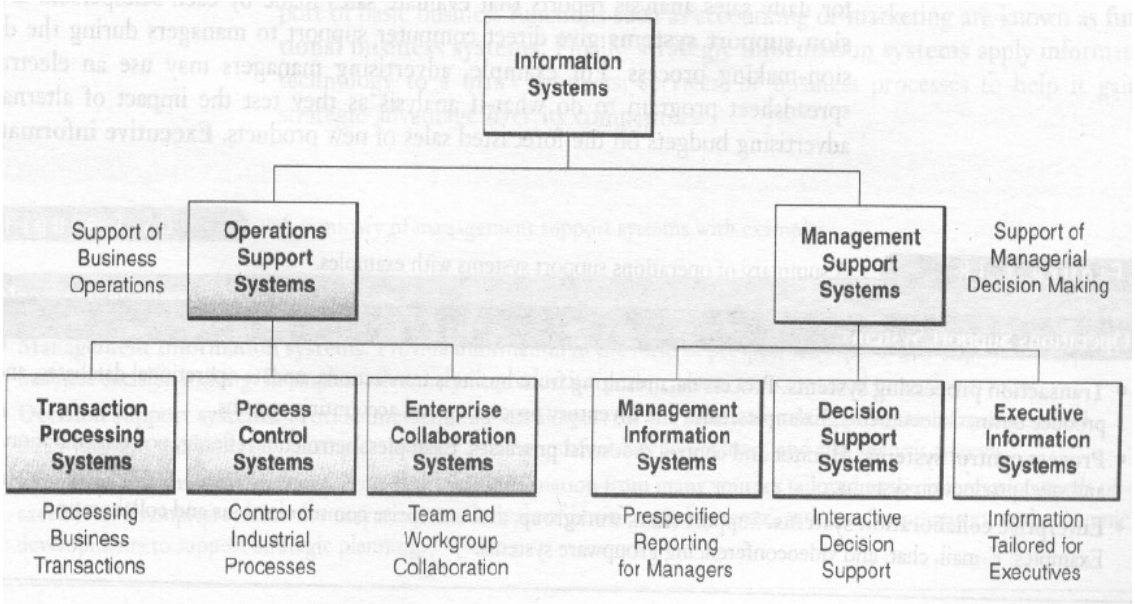
This helped in forecasting and long term perspective planning.

* The managers attention is brought to a situation which is exceptional in nature, inducing him to take action or a decision in the matter.

Expanding roles of the business applications of information systems :



Operations and management classifications of information systems :



Type of Information System	Focus
Knowledge mangement systems	Knowledge—from knowledge workers.
Expert systems	Knowledge—from experts
Decision support systems	Decisions—interactive support
Executive information systems	Information—for executives and others
Management information systems	Information—for managerial end users
Transactions processing systems	Data—from business operations

Operations Support Systems :

Operations Support Systems are used to process data generated by, and used in, business operations. The role of a business firm's operations support systems is to efficiently process business transactions, control industrial processes, support enterprise communications and collaboration, and update corporate databases.

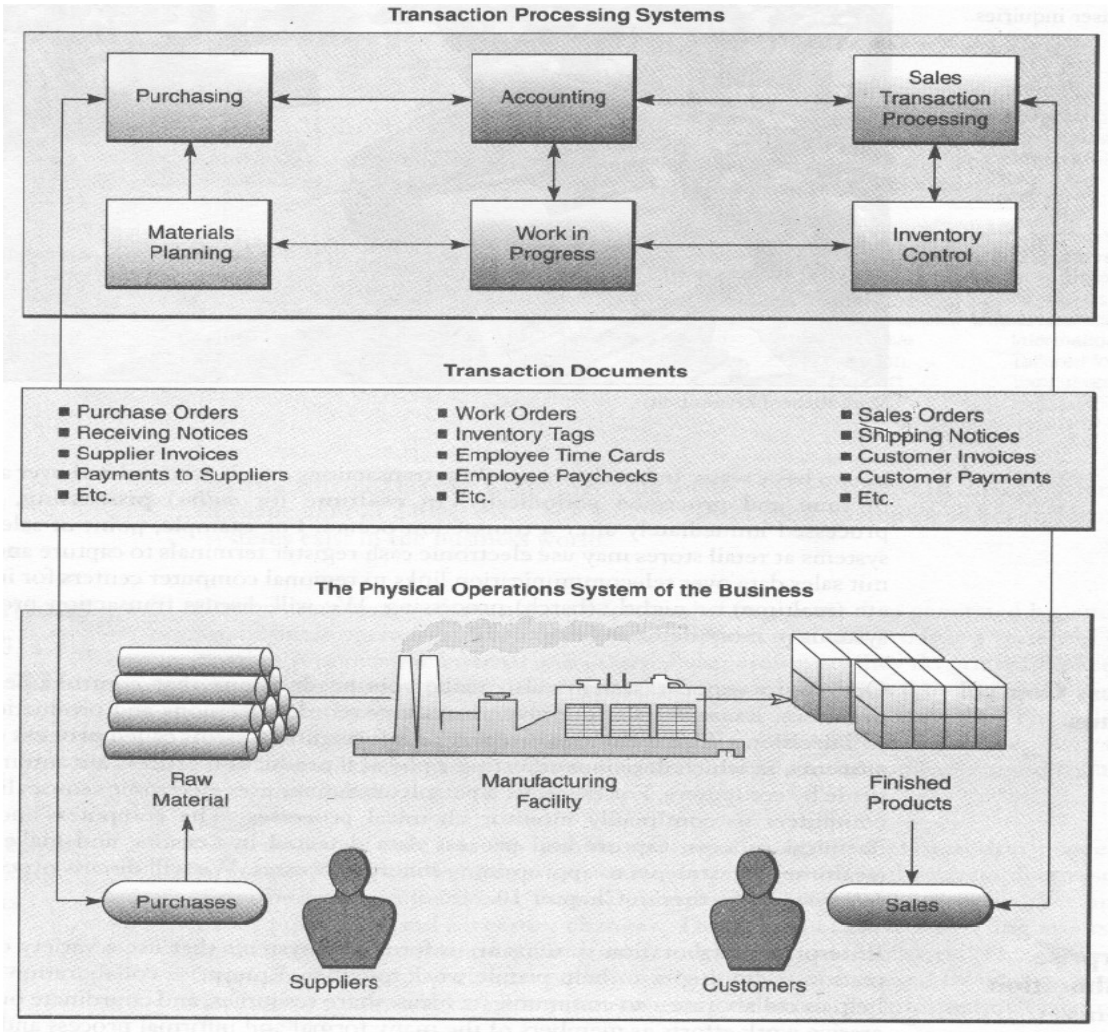
1. Transaction Processing Systems

They record and process data resulting from business transactions. They process transactions in two basic ways.

In *batch processing,* transactions data are accumulated over a period of time, and processed periodically.

In *real-time* (or online) processing, data are processed immediately after a transaction occurs.

For example, point-of-sale (POS) systems at many retail stores use electronic cash register terminals to electronically capture and transmit sales data over telecommunications links to regional computer centers for immediate (real-time) or nightly (batch) processing.



2. Process control systems :

Process control systems monitor and control physical processes.

For example, a petroleum refinery uses electronic sensors linked to computers to continually monitor chemical processes and make instant (real-time) adjustments that control the refinery process.

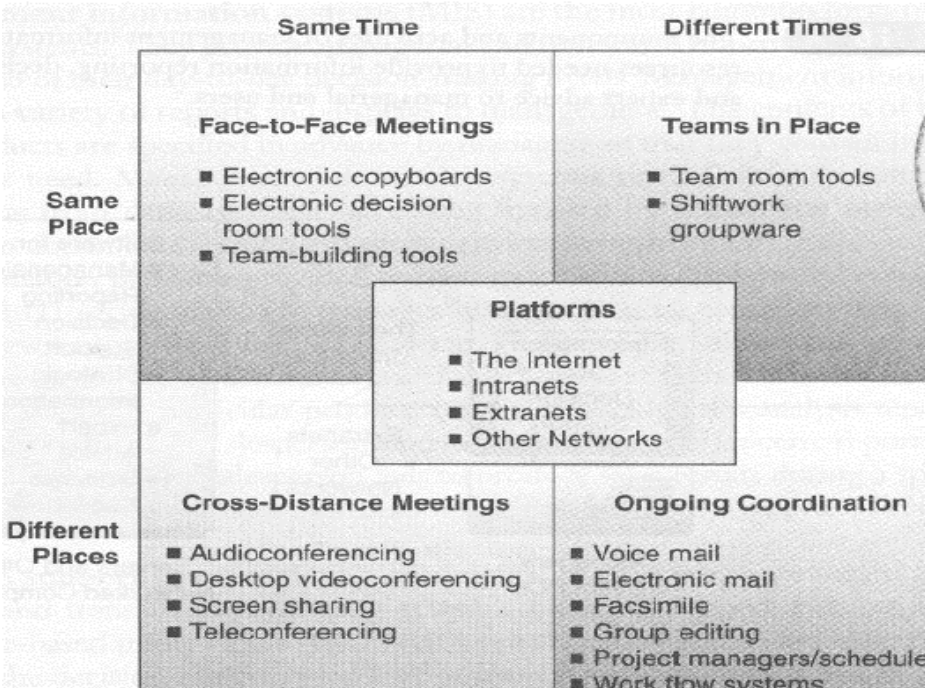
3. Enterprise Collaboration Systems :
Enterprise collaboration systems enhance team and workgroup communications and productivity, and are sometimes called *office automation systems.*

For example, knowledge workers in a project team may use electronic mail to send and receive electronic messages, and videoconferencing to hold electronic meetings to coordinate their activities.

B. Management Support Systems

When information system applications focus on providing information and support for effective decision making by managers, they are called management support systems.
Conceptually, several major types of information systems support a variety of decision-making responsibilities:

(1) Management information systems,
(2) Decision support systems, and
(3) Executive information systems.

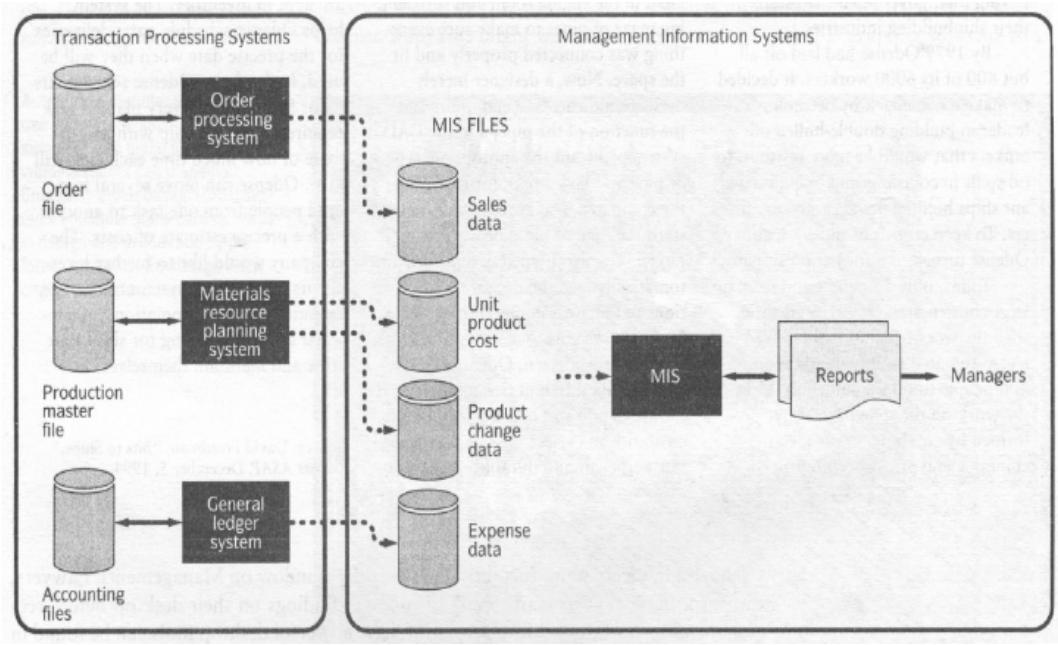


Enterprise collaboration systems

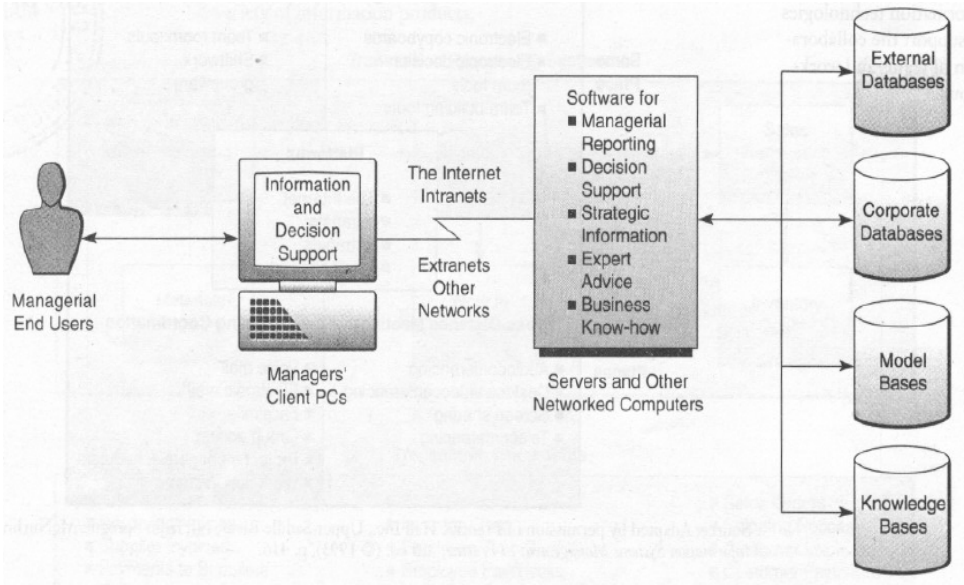
1. Management Information Systems

MIS provide information in the form of reports and displays to managers and many business professionals.

For example, sales managers ,may use their networked computers and Web browsers to get instantaneous displays about the sales results of their products and to access their corporate intranet for daily sales analysis reports that evaluate sales made by each salesperson.



The components and activities of management information systems.



2. Decision Support Systems

Decision support systems give direct computer support to managers during the decision-making process. For example, advertising managers may use an electronic spreadsheet program to do what-if analysis as they test the impact of alternative advertising budgets on the forecasted sales of new products.

3. Executive Information Systems

EIS provide critical information from a wide variety of internal and external sources in easy-to-use displays to executives and managers. For example, top executives may use touch-screen terminals to instantly view text and graphics displays that highlight key areas of organizational and competitive performance.

Other Classifications of Information Systems :

Expert systems can provide expert advice for operational chores like equipment diagnostics, or managerial decisions such as loan portfolio management.

Knowledge management systems are knowledge based information systems that support the creation, organization, and dissemination of business knowledge to employees and managers throughout a company. Information systems that focus on operational and managerial applications in support of basic business functions such as accounting or marketing are known as ***Functional business systems***.

Strategic information systems apply information technology to a firm's products, services, or business processes to help it gain a strategic advantage over its competitors.

Assignment 1 :

1. What are the different levels of management in an organization ? What types of information required in each level for effective decision making ?
2. Define Management Information System ? Explain various characteristics of MIS
3. Write a note on impact of information system on an organizational effective ness.
4. What are the different types of Information Systems ? Explain each of them ?

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Case Study 1 - E-Seva

eSeva - an online community bill payment system, is Andhra Pradesh Government initiative to deliver government information and services online to the state's citizens. The service will provide real-time utility bill payments for water, electricity, telephone, municipal taxes, birth and death certificates, passport applications, permits and licenses, transport department services and other G2C (government-to-citizen) services (http://www.esevaonline.com)

eSeva is a brain child of chief minister Mr. Chandra Babu Naidu and kicked off in 1999 at Hyderabad. In August 2001 19 centres were started in the cities of Hyderabad and Secunderabad. At present there are 35 eSeva centres (with 280 service counters) The whole concept is based on real-time utility payment system, which is very common in

western world. eSeva has tied-up with ICICI bank, HDFC bank, Global Trust bank and UTI bank for online payments.

The main data centre for eSeva is at Khairatabad, which is used to store all information, facilitate transaction and update local department servers. The citizen service centre and governmental departments are linked to main WAN through a LAN.

eSeva is based on three-tier network architecture. Transactions are conducted on a real-time basis. Departmental servers are connected to the data centre, which in turn is connected to the eSeva centres. Leased lines, with back-up ISDN lines, connect the departmental servers to the eSeva data centre. Transactions done at the eSeva centres are recorded directly on the server of the department concerned.

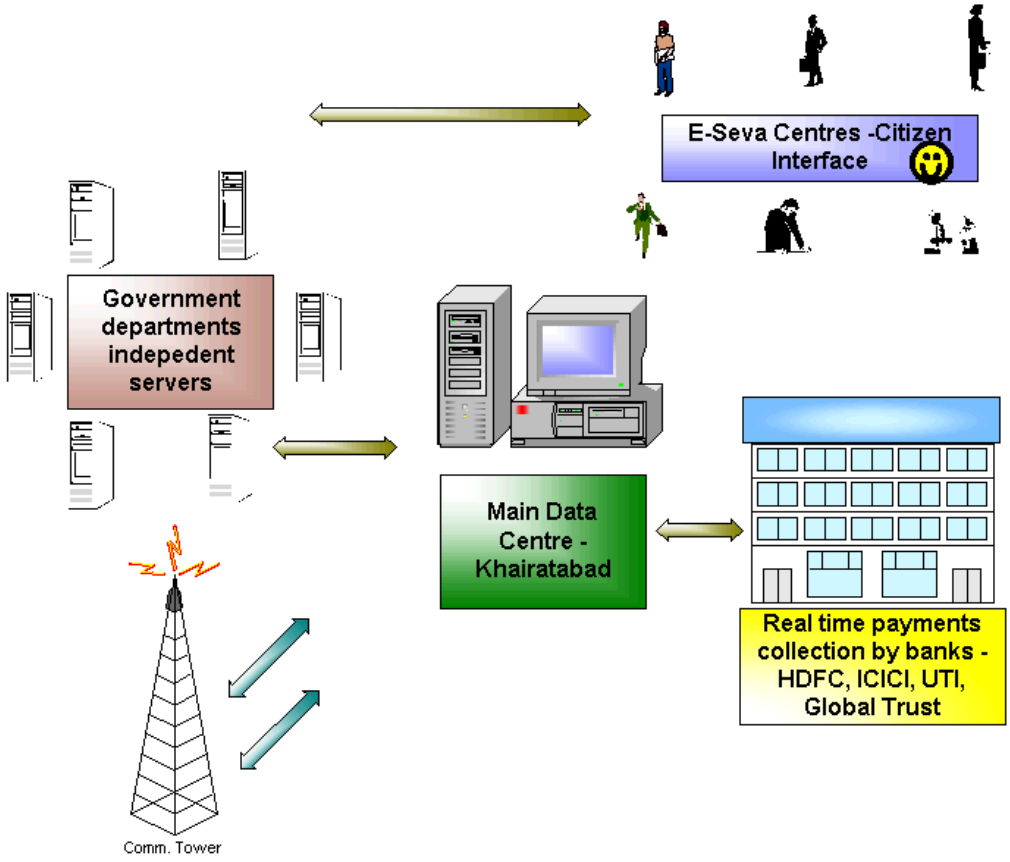

Fig. 1: E-Seva

Case Study 2 - Farmer Service Centre (FSC's)

India is an agricultural based economy. Agri industry in India contributes over 30% of the GDP (gross domestic product). Farmer Service Centre (FSC's) is a pioneering concept nourished by government of India. Farmers and rural residents are benefited from a

common customer computer data base and smart card, which can be used for remote transactions. There are over 2 billion smart cards in use around the world. These enhancements to the information system will lead to rural customers being able to access their individual records, apply for loans and other transactional services using their smart card. FSC's is a major step to provide more convenience and quality service to rural consumers.

FSC's is one-stop-shop for farmers to make purchases of raw materials, sell there goods and financial transactions. All the information related to farmer is stored on his unique smart card. Smart cards are safe to use. Through smart card farmers can access e-cash, it is a payment system which offers an alternative to paying cash for goods and services. Smart cards can be used for storing and dispensing cash electronically, making bills and coins lesser necessary and farmers can do money transaction in fast, secure way. It transfers funds over phone lines (which are in-turn connected to bank), making it easier to reload farmers smart cards. This acts as a electronic purse that allows person-to-person payments. The telephone or internet link makes payments possible anywhere. Mainly all the activity are controlled and monitered by FSC's, which provide assistance and guidance to farmers to use smart cards for their transactions.

All FSC's are connected to bank/financial institution through high speed, secured internet link. Farmers can top up there e-purse or make deposits to there banks accounts from FSC's. These FSC's also acts as the information centre for the government. Government can gather large amount of accurate rural data, also farmers can get the latest governmental policies like rates of crops, seeds, subsidies etc.

Other than banking transactions, these smart cards can be used in retail payments, vehicle registration, farmer unique ID (citizen ID), e-governance, driving license, health records and for maintaining previous crops records of farmers. These farmer service centres, can be used as central body in monitoring and implementing of welfare schemes such public distribution systems, health, education & training to villagers.

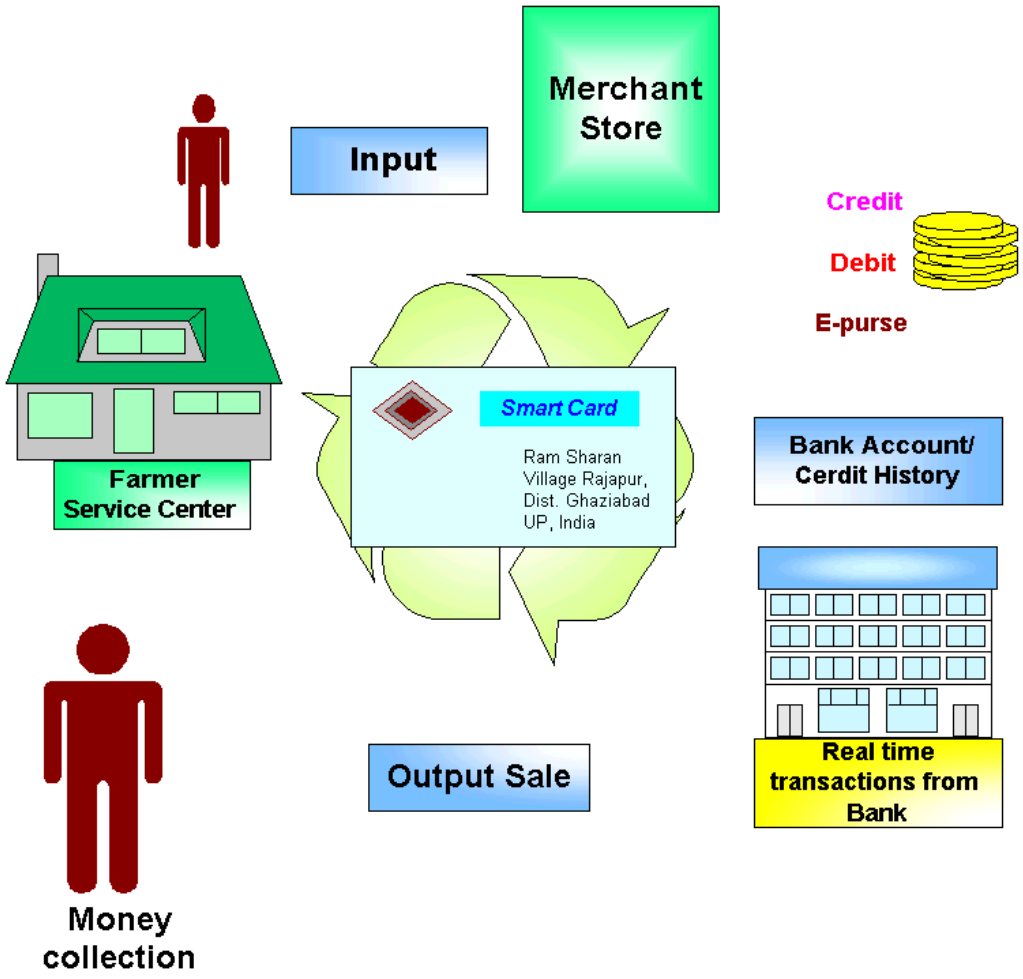

Fig. 2: Farmer Service Centre

Business Case 3 :

California Pizza controls costs with IS

California Pizza Kitchen (CPK) started out in 1985 as a venture by two former federal prosecutors who wanted to do something different. They decided to sell "designer pizza" in which the pizza dough is a "canvas" for exotic food toppings such as Thai chicken, shrimp pesto, Peking duck, or southwestern burritos. By offering stylish entrees costing less than $10 in a sit-down setting, CPK mushroomed into a national chain of 70 restaurants in only nine years, with PepsiCo buying half-ownership in 1992.

Success did not come easily to this Los Angeles-headquartered chain. The restaurant business is a high-risk industry with many factors that are beyond their control-like :swelling competition, fickle customer tastes, and rising real estate costs. Thus,

restaurants need to tightly control food and labor costs to remain profitable-without affecting the quality of their food or service.

CPK company is poised for another take-off. It hopes to expand to 700 restaurants by using information systems to control food costs and make employees more productive. Since diners are turned away by high prices, the only way to control costs is through inventory and portion control -keeping precise track of the amount of ingredients used in each menu item and stocking only as much of these ingredients as each restaurant actually needs.

All California Pizza Kitchen restaurants installed point-of-sale (POS) devices, which capture data about each item sold at the time the sale takes place. The sales data and inventory reports prepared by restaurant managers are transmitted from each restaurant to the company's central computer, where the information is consolidated and analyzed. An application called Inventory Express "remembers" ordering patterns, such as the amount of lettuce a restaurant needs each week, and also compares the amount of each item used to what each restaurant actually sold. If, for example, a restaurant sold 100 Thai shrimp pizzas in one week, it should have used a predetermined amount of shrimp, such as 40 pounds, based on portion measurements established by CPK management.

Using more shrimp would indicate a problem with over portioning or waste. Restaurants with out-of-line portions would be told to take corrective action. The POS-derived data is used for other purposes besides portion control. CPK's restaurant operations group uses the data to determine peak sales at each location so that they can schedule employee work shifts. The data tell food and beverage specialists how well each item sells. CPK found that it should get rid of its egg-salad pizza, for instance, when the item registered poor sales. California Pizza now has pilot projects to move to more state-of-the art information system technology. Waiters and waitresses are experimenting with hand-held point-of-sale devices, which management hopes will boost productivity by reducing the amount of time employees spend with customers.

The devices use radio frequencies to transmit orders to a computer in the back of the restaurant, eliminating the need for employees to run back and forth to a stationary POS device to place orders. CPK can also use its information systems to calculate the relative costs of different markets so it can determine if it has a lower profit margin on Hawaiian pizza in Maryland, than in Waikiki. (Pineapple should be less expensive in Hawaii than in the northeastern United States.) CPK's corporate accounting department can use the aggregated sales data to tally revenue and can manage the accounts payable and accounts receivable processes by combining that data with financial data residing on a central CPK computer.

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MIS Chapter 2

Structure of MIS

2.1. Structure of Information Systems :

2.1.1 Components of IS :

An information system is a system that accepts data resources as input and processes them into information products as output. The figure 2.1 illustrates an information system model that express fundamental conceptual framework for the major components and activities of information systems.

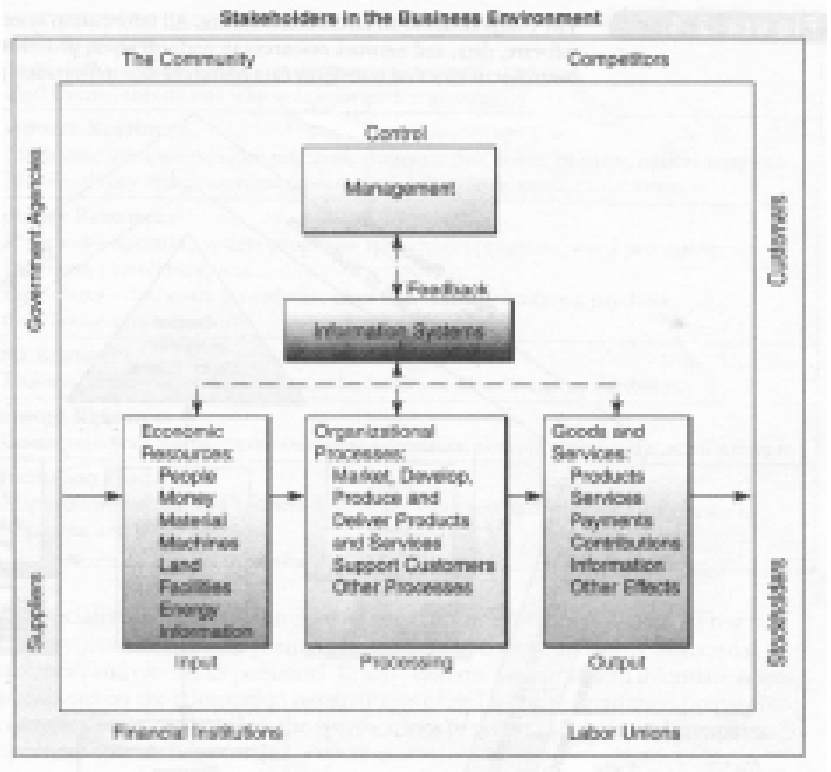


Fig. 2.1 : Business Information System model.

An information system depends on the resources of people (end users and IS specialists), hardware (machines and media), software (programs and procedures), data (data and knowledge bases), and networks (communications media and network support) to perform input, processing, output, storage, and control activities that convert data resources into information products. This information system model highlights the relationships among the components and activities of information systems. It provides a framework that emphasizes our major concepts that can be applied to all types of information systems : People, hardware, software, data, and networks are the five basic resources of information systems.

People resource include end users and IS specialists, hardware resources consist of machines and media, software resources include both programs and procedures, data resources can include data and knowledge bases, and network
resource include communications media and networks.

Data resources are transformed by information processing activities into a variety of information products for end users. Information processing consists of input, processing, output, storage, and control activities.

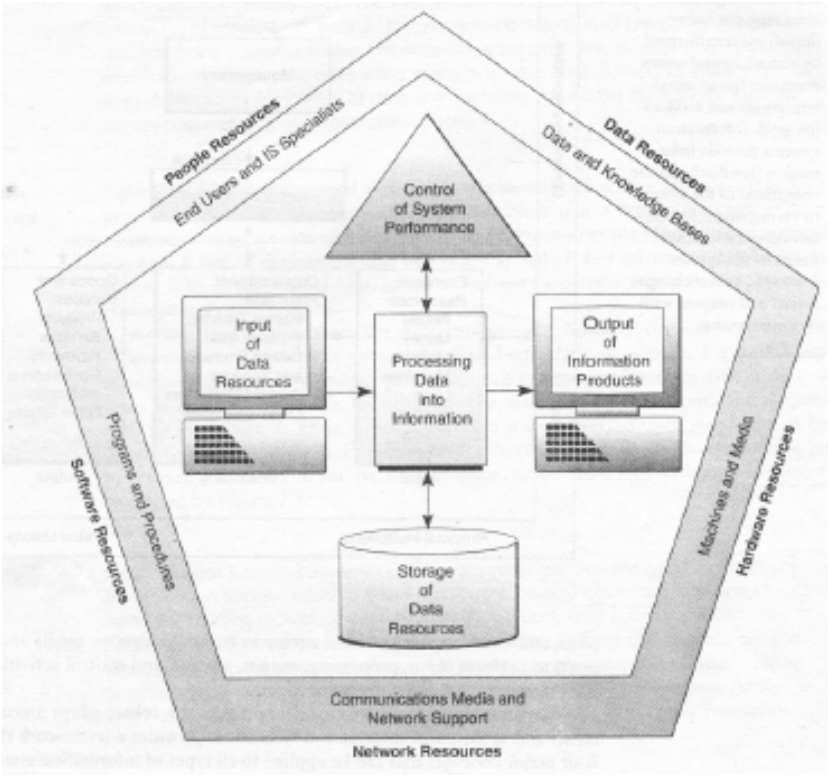


Fig 2.2 : The components of an information system.

2.1.2 Information System Resources :

The basic IS model shows that an information system consists of five major resources: people, hardware, software, data, and networks. Let's briefly discuss several basic concepts and examples of the roles these resources play as the fundamental components of information systems. You should be able to recognize these five components at work in any type of information system you encounter in the real world. Following box outlines several examples of typical information system resources and products.

People Resources Specialists—systems analysts, programmers, computer operators. End Users—anyone else who uses information systems.
Hardware Resources Machines—computers, video monitors, magnetic disk drives, printers, optical scanners. Media—floppy disks, magnetic tape, optical disks, plastic cards, paper forms.
Software Resources Programs—operating system programs, spreadsheet programs, word processing programs, payroll programs. Procedures—data entry procedures, error correction procedures, paycheck distribution procedures.
Data Resources Product descriptions, customer records, employee files, inventory databases.
Network Resources Communications media, communications processors, network access and control software.
Information Products Management reports and business documents using text and graphics displays, audio responses, and paper forms.

(1) People Resources :

People are required for the operation of all information systems. These people resource include end users and IS specialists.

☛ **End users :** (also called users or clients) are people who use an information system or the information it produces. They can be accountants, salespersons, engineers, clerks, customers, or managers. Most of us are information system end users.

☛ **IS specialists :** are people who develop and operate information systems. They include systems analysts, programmers, computer operators, and other managerial, technical, and clerical IS personnel. Briefly, systems analysts design information systems based on the information requirements of end users, programmers prepare computer programs based on the specifications of systems analysts, and computer operators operate large computer systems.

(2) Hardware Resources :

The concept of hardware resources includes all physical devices and materials used in information processing. Specifically, it includes not only machines, such as computers and other equipment, but also all data media, that is, all tangible objects on which data is recorded, from sheets of paper to magnetic disks. Examples of hardware in computer-based information systems are:

☛ **Computer systems :** which consist of central processing units containing microprocessors, and a variety of interconnected peripheral devices. Examples are microcomputer systems, midrange computer systems; and large mainframe computer systems.

☛ **Computer peripherals :** which are devices such as a keyboard or electronic - mouse for input of data and commands, a video screen or printer for output of information, and magnetic or optical disks for storage of data resources.

(3) Software Resources :

The concept of software resources includes all sets of information processing instructions. This generic concept of software includes not only the sets of operating instructions called programs, which direct and control computer hardware, but also the sets of information processing instructions needed by people, called procedures. . It is important to understand that even information systems that don't use computers have a software resource component. This is true even for the information systems of ancient times, or the manual and machine-supported information systems still used in the world today. They all require software resources in the form of information processing instructions and procedures in order to properly capture, process, and disseminate information to their users.

The following are examples of software resources:
☛**. System software :** such as an operating system program, which controls and supports the operations of a computer system.
☛**. Application software :** which are programs that direct processing for a particular use of computers by end users. Examples are a sales analysis program, a payroll program, and a word processing program.
☛**. Procedures :** which are operating instructions for the people who will use an information system. Examples are instructions for filling out a paper form or using a software package.

(4) Data Resource :
Data is more than the raw material of information systems. The concept of data resources has been broadened by managers and information systems professionals. They realize that data constitutes a valuable organizational resource. Thus, you should View data as data resources that must be managed effectively to benefit all end users in an organization.

Data can take many forms, including traditional alphanumeric data, composed of numbers and alphabetical and other characters that describe business transactions and other events and entities. Text data, consisting of sentences and paragraphs used in written communications; image data, such as graphic shapes and figures; and audio data, the human voice and other sounds, are also important: forms of data. The data resources of information systems are typically organized into:
☛**. Databases** that hold processed and organized data.
☛**. Knowledge bases** that hold knowledge in a variety of forms such as facts, rules, and case examples about successful business practices.

For example, data about sales transactions may be accumulated and stored in a sales database for subsequent processing that yields daily, weekly, and monthly sales analysis reports for management. Knowledge bases are used by knowledge management systems and expert systems to share knowledge and give expert advice on specific subjects.

Data versus Information : The word data is the plural of *datum,* though data commonly represents both singular and plural forms. Data are raw facts or observations, typically about physical phenomena or business transactions. For example, a spacecraft launch

or the sale of an automobile would generate a lot of data describing those events. More specifically, data are objective measurements of the *attributes* (the characteristics) of *entities* (such as people, places, things, and events).

(5) Network Resources :

Telecommunications networks like the Internet, intranets, and extranets have become essential to the successful operations of all types of organizations and their computer-based information systems. Telecommunications networks consist of computers, communications processors, and other devices interconnected by communications media and controlled by communications software. The concept of network resources emphasizes that communications networks are a fundamental resource component of all information systems. Network resources include:

☛**. Communications media :** Examples include twisted-pair wire, coaxial cable, fiber-optic cable, microwave systems, and communications satellite systems.

☛**. Network support :** This generic category includes all of the people, hardware, software, and data resources that directly support the operation and use of a communications network. Examples include communications processors such as modems and internet work processors, and communications control software such as network operating systems and Internet browser packages.

2.1.3 Information System Activities :

When we take a closer look at each of the basic information processing (or data processing) activities that occur in information systems, we should be able to recognize input, processing, output, storage, and control activities taking place in any information system you are studying. Following lists business examples that illustrate each of these information system activities.

• **Input.** Optical scanning of bar-coded tags on merchandise.
• **Processing.** Calculating employee pay, taxes, and other payroll deductions.
• **Output.** Producing reports and displays about sales performance.
• **Storage.** Maintaining records on customers, employees, and products.
• **Control.** Generating audible signals to indicate proper entry of sales data.

(1) Input of Data Resources :

Data about business transactions and other events must be captured and prepared for processing by the input activity. Input typically takes the form of *data entry* activities such as recording and editing. End users typically record data about transactions on some type of physical medium such as a paper form, or enter it directly into a computer system. This usually includes a variety of editing activities to ensure that they have recorded data correctly. Once entered, data may be transferred onto a machine readable medium such as a magnetic disk or semiconductor memory until needed for processing.

For example, data about sales transactions can be recorded on source documents such as paper sales order forms. (A source document is the original formal record of a

transaction.) Alternately, salespersons can capture sales data using computer keyboards or optical scanning devices; they are visually prompted to enter data correctly by video displays. This provides them with a more convenient and efficient user interface, that is, methods of end user input and output with a computer system. Methods such as optical scanning and displays of menus, prompts, and fill-in-the-blanks format make it easier for end users to enter data correctly into an information system.

(2) Processing of Data into Information :

Data is typically subjected to processing activities such as calculating, comparing, sorting, classifying, and summarizing. These activities organize, analyze, and manipulate data, thus converting them into information for end users. The quality of any data stored in an information system must also be maintained by a continual process of correcting and updating activities.

For example, data received about a purchase can be (1) *added* to a running total of sales results, (2) *compared* to a standard to determine eligibility for a sales discount, (3) *sorted* in numerical order based on product identification numbers, (4) *classified* into product categories (such as food and nonfood items), (5) *summarized* to provide a sales manager with information about various product categories, and, finally, (6) used to *update* sales records.

(3) Output of Information Products :

Information in various forms is transmitted to end users and made available to them in the output activity. The goal of information systems is the production of appropriate information products for end users. Common information products include messages, reports, forms, and graphic images, which may be provided by video displays, audio responses, paper products, and multimedia. We routinely use the information provided by these products as we work in organizations and live in society. For example, a sales manager may view a video display to check on the performance of a salesperson, accept a computer-produced voice message by telephone, and receive a printout of monthly sales results.

What characteristics would make information products valuable and useful to you?
One way to answer this important question is to examine the characteristics or attributes of information quality. Information that is outdated, inaccurate, or hard to understand would not be very meaningful, useful, or valuable to you or other end users.
People want information of high quality, that is, information products whose characteristics, attributes, or qualities help make it valuable to them. It is useful to think of information as having the three dimensions of time, content, and form.

(4) Storage of Data Resources :

Storage is a basic system component of information systems. Storage is the information system activity in which data and information are, retained in an organized manner for later use. For example, just as written text material is organized into words, sentences, paragraphs, and documents, stored data is commonly organized into fields, records, files, and databases. This facilitates its later use in processing or its retrieval as output when needed by users of a system.

(5) Control of System Performance :

An important information system activity is the **control** of its performance. An information system should produce feedback about its input, processing, output, and storage activities. This feedback must be monitored and evaluated to determine if the system is meeting established performance standards. Then appropriate system activities must be adjusted so that proper information products are produced for end users.

For example, a manager may discover that subtotals of sales amounts in a sales report do not add up to total sales. This might mean that data entry or processing procedures need to be corrected. Then changes would have to be made to ensure that all sales transactions would be properly captured and processed by a sales information system.

2.2. Strategic use of Information Systems :

2.2.1. Information Systems for competitive strategy :

The strategic role of information systems involves using information technology to develop products, services, and capabilities that give a company strategic advantages over the competitive forces it faces in the global marketplace. This creates strategic information systems, information systems that support or shape the competitive position and strategies of an enterprise. So a strategic information system can be any kind of information system (TPS, MIS, DSS, etc.) that helps an organization gain a competitive advantage, reduce a competitive disadvantage, or meet other strategic enterprise objectives. Let's look at several basic concepts that define the role of such strategic information systems.
How should a managerial end user think about competitive strategies? How can competitive strategies be applied to the use of information systems by an organization?

Several important conceptual frameworks for understanding and applying competitive strategies have been developed by Michael Porter, Charles Wiseman and others. Figure 2.3 illustrates several important concepts. A firm can survive and succeed in the long run if it successfully develops strategies to confront five competitive forces that shape the structure of competition in its industry. These are: (1) rivalry of competitors within its industry, (2) threat of new entrants, (3) threat of substitutes, (4) the bargaining power of customers, and (5) the bargaining power of suppliers.

A variety of competitive strategies can be developed to help a firm confront these competitive forces. For example, businesses may try to counter the bargaining power of their customers and suppliers by developing unique business relationships with them. This effectively locks in customers or suppliers by creating "switching costs" that make it expensive or inconvenient for them to switch to another firm. Thus, competitors are also locked out by such strategies. Companies may use other strategies to protect themselves from the threat of new businesses entering their industry, or the development of substitutes for their products or services. For example, businesses may try to develop legal, financial, or technological requirements that create barriers to entry to discourage firms from entering an industry, or make substitution unattractive or uneconomical.

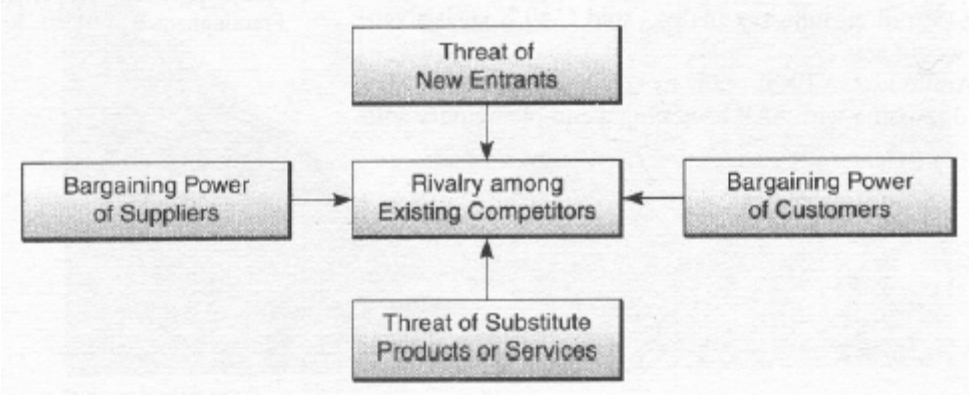


Fig. 2.3 : The competitive environment of an industry.

The five basic competitive strategies to be implemented in any business are :
1. Cost Leadership Strategy. Becoming a low-cost producer of products and services in the industry. Also, a firm can find ways to help its suppliers or customers reduce their costs or to increase the costs of their competitors.

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

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

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

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

2.2.2. Strategic Role of Information Systems :

How can the preceding competitive strategy concepts be applied to the strategic role of information systems in an organization? or, How can managers use investments in information technology to directly support a firm's competitive strategies?
These questions can be answered in terms of the key strategic roles that information systems can perform in a firm. Following table summarizes how information technology can be used to implement a variety of competitive strategies.

Lower Costs • Use IT to substantially reduce the cost of business processes. • Use IT to lower the costs of customers or suppliers.
Differentiate • Develop new IT features to differentiate products and services. • Use IT features to reduce the differentiation advantages of competitors. • Use IT features to focus products and services at selected market niches.
Innovate • Create new products and services that include IT components. • Make radical changes to business processes with IT. • Develop unique new markets or market niches with the help of IT.
Promote Growth • Use IT to manage regional and global business expansion. • Use IT to diversify and integrate into other products and services.
Develop Alliances • Use IT to create virtual organizations of business partners. • Develop interorganizational information systems linked by the Internet, extranets, or other networks that support strategic business relationships with customers, suppliers, subcontractors, and others.
Improve Quality and Efficiency • Use IT to dramatically improve the quality of products and services. • Use IT to make continuous improvements to the efficiency of business processes. • Use IT to substantially shorten the time needed to develop, produce, and deliver products and services.
Build an IT Platform • Leverage investment in IS people, hardware, software, and networks from operational uses into strategic applications. • Build a strategic information base of internal and external data collected and analyzed by using IT.
Other Strategies • Use interorganizational information systems to create switching costs that lock in customers and suppliers. • Use investment in IT to build barriers to entry against industry outsiders. • Use IT components to make substitution of competing products unattractive. • Use IT to help create, share, and manage business knowledge.

These include not only the five basic competitive strategies, but also other ways that companies can use information systems strategically to gain a competitive edge. Following table has examples of how companies used information technology to implement five competitive strategies for strategic advantage.

Strategy	Company	Strategic Information System	Business Benefit
Cost leadership	Levitz Furniture	Centralized buying	Cut purchasing costs
	Metropolitan Life	Medical care monitoring	Cut medical costs
	Deere & Company	Machine tool control	Cut manufacturing costs
Differentiation	Navistar	Portable computer-based customer needs analysis	Increase in market share
	Setco Industries	Computer-aided job estimation	Increase in market share
	Consolidated Freightways	Customer online shipment tracking	Increase in market share
Innovation	Merrill Lynch	Customer cash management accounts	Market leadership
	Federal Express	Online package tracking and flight management	Market leadership
	McKesson Corp.	Customer order entry and merchandising	Market leadership
Growth	Citicorp	Global telecommunications network	Increase in global market
	Wal-Mart	Merchandise ordering by satellite network	Market leadership
	Toys 'Я' Us Inc.	POS inventory tracking	Market leadership
Alliance	Wal-Mart/Procter & Gamble	Automatic inventory replenishment by supplier	Reduced inventory costs/increased sales
	Levi Strauss/Designs Inc.	Electronic data interchange	Just-in-time merchandise replenishment
	Airborne Express/ Rentrak Corp.	Online inventory management/ shipment tracking	Increase in market share

2.2.3. Strategic Use of Information Systems :

(1) Improving Business Process :

One of the strategic business values of information technology is its role in making major improvements in a company's business processes. Investments in information technology can help make a firm's operational processes substantially more efficient, and its managerial processes much more effective. Making such improvements to its business processes could enable a company to cut costs, improve quality and customer service, and develop innovative products for new markets. For example, manufacturing processes for everything from automobiles to watches have been automated and significantly improved by computer-aided design, engineering, production, and manufacturing resource management technologies. In the automobile industry, the process for the production, distribution, and sales of cars and parts and the sharing of vital business data by managers and others has been substantially improved by using the Internet, extranets, and other networks that electronically connect an automobile manufacturer's production and distribution facilities with car dealers and suppliers.

Following table outlines many of the ways that information technology can improve business processes.

IT Capability	How IT Improves Business Processes
Transactional	Transform unstructured processes into routine transactions
Geographical	Transform information quickly and easily across large distances, making processes independent of geography
Automational	Reduce or replace human labor in a process
Analytical	Bring complex analytical methods to bear on a process
Informational	Bring large amounts of detailed information into a process
Sequential	Enable changes in the sequence of tasks, often allowing multiple tasks to be worked on simultaneously
Knowledge	Allow the capture and dissemination of knowledge and expertise to improve a process
Tracking	Allow the detailed tracking of the status, inputs, and outputs of a process
Disintermediation	Connect two parties within a process that would otherwise communicate through an intermediary.

Chrysler's CATIA Pipeline : Chrysler Corporation has reorganized its vehicle development process into multidisciplinary platform teams interconnected by the CATIA Pipeline, a telecommunications network that connects nearly every part of the company's "extended enterprise" to every other, including external suppliers and contractors. The software engine that moves data through the network and manages its database is CATIA (Computer-Aided Three-Dimensional Interactive Application), an integrated computer-aided design, development, engineering, and manufacturing execution system from Dassault Systems of France. Product information flows instantaneously from all directions and in all directions, linking managers, designers, engineers, marketers, service technicians, suppliers, and manufacturing.
The 1998 Dodge Intrepid and Chyrsler Concorde were the first products developed with the CATIA Pipeline. The cars and almost all of their components were electronically designed, tested, and stored in the CATIA database before any physical models or prototypes were made. Chyrsler designers and engineers are able to design and test every part thousands of times, simulate crashes, test air conditioners, plan production processes, and practice servicing procedures-all electronically. More importantly, CATIA determines how any design change affects any others and instantly notifies everyone affected. CATIA has thus made significant improvements to Chrysler's business process. The payoff to Chrysler has been dramatic reductions in costs, and major improvements in production efficiency and in product quality and performance.

Investments in information systems technology can result in the development of unique products and services or processes. This can create new business opportunities and enable a firm to expand into new markets or into new segments of existing markets.
The use of automated teller machines (ATMs) in banking is another classic example of an innovative investment in information systems technology.

Citibank and ATMs : By being first to install ATMs, Citibank and several other large banks were able to gain a strategic advantage over their competitors that lasted for

several years. ATMs lured customers away from other financial institutions by cutting the cost of delivering bank services and increasing the convenience of such services. The more costly and less convenient alternative would have been to establish new bank branch offices. ATMs are also an example of product differentiation, single bank services are now provided in a new way. ATMs raised the cost of competition, which forced some smaller banks that could not afford the investment in new technology to merge with larger banks. ATMs represented an attractive and convenient new banking service produced and distributed to customers by making innovative changes in the delivery of bank services. Thus, information systems technology was used to develop a strategic new distribution process for bank services.

(2) Locking In Customers and Suppliers :

Investments in information technology can also allow a business to lock in customers and suppliers (and lock out competitors) by building valuable new relationships with them. This can determine both customers and suppliers from abandoning a firm for its competitors or intimidating a firm into accepting less-profitable relationships. Early attempts to use information systems technology in these relationships focused on significantly improving the quality of service to customers and suppliers in a firm's distribution; marketing, sales, and service activities. Then businesses moved to more innovative uses of information technology.

Wal-Mart and Others : For example, Wal-Mart built an elaborate satellite network linking all of its stores. The network was designed to provide managers, buyers, and sales associates with up-to-date sales, shipping, inventory, and account status information to improve product buying, inventories, and store management. Then the firm began to use the operational efficiency of such information systems to offer better quality products and services and thereby differentiate itself from their competitors.
Companies like Wal-Mart began to extend their networks to their customers and suppliers in order to build innovative relationships that would lock in their business. This creates inter-organizational information systems in which the Internet, extranets, and other networks' electronically link the computers of businesses with their customers and suppliers, resulting in new business alliances and partnerships. Electronic data interchange (EDI) links between businesses and their suppliers, are a prime example of such strategic linkages. An even stronger link is formed by automatic inventory replenishment systems such as those between Wal-Mart and Procter & Gamble. In that system, Proctor & Gamble automatically replenishes Wal-Mart's in-store stock of Proctor & Gamble products.

(3) Creating Switching Costs :

A major emphasis in strategic information systems has been to find ways to build switching costs into the relationships between a firm and its customers or suppliers. That is, investments in information systems technology have attempted to make customers or suppliers dependent on the continued use of innovative, mutually beneficial inter-organizational information systems. Then, they become reluctant to pay the costs in time, money, effort, and inconvenience that it would take to change to a company's competitors.

SABRE and APOLLO : A classic example is the computerized airline reservation systems, such as the SABRE system of AMR Corporation (American Airlines) and the APOLLO system of COVIA (United Airlines), used by most travel agents. Once a travel agency has invested a substantial sum in installing such an inter organizational system, and travel agents have been trained in its use, the agency is reluctant to switch to another reservation system. Thus, what seemed to be just a more convenient and efficient way of processing airline reservations became a strategic weapon that gave these providers a major competitive advantage. Not only does an airline reservation system raise competitive barriers and increase switching costs, it also continues to give their providers an advantage in gaining reservations for themselves, even with the enforcement of new legal guidelines to protect competition. Such systems also provide these companies with a major new line of information products. Thus, computer-based reservation services are a major source of revenue for their providers, which charge a variety of fees to travel agencies and airlines who use their systems. Both companies have now extended these systems to the Internet. It will be interesting to see how well their services compete with other airlines and online travel services on the World Wide Web. The low cost and easy access of Internet-based services tend to significantly reduce switching costs.

(4) Raising Barriers to Entry :
By making investments in information technology to improve its operations or promote innovation, a firm could also erect barriers to entry that would discourage or delay other companies from entering a market. Typically, this happens by increasing the amount of investment or the complexity of the technology required to compete in an industry or a market segment. Such actions would tend to discourage firms already in the industry and deter external firms from entering the industry.

Merrill Lynch : Merrill Lynch's cash management account is a classic example. By making large investments in information technology, along with a ground breaking alliance with BancOne, they became the first securities brokers to offer a credit line, checking account, Visa credit card, and automatic investment in a money market fund, all in one account. This gave them a major competitive advantage for several years before their rivals could develop the IT capability to offer similar services on their own. Thus, large investments in computer-based information systems can make the stakes too high for some present or prospective players in an industry.

(5) Leveraging a Strategic IT Platform :

Investing in information technology enables a firm to build a strategic IT platform that allows it to take advantage of strategic opportunities. In many cases, this results when a company invests in advanced computer-based information systems to improve the efficiency of its own business processes. For example, they may develop client/server networks of PC and NC clients and network servers; develop intranets, extranets, and Internet services; hire more IS specialists; and do extensive multimedia training of end users. Then, armed with this technology platform, the firm can leverage investment in information technology by developing new products and services that would not be possible without a strong IT capability.

An important current example is the development of corporate intranets and extranets by many companies, which enables them to leverage their previous investments in Internet

browsers, servers, and client/server networks. Another classic example was the development by banks of remote banking services using automated teller machines. This innovative business use of IT was based in part on leveraging their expertise in teller terminal networks, which already interconnected their branches.

(6) Developing a Strategic Information Base :

Information systems also allow a firm to develop a strategic information base that can provide information to support the firm's competitive strategies. Information in a firm's corporate databases has always been a valuable asset in promoting efficient operations and effective management of a firm. However, information about a firm's operations, customers, suppliers, and competitors, as well as other economic and demographic data, stored in data warehouses, data marts, and other corporate databases, is now viewed as a strategic resource. That is, it is used to support strategic planning, marketing, and other strategic initiatives. In much the same way, information about *best business practices* and other business knowledge shared in intranet Web site databases is a strategic knowledge base.

For example, many businesses are now using data mining and online analytical processing to help design targeted marketing campaigns to selectively sell customers new products and services. This is especially true of firms that include several subsidiaries offering a variety of products and services. For example, once you become a customer of a subsidiary of American Express, you quickly become a target for marketing campaigns by their many other subsidiaries, based on information provided by the American Express strategic information resource base. This is one way a firm can leverage its investment in electronic commerce, transaction processing, and customer management systems-by linking its databases to its strategic planning and marketing systems. This strategy helps a firm create better marketing campaigns for new products and services, build better barriers to entry for competitors, and find better ways to lock in customers and suppliers.

2. 3. Strategic MIS :

Strategic MIS is the set of systems which are considered critical to the current or future business competitiveness, and hence the survival of an organization. Strategic MIS also supplies an organization with business intelligence. In other words, if an information system is used in creative ways to achieve goals and fulfill set organizational missions, it can be considered to be a strategic MIS.

Strategic MIS can be external or internal systems. External strategic MIS are used mainly by external quantities in the business environment, such as customers, suppliers, distributors etc and have a value added component that gives developers some time to reap the benefits of the system innovation. Internal strategic MIS are used by employees within the organization and do not have value added component. The employees focus on issues such as improving the quality of products, services and also enhancing the decision making capabilities of managers. Such systems are used at all levels in the organization and they have long term implications for the firm and also for the business processes within the firm.

In general, Strategic MIS can be divided into 3 categories :
(a) systems that focus on innovation fro competitive edge
(b) systems that use information as a weapon

(c) systems that increase productivity and lower the costs of goods and services

2.3.1 Characteristics

There are three common characteristics in all Strategic MIS. They are :
(a) telecommunications as a central part of SMIS
(b) reliance on a number of vendors fro providing information technologies
(c) cooperation among a number of organizations

Telecommunications is a vital part of SMIS. Successful organizations transcended traditional organizational boundaries and eliminated the barriers of time and space through the use of telecommunications. However, developing and implementing information systems that rely heavily on telecommunications is a challenging task and often becomes one of the bottlenecks for the development of SMIS.

For integration of complex technologies to develop an SMIS, a number of vendors are needed in many cases. Therefore, one of the ingredients of an SMIS of an SMIS is the ability to identify, coordinate and manage transactions with a number of vendors and effectively bring together diverse technologies to achieve a goal.

Inter organizational systems are those systems which are shared by more than two organizations, in terms of cooperation and collaboration rather than competition. Such ventures often result in powerful systems enhancing productivity, reduction in operating costs, increased market share, creating new partnerships, especially for organizations that conduct business transactions in the global market.

3. 2 Barriers of SIMS :

Researchers, Chris Kemerer and Glen Sosa, both from the Sloan school of management, identified 12 barriers to successful development of SMIS. These barriers fall into 3 categories
(a) Problem definition
(b) Implementation
(c) Maintenance

Problem definition barriers

- Generating workable idea require leadership and team work
- Many innovative ideas are technically infeasible
- Many innovative ideas are prohibitively expansive
- Many ideas die because they lack a sufficient market

Implementation barriers

- Telecommunications increases the complexity of implementing SMIS
- Multiple systems are difficult to integrate
- SMIS systems often require inter organizational cooperation
- State of the art technologies are difficult to implement

Maintenance barriers

- Competitors can copy SMIS
- Unanticipated demand can overwhelm the usefulness of an SMIS
- Applications can be expensive to maintain or enhance
- High exit barriers can cause devastating losses

Organizations with limited financial resources technological sophistication and organizational flexibility are likely to face one or more of the above mentioned barriers.

4. Success and Failure of MIS :

Most organizations use MIS more successfully than other organizations. Through hardware, software and technology available are the latest and the best, its use is more for the collection and storage of data and its elementary processing. There are some factors, which make MIS, a success while there are some factors, which make it a failure.

Factors contributing to success of MIS : If MIS is to be a success, then it should have all the features listed below :

- MIS is integrated into the management function. It sets clear objectives to ensure that MIS focuses on the major issues of the business. Also adequate development resources are provided and human & organizational barriers to progress are removed.
- An appropriate information processing technology required to meet the data processing and analysis needs of the users of MIS is selected.
- MIS is oriented, defined and designed in terms of the users requirements and its operational viability is ensured.
- MIS is kept under continuous surveillance, so that its open system is modified according to the changing information needs.
- MIS focuses on results and goals, and highlights the factors and reasons for non achievements.
- MIS is not allowed to end up into an information generation mill avoiding the noise in the information and the communication system.
- MIS recognizes that a manager is a human being and therefore, the systems must consider all the human behavioral aspects in the process of management.
- MIS recognizes that the different information needs for different objectives must be met with. The globalization of information in isolation from the different objectives leads to too much information and its non use.
- MIS is easy to operate and therefore, the design of MIS has such good features which make up a user friendly design.
- MIS recognizes that the information needs become obsolete and new needs emerge. The MIS design, therefore, has a potential capability to quickly meet newer and newer needs of information.
- MIS concentrates on developing the information support to manage critical success factors. It concentrates on the mission critical applications serving the needs of the top management.

Factors contributing to failures : Many times, MIS is a failure. The common factors which are responsible for this are as follows :

- MIS is conceived as a data processing and not as an information system.
- MIS does not provide that information which is needed by managers but it tends to provide the information generally the function calls for. MIS then becomes an impersonal function.
- Underestimating the complexity in the business systems and not recognizing it in the MIS design leads to problems in the successful implementation.
- Adequate attention is not given to the quality control aspects of the inputs, the process and the outputs leading to insufficient checks and controls in MIS.
- MIS is developed without streamlining the transaction processing systems in the organizations.
- Lack of training and appreciation that the users of the information and the generators of the data are different, and they have to play an important role in the MIS.

- MIS does not meet certain critical and key factors of its users, such as a response to the query on the database, an inability to get the processing done in a particular manner, lack of user friendly system and the dependence on the system personnel.
- A belief that the computerized MIS can solve all the management problems of planning and control of the business.
- Lack of administrative discipline in following the standardized systems and procedures, wrong coding and deviating from the system specifications result in incomplete and incorrect information.
- MIS does not give perfect information to all the users in the organization. Any attempt towards such a goal will be unsuccessful because every user has a human ingenuity, bias and certain assumptions not known to the designer. MIS cannot make up these by providing perfect information.

Assignment Questions :

1. Explain the different components of Information Systems and Information System Resources ? 12 M

2. Write a note on various Information System Activities 12 M

3. Explain how information Systems can be used for competitive Strategy 12 M

4. What are the strategic role of Information Systems ? Explain 12 M

5. Write a note on Strategic Use of Information Systems 12 M

6. List the factors contributing success & failure of MIS 12 M

Case 1 : Pepsi Cola Co. : Web Marketing Strategies

Would you shop for a soft drink online? Seems like a silly question. Of all the products for sales in the Universe, bottles and cans of sweet, carbonated liquid are probably the last things shoppers will want to buy on the Internet. Even frozen food has more potential. But soft drinks? They're cheap. They require no research to purchase. They are available on practically every street corner in the world. So why is Pepsi-Cola Co. trying so hard online? While many traditional advertisers have dabbled in the Net, Pepsi has a range of programs on the virtual air, from music sites to banner ads to Internet sweepstakes. Though only about 3 percent of its estimated $400 million soft drink ad budget goes online, that belies the emphasis the company places on the Web. "This medium is here to stay, and we buy that," says John Vail, director of digital media and marketing for Pepsi-Cola.

One reason: Despite the difficulties in measuring online ad performance, Pepsi has crafted deals that already show benefits. In a barter arrangement with Yahoo! Inc.) Pepsi plastered the portal's logo on 1.5 billion cans. In return, Yahoo took the cola company's already established loyalty program, Pepsi Stuff, to new heights. A co-branded web site, PepsiStuff.com let consumers collect points from bottle caps. The points were redeemable on the 'Web site for prizes-everything from electronic goods to concert tickets.

The results were considerable. Three million consumers logged on and registered at the PepsiStuff site, giving the cola company detailed consumer data that normally must be paid for in market research or gleaned from focus groups.
Information that once took months to obtain could now be had in days. What's more, Vail was able to tweak the program while it was in progress, maintaining the right inventory of the most popular prizes. "Instead of lagtime data, we had real-time and we could react to it," says Vail. Sales volume rose 5 percent during the online promotion and the cost was about one-fifth what it had been 'as a mail-in project.
Pepsi has no intention of slowing its Internet rush. The 'Web is the medium of choice for Pepsi's prime demographic audience, those under 25. "They are going to where their customer hangs out and flashing their name," says Tom Pirko, a beverage consultant for Santa Barbara-based Bevmark Ic. "This is aimed at flipping the next generation. For Pepsi, the Internet is serious. It's not a toy."
For consumer Shane Erstad, 29, that's good news. Intrigued by the prizes and the ability to collect the points online, he became devoted to Mountain Dew and a fan of the Pepsi Stuff site. Even now that the game has ended, he hasn't cut back. "I hope they repeat the promotion," he says. He can count on it, and much more. For Pepsi knows that its E-commerce marketing strategies are a work in progress. Pepsi's online marketing road has been long and bumpy.

On February 29, 1996, the company launched Pepsi World, a Web site of sponsored content designed to attract the youthful consumer. Sports and music news was mixed with online games and animation. A seven figure publicity budget backed the debut. But it quickly became clear through focus groups and traffic numbers that Pepsi hadn't reached its target. Eyeballs were too fleeting, visitors too fickle. By the summer of 1997, Vail revamped the site to be less of a sports news digest and more of a vehicle to promote Pepsi-sponsored athletes, such as NASCAR driver Jeff Gordon.

Going forward, Pepsi plans to expand on its Web site-centric E-commerce marketing efforts. Although banner ads and other more traditional ad buys have had some success, it's the creation of engaging Pepsi Web sites that has given the brand the most traction online. For example, Vail would like to bring a virtual experience to many other Pepsi promotions, such as Choose Your Music, a current in-store create-your-own-CD promotion at participating music outlets.
"We're looking ahead to the next evolution," says Vail.

Case Study Questions
1. What are the major business benefits of Pepsi's online marketing efforts?
2. Do you approve of Pepsi's "Web-centric" E-commerce marketing strategy? Why or why not:
3. Visit www.pepsistuff.com or other Pepsi websites. What else could Pepsi do to improve its web-based marketing efforts? Explain.

Case 2 : General Electric Company –Evaluating E-business Strategy
General Electric (GE) is the world's largest diversified manufacturer. *Fortune* named GE "America's Most Admired Company" in 1998, 1999, and 2000. Jack Welch, GE's CEO and chairman since 1981, is often cited as the most admired CEO in the United States. Headquartered in Fairfield, Connecticut, the company consists of 20 units, including Appliances, Broadcasting (NBC), Capital, Medical Systems, and Transportation Systems. With the acquisition of Honeywell, announced in October 2000, GE became a company

of $155 billion in revenue and 460,000 employees in 100 countries. Despite GE's size and old-economy businesses, *Internet Week* named GE its e-business company of 2000. Did GE transform itself into a digital firm?

At a January 1999 meeting of 500 top GE executives in Boca Raton, Florida, Welch announced a new initiative to turn GE into an Internet company. Earlier initiatives transformed GE and are partially responsible for its phenomenal rise in profit over the past two decades. Those initiatives were globalization of GE in the late 1980s, "products plus service" in 1995, which placed emphasis on customer service, and Six Sigma in 1996, a quality program that mandated GE units to use feedback from customers as the center of the program.

Welch announced that the Internet "will forever change the way business is done. It will change every relationship, between our businesses, between our customers, between our suppliers." By Internet-enabling its business processes, GE could reduce overhead costs by half, saving as much as $10 billion in the first
two years. Gary Reiner, GE's corporate CIO, later explained "We are Web-enabling nearly all of the [purchasing] negotiations process, and we are targeting 100 percent of our transactions on the buy side being done electronically." On the sell side Reiner also wanted to automate as much as possible, including providing customer service and order taking.

GE had quietly been involved with the Internet years before the Boca Raton meeting, conducting more purchasing and selling on the Internet than any other non computer manufacturer. For example, within six months after beginning to use the Internet for purchasing in mid-1996, GE Lighting had reduced its purchasing cycle from 14 to 7 days. It also reduced its supply prices by 10 to 15 percent because of open bidding on the Internet. In 1997, seven other GE units began purchasing via the Net. The company even sold the concept to others, including Boeing and 3M.

Polymerland, GE Plastic's distribution arm, began distributing technical documentation over the Web in 1994. It put its product catalog on the Net in 1995 and in 1997 established a site for sales transactions. Its on-line system enables customers to search for product by name, number, or product characteristics, download product information, verify that the product meets their specifications, apply for credit, order, track the shipment, and even return merchandise. Polymerland's weekly on-line sales climbed from $10,000 in 1997 to $6 million in 2000.

Welch ordered all GE units to determine how dot.com companies could destroy their businesses, dubbing this project DYB (destroy your business). Welch explained that if these GE units didn't identify their weaknesses, others would. Once armed with these answers, managers were to change their units to prevent
it from happening. Each of GE's 20 units created small cross functional teams to execute the initiative. Welch also wanted them to move current operations to the Web and to uncover new Net-related business opportunities. The final product was to be an Internet-based business plan that a competitor could have used to take away their unit's customers, and a plan for changes to their unit to combat this threat. Reiner ordered GE units to "come back with alternative approaches that enhance value to the customer and reduce total costs."

The Internet initiative started by trying to change GE's culture at the very top. GE's internal newsletters and many of Welch's memos became available only on-line. To give blue-collar workers access to the Net, GE installed computer kiosks on factory floors. One thousand top managers and executives, including Welch (who also had to take typing lessons), were assigned young, skilled mentors to work with them three to four hours per week in order to make them comfortable with the Web. They had to be able to evaluate their competitors' Web sites and to use the Web in other beneficial ways. Every GE employee was given training. Welch announced in 2000, that GE would reduce administrative expenses by 30 to 50 percent (around $10 billion) within 18 months through use of the Internet.

Many projects came out of the initiative. For example GE Medical Systems, which manufactures diagnostic imaging systems, such as CAT scanners and mammography equipment, identified its DYB threat as aggregators, such as WebMD, which offered unbiased information on competing products as well as selling those products. GE products on these sites looked like just another commodity. The GE unit's major response was iCenter, a Web connection to customers' GE equipment to monitor the equipment operation at the customer site. iCenter collects data and feeds it back to each customer who can then ask questions about the operation of the equipment through the same site. GE compares a customer's operating data with the same equipment operating elsewhere to aid that customer in improving performance. In addition customers are now able to download and test upgraded software for 30 days prior to having
to purchase it. The unit also began offering its equipment training classes on-line, allowing clients to take them at any time. The aggregators were also auctioning off used equipment that was in demand in poorer countries. Medical Systems established its own site to auction its own used equipment, thus opening new markets (outside the United States). GE Aircraft adapted iCenter and now monitors its customers' engines while they are in flight.

GE Power Systems then developed its Turbine Optimizer, which uses the Web to monitor any GE turbine, comparing its performance (such as fuel burn rate) with other turbines of same model anywhere in the world. Their site advises operators how to improve their turbines' performance and how much money the improvements would be worth. The operator can even schedule a service call in order to make further performance improvements.

Late in 1999 GE Transportation went live with an Internet , auction system for purchasing supplies. Soon other units, including Power and Medical, adopted the system. GE later estimated) the system would handle $5 billion in GE purchasing in 2000, and the company would do at least 50 percent of its purchasing on-line in 2001. The system lowers prices for GE because approved suppliers bid against each other to obtain GE contracts. It also results in fewer specification errors and speeds up the purchasing process. GE estimates it saves between 10 and 15 percent of purchasing costs altogether.

GE Appliances realized that appliances are traditionally sold through large and small retailers and that the Internet might destroy that model, turning appliances into commodities sold on big retail and auction sites. GE wanted to maintain the current system, keeping consumer loyalty to their GE brand (versus May tag, Whirlpool, and

Frigidaire). Appliances developed a point-of-sale system, which they placed in retail stores such as Home Depot, where customers enter their own orders. The retailer is paid a percentage of the sale. The product is shipped from GE directly to the customer. GE Appliances claims it can now take products from its factories and get them shipped anywhere in the United States virtually overnight on a cost-effective basis. In 2000 Appliances reported 45 percent of its sales, totaling $2.5 billion, took place on the Internet. It estimates 67 percent of its sales will be on the Internet in 2001.

The corporation and its units have issued a blizzard of press releases touting the successes of each of GE's Internet initiatives and the consequent positive effect on financial results. "In 1999, 30 percent of our orders came in via the Web," announced Marian Powell, the senior vice president for e-business at GE Capital Fleet Services. And in 2000 "we'll have over 60 percent. That's over a billion dollars in orders." CIO Reiner said, "We are not talking about incremental change. We're talking total transformation."

A January 2001 article by Mark Roberti of *The Industry Standard* was skeptical. Roberti commended GE for embracing the Internet so quickly. He also noted that "these endeavors are unlikely to make GE vastly more profitable. . . because the company isn't using the Internet to reach new markets or create major new sources of revenue." Roberti questioned the great savings through Internet-based cost cutting that GE claimed. To cut costs by moving business processes on-line, a firm "must eliminate-or redeploy-a significant number of employees" and "GE hasn't." For example, Roberti says, 60 percent of orders to GE Capital Fleet Services are now placed on-line, but it has not reduced its call center staff. GE reports that its selling, general, and administrative expenses as a percentage of sales fell for the first nine months of 2000 from 24.3 in 1999 to 23.6, a minor drop at best. Moreover, he notes caution coming from GE executives themselves. For example, although Reiner had projected a $10 billion saving over the next 18 months in 1999, in December 2000 he revised the 2001 savings to about $1.6 billion-not an insignificant sum, but far from the gigantic savings predicted. Reducing costs by having customers and employees serve themselves via the Web has proved elusive at other companies as well, such as IBM and UPS. Roberti claims that the Internet has not brought GE a significant number of new customers.

Overall, Roberti points out, "Through the third quarter of 2000, GE still hadn't demonstrated any significant improvement in its financial results that can be directly attributed to e-business." Although GE has achieved genuine progress and even leadership, the company could not be generating the savings management had been predicting. He speculates that the purpose of the continuous declarations of great savings may be to boost the price of GE's stock. Perhaps, most importantly, Roberti claims that although GE's Internet activities will give the company a boost, it will take its competitors only a few months to catch up, leaving GE without any competitive advantage.

CASE STUDY QUESTIONS

1. Summarize the business and technology conditions causing GE to launch its Internet initiative.
2. How is GE using Internet technology in its internal and external business processes?
3. What management, organization, and technology issues did GE have to address in its Internet initiative?

4. Evaluate GE's Internet initiative. Is it successful? Is the company transforming itself into a digital firm? Why or why not?

Case 3 : What Happened to Kmart?

On January 22, 2002, Kmart filed for bankruptcy protection. It was the largest retailer ever to do so and shocked many people. Kmart had made retail history when its founder, the Kresge "five and dime store" chain, invented the concept of the discount store. The first Kmart was established in Detroit in 1962, the same year Wal-Mart opened its first store in Rogers, Arkansas. By the end of 1963 Kmart had 63 stores converted from Kresge's. In the following years, however, Wal-Mart expanded quickly by following a strategy of everyday low prices. Wal-Mart used information technology (IT) to track sales in all its stores and to replenish its fastest selling products. Wal-Mart demonstrated its willingness to spend needed funds on IT by installing registers with bar-code scanners in each store during the late 1970s and early 1980s, which fed the sales data into the back-end store computers. The result was Wal-Mart sales data were always current and store managers knew what was selling well and what was not.

In time many orders were routed straight from the Wal-Mart store to the appropriate supplier, and the delivery went from that supplier directly to the store. Wal-Mart recently developed an extranet to work closely with key suppliers on problems such as how to increase sales on specific products. Many analysts believe Wal-Mart has the most sophisticated supply chain systems in the industry.

By 1983, with its cutting edge information systems, Wal-Mart was already spending only two cents per dollar getting goods to its stores while Kmart was spending five cents. From that differential alone, Wal-Mart could sell the same product at a price 3 percent lower than Kmart, an important saving to many shoppers. In 1990 Wal-Mart passed Kmart as the largest discount chain with annual sales of $32.6 billion for Kmart's $32.3 billion. Wal-Mart was well on its way to becoming the world's largest retailer. In December 2001, Target, Kmart's other major competitor, passed Kmart as the second largest discount chain. Target had prospered by emphasizing its merchandising, distinguishing itself as a low-cost source of quality and style.

Kmart, in contrast, used a promotions-driven business model, drumming up business by advertising "blue-light" specials using circulars inserted into local newspapers. In an attempt to stay ahead ofWal-Mart, Kmart started investing $1 billion to modernize its information systems in 1987. According to David Carlson, then Kmart's CIa, the company developed capabilities to collect the necessary data, bUt it did not use them to forecast demand, relying instead on management's judgments.

Carlson notes that Kmart's suppliers promoted as many of their products as they could sell rather than helping Kmart to focus on the better selling items, as was Wal-Mart's approach. Beginning in 1984, Kmart began diversifying its businesses by acquiring Waldenbooks, rayless Drugstores, Sports Authority, and OfficeMax. It also opened its first Super Kmart Center, a much larger store that now included groceries. Kmart continued to lose ground to competitors while it gained the image of being old-fashioned, outdated, and frumpy. It had a reputation of being a run-down place to shop with an inferior selection of products. Many of its shelves were empty while its prices were too high. It was even considered to offer poor customer service and to not care about competition. By 1994, Kmart was on the verge of bankruptcy. It sold off its newer businesses to concentrate on its discount stores, and, in 1997, it inaugurated the very popular Martha Stewart product lines for the home. In 1999, Kmart began developing BlueLight.com, a Web site designed to sell a few items in order to draw customers to physical stores and to polish its image. In May 2000, watching its hemorrhaging continue,

the company hired Charles Conaway, the former CVS drugstore chain president, as Kmart's chairman and CEO. Conaway pledged to turn the company around within two years, and said his goal was to make Kmart the primary destination for mothers looking for low-priced clothing, housewares, and packaged food for their families. He announced plans to restructure Kmart to increase the productivity of Kmart stores, inventories, and information systems. He closed 72 stores, reducing staff by 5,000. He even announced Kmart would spend about $1.4 billion for IT over two years versus only $263 million during the previous two years. However, in August 2001, Kmart announced a second quarter loss of $22 million, and Conaway blamed pricing pressure, particularly from Wal-Mart. Kmart reduced prices on 30,000 of its 70,000 items and cut down on advertising circulars. Consumer habits are hard to change and Kmart sales took a big hit.

Sales at Wal-Mart and Target grew in 2001, while those at Kmart continued to decline. Conaway said he had not found a formula to distinguish his company from his competitors. Since Conaway had taken over, Kmart had increased the percentage of items in stock to 86 percent, compared to 73 percent two to three years earlier. In a conference with Wall Street analysts, Conaway said Kmart was "doing a phenomenal job of reinventing" its supply chain, which would be visible to all in a year's time.

Despite Kmart's continuing falling sales and rising losses Conaway again mandated price cuts, this time on 50,000 products. When Fleming Companies, now Kmart's sole grocery supplier, suspended shipments to Kmart because of Kmart's failure to meet its weekly payment of $78 million, the company realized it could no longer meet all of its financial obligations. Kmart had to declare bankruptcy. Kmart had clearly exhibited many problems. For instance, former Kmart CIO Dave Carlson said he had tried to unify Kmart's two separate computers in its distribution system, but he was turned down because the project was considered to be too expensive. When Conaway was first hired, he wanted to find new ways to bring customers into the stores, and so he cut back on Kmart's primary method of Sunday circulars but offered no dear alternative strategy. In 2000, central planners were still allocating 60 percent of Kmart's goods to specific stores. Conaway tried to address this problem, but by December 2001, 40 percent of its goods were still being allocated by central planning rather than by local stores. Also, Kmart continued to expand the variety of its products rather than focusing on fast selling items, as did Wal-Mart. Shipping was such a problem that in December 2000, being limited to only 900 trucks per day, Kmart was forced to choose between shipping toothpaste or Christmas trees. Warehousing was also an obvious problem since 15,000 truck-trailers were parked behind its stores holding excess inventory because they had no more storage space. Conaway did successfully eliminate this problem within a few months, thereby also reducing the "shrink" (stolen product) rate. Many analysts and observers, including Conaway, believed supply chain management was Kmart's most serious problem, particularly when compared to Wal-Mart. Kmart's promotions driven business model created sharp spikes and drops in demand for products and has been much more difficult to support with supply chain management systems than everyday low pricing models such as Wal-Mart's. Indications of supply chain troubles were everywhere. Outdated technology at the distribution centers resulted in supplies often sitting on pallets for 24 or more hours until they were recorded in the central tracking system. The shelves displaying popular products were often empty, and to reorder them from regional distribution centers, store merchandisers first had to hand sift through previous purchasing receipts. Kmart's inventory turnover rate was very low. In the year 2000, Kmart's was an anemic 3.6; while Wal-Mart's was 7.3, and Target's was 6.3. Gary Buzek, the president of IHL Consulting Group, estimated that Kmart could add $1.9 billion in profit just by matching its competitors' turnover rates. Conaway moved ahead quickly. In

July, he selected i2 Technologies of Dallas, Texas, to work with Kmart in a project to rebuild its supply-chain systems. i2 had been a highly successful vendor of supply-chain software, although principally for manufacturers, while Kmart's new software had to be designed for its retail business. The project was to improve Kmart's management of sales forecasting, inventory sourcing, logistics, and reporting. i2 planned to use the Kmart project to create templates for sale to the retail industry in general and then customize them specifically for Kmart. The project would also connect these new systems to appropriate in-store technology such as bar-code scanners at cash registers. It would also include micro merchandising, which enables individual stores to select their own merchandise according to the needs and demands of their local community. i2 claimed its software would track the ability of key suppliers to supply their products. It would also analyze Kmart's needs, and execute the required orders, schedule shipments, and record the delivery of products. i2 claimed its software would reduce excess inventory in stores and distribution centers, thus lowering costs, and enabling Kmart to lower prices. Sales would then grow and profits increase. Conaway stated Kmart's supply chain would become the best in the retail business, although Lora Cecere, a Gartner analyst, did question the ability of the project to succeed in such a giant, complex project.

Katrina Roche, i2's chief marketing officer, stated that "i2 excels at sales but its execution isn't always flawless." Supply chain management software for manufacturing still accounted for 90 percent of i2's business, and it had only recent and limited experience in the retail sector. One major roadblock was that manufacturers use a relatively small number of stock-keeping units (SKUs) that must be handled by supply chain management software. Unfortunately, Kmart had over 70,000 SKUs in its 2,100 stores, meaning the system must deal with 147 million possible pairings, and this number is increased by inserting many distribution centers and time periods involved. The i2 software was simply not designed to handle such huge data sets. Yet advanced planning software is fundamental to supply chain management, and the problem could only be solved by Kmart purchasing more hardware; an expensive solution for a company facing Kmart's financial problems.

The i2 project was organized with a team of 500 working in an isolated location. It included over 100 personnel from Deloitte Consulting who were to customize i2's existing software, making it able to track the movement of goods to Kmart's more than 2,100 stores. Conaway announced that the first applications would go live in early 2001, followed by a "rapid, methodical rollout" of several dozen business releases with a total of93 distinct improvements, all by August 2002.

In February 2001, several suppliers, including Pharmavite Corp. of Northridge, California, and Bell Sports Corp. of Irving, Texas, said they were seeing improved inventory management in the last three months. Also, Kmart announced a $200 million program to purchase and install new point-of-sale terminal cash registers from IBM to improve customer service with faster checkout technologies.

In June 2001, Kmart began installing new warehouse management software called PkMS, from Manhattan Associates. Its goal was to move products-more quickly through Kmart's distribution centers to the stores, thereby cutting costs while getting the product on the shelves before it has been sold out. The software

was installed at corporate headquarters and in all distribution centers. Using it, workers who pick, pack, and ship products to the stores use bar-code scanners to locate each item and to track the flow of the goods. A spokesperson said Kmart would save $15 million a year by increasing productivity and lowering labor costs. Management hoped it might also increase sales. The result was that Kmart could track 30 SKUs at the

beginning of the third quarter (2001), 119,000 in late November, and 500,000 three months later. However, Buzek believed the information would be useless because management just didn't believe in the system. In September, the company announced a $148 million write-off of its previous warehouse management system because it was so extensively modified that it no longer could work well and cost too much to maintain. Observers and analysts claim the write-off included abandoning some of i2's software. Kmart also wrote off $65 million for two outdated distribution centers, replacing them with two newer ones purchased from Toys 'R" Us. In December 2001, word came out that the i2 project had fallen way behind. John West, i2's chief technology officer until late in 2001, said the software worked, but the project had stalled because of Kmart's "operational issues." One member of the i2 users group said, "If the data's not right, it's not that it doesn't work; it's just that you won't get the answer you want." Interestingly, when i2 had problems with Nike, it also blamed its customer and not itself. According to Karen Peterson, a Gartner analyst, Kmart originally did not understand the complex difficulties of the project. Another observer, Jim Dion, president of Chicago retail consulting firm Dionco Inc., said that with the project's difficulty in connecting its point-of-sale and inventory systems to its distribution systems, Kmart was still sending many of its orders on paper. Also in December, Kmart indicated it was now trying to modernize 800 of its stores at a cost of around $1 billion, and that money was competing with funds needed to modernize its supply chain. During the Christmas 2001 selling period Kmart moved less product off its shelves than it had in 2000.

When Kmart was forced to declare bankruptcy, it did indicate some plans for survival. Conaway announced that the company would use Chapter 11 bankruptcy protection to break store leases in 284 stores in 40 states and then close them. In June 2002, Kmart c4anged the name of its Web site from Bluelight.com to Kmatt.com to attract a younger audience and help focus on Kmart stores and sales promotions. (Bluelight had never become a profitable Web business.) Kmart.com will also see an expanded variety of name brand products such as Pentax cameras and Disney apparel. Management believes Kmart.com also meshes better than Bluelight.com with the company's current "Stuff of Life" campaign, which is trying to position the chain as a family-friendly budget-minded store.

Emphasizing exclusive brands such as Martha, Stewart, Everyday, and Joe Boxer may help Kmart distinguish itself from its rivals. Conaway believes Kmart should be able to emerge from Chapter 11of Bankruptcy in 2003. The question is, will Kmart truly be able to bounce back? What will it take to keep going? The company still doesn't have a low enough cost structure to compete with Wal-Mart's low prices, nor does it have the trendy image of Target. What can Kmart do to become the shopping destination of choice?

CH 3
Planning for MIS

3.1. Introduction :

Complexity of the information resource environment suggests that the planning for information systems is vital for their success. Companies that plan tend to achieve better results than those that do not or plan poorly. In spite of this fact, many companies do not put proper emphasis on information system planning, particularly for developing long-range information systems. With the result, information systems in such companies create chaos and confusion rather than supporting the managerial decision making. Therefore, it is essential that companies develop information system plan to guide in initial development of information systems and making subsequent changes in these systems.

3.2. Planning for Information :

An information system plan describes the structure and content of the information systems and how these can be developed. Since all projects relating to information systems cannot be developed and implemented concurrently, priorities must be set. Since in a dynamic organization, there are more opportunities for information system applications than can be handled at one time, an allocation process must be worked out. Further, a very important fundamental concept of information system planning is that the organization's strategic plan should be the basis for the information system strategic plan. Therefore, there should be integration of information system plan to organizational plan.

An information system plan has two time perspectives-long range and short range. The long-range plan, which usually covers three to five years, provides general guidelines for direction. The short-range plan provides a basis for specific accountability as to operational and financial performance. Since the short-range plan is derived out of the long-range plan, both the plans should be fully integrated. An information system plan usually, contains the following four sections:

1. Information system objectives and architecture.
2. Inventory of existing information systems.
3. Forecast of developments affecting the plan.
4. Specific plan.

Information System Objectives and Architecture

At the starting level of developing a plan of any type, its objectives should be defined so that those who are responsible for developing the plan are clear as to what they have to achieve through planning exercise. This is true for developing a plan for information systems too. However, information system objectives are

not ends in themselves from the organization's point of view because these objectives contribute to the achievement of organizational objectives which are ends in themselves. Therefore, while defining the information system objectives, following factors should be considered :

1. Organizational objectives particularly the long term.
2. Organizational strategies to achieve those objectives,
3. External environment affecting the operation of the organization (such as nature of industry, government regulations, customers, suppliers),
4. Internal organizational constraints (such as management philosophy, organizational culture, etc.), and
5. Assumptions about business risks and potential consequences.

Thus, the information system objectives are defined within the overall organizational objectives. These objectives, in turn, provide the direction for developing information systems. While defining the information system objectives, these should be defined in both broad and operational ways. A broad objective defines what the information systems are going to achieve; how they would contribute to the achievement of organizational objectives. An Operational objective defines what the information systems are going to achieve in a specific time frame. For example, while the overall objective of the information systems may be defined in terms of 'providing information on a timely basis to all organizational units', the operational objective may be defined in terms of 'providing periodic financial reports within 24 hours after the end of the period'.
Based on the objectives, information system architecture is defined. Information system architecture provides a framework for detailed planning. It defines major categories of information and the major information subsystems or applications for the organization as a whole.

Inventory of Existing Information Systems

Inventory of existing information systems indicates the current status of information systems in use. Inventory includes such items as hardware, software, and applications (if the information systems are computerized); analysis of expenses, hardware and software utilization, and personnel utilization; and assessment of strengths and weaknesses of the existing information systems.

The basic objective of inventory is to determine the extent to which the existing systems would contribute to the proposed systems. For example, when an organization is switching from centralized computing to client/server computing, it must identify which of the hardware and software (both system and application) can be used in the latter. Similar is the case with personnel utilization. However, in the case of personnel, some additional problems arise specially when there is a change of manual to computerized information systems. In such a case, many existing personnel may become redundant unless suitable training is provided to

them. Further, the organization has to develop plan to utilize surplus personnel which may result because of computerization.

Forecast of Developments Affecting the Plan

While developing an information system plan, it is necessary that future developments which may affect the implementation of the plan are taken into account. Such developments may be. in the area of information technology, methodology, and environment. Information technology has the greatest influence on the effectiveness of any information system. Therefore, how information technology, both in terms of hardware and Software, would shape in future should be given adequate consideration. Though it is very difficult to predict the nature of technological development at the time of preparing the plan, organizations acting on proactive basis can plan the assimilation of new technology easily because of time lag between technology development and its application. Usually, it happens that technology development is announced much earlier than its commercial use.

Besides information technology, methodology change can also be forecast in advance. In order to incorporate methodology change, it is better to consider alternative system development methodologies in place of or in addition to traditional life cycle methods. Environmental changes, such as change in government regulations, tax laws, competitors' actions, etc. should also be included in so far as they affect information systems.

Specific Plan

After determining the above three factors, the organization can draw a specific plan for information systems. At the initial level, a specific plan may be prepared for a longer term, say up to five years. Based on this, plan may be prepared for shorter term, say for the next year or two years. However, these two-period plans should not be prepared independent of each other but both of these should be fully integrated. This integration can be achieved if the shorter-term plan is derived from the longer-term plan. The specific plan should include hardware acquisition schedule, purchased software schedule for both system software and application software, application software development schedule, software maintenance and conversion schedule, personnel resources required and their recruitment and training schedule, and financial resources required-capital expenditure for acquiring hardware, Software, and other accessories; operating expenditure for operations, maintenance, and new development.

There should be a provision for updating the plan as each year passes, the information system plan requires updating. Future plans are affected by changes in technology, experience with the systems that have been developed, changing needs for new systems, and changes in the organization itself. The plan should be updated in anticipation of these changes rather than the actual changes. This facilitates the organization to be ready to face challenges emerging out of these changes.

INFORMATION SYSTEM GROWTH CYCLE

Every system has a life cycle In which a system develops Into stages. For example, human beings have life cycle consisting of birth, adolescence, youth, adult, maturity, and decay. In the same way, an Information system has a life cycle with different stages. Nolan has presented a stage model of Information system life cycle. Nolan stage model is a framework for Information system planning that matches various features of Information systems to stages of growth. It is a contingency theory which states-if these features exist, then the information system Is In this stage. It states that an organization must go through each stage of growth before It can progress to the next one. Thus, the stage model provides a set of limits if the organization's current stage of growth can be diagnosed.

Information System Growth Stages

Nolan originally presented four stages of Information system life cycle-Initiation, expansion (or contagion), formalization (or control), and maturity (or Integration). In a subsequent model, Nolan expanded these four stages into six stages-initiation, contagion, control, Integration, data administration, and maturity. Management responses to growth in computing are reflected In different levels of control or slack with each stage. Control is characterized by management policies and systems which ensure efficiency of computing use. Slack is the lack of control and the availability of resources to experiment with application features not required to perform basic processing. Table 3.1 shows the levels of control or slack In different stages of Information system growth model.

Table 3.1: **Levels of control or slack in different stages**

Stage	*Levels of control or slack*
Initiation	Low control and some slack; little or no information system planning.
Contagion	Greater slack in order to encourage use; lack of planning; costs rise and costs from lack of integration become visible.
Control	High level of control; information system planning is given increased emphasis.
Integration	Emphasis on integration; use of databases; emphasis on user control of information system costs.
Data administration	Focus on data administration; some slack to encourage development of systems which contribute to strategic advantage to the organisation.
Maturity	Application portfolio is complete and matches the organisational objectives.

While proposing stage model of information system growth cycle, Nolan has made certain assumptions about the growth dynamics of movement through the stages. These assumptions are as follows:

1. Organizational learning permits movement through stages. Organizational learning is the process by which an organization identifies action-outcome relationships, identifies and corrects errors, stores the experience in organizational personnel who teach new employees, and stores the systems, procedures, rules, computer programs, and other forms of transferring experience. Thus, organizational learning exhibits adaptive behaviour. This adaptive behaviour is useful in moving from one stage to another stage of information system growth cycle. For example, limited experimentation of stage one (initiation) is the basis for the second stage (contagion), and contagion stage allows diffusion of the technology before controls are applied.

2. Various stages of information system growth cycle cannot be skipped because experience is necessary before the organization is ready for the next stage. If experimentation is not performed. there are no early users to promote contagion. If the organization goes from initiation to control directly, technology diffusion does not occur because the control stifles widespread trial-and-error use.

3. Although there are certain natural growth processes involved, various stages of growth model can be planned, coordinated, and managed to move through stages efficiently and effectively. Organizational culture, leadership styles, and power relationships shift to meet the needs of each stage. Thus, various stages represent a sequence for planned and managed change.

Nolan has also proposed that major changes in information technology eliminate the maturity stage. With the introduction of new hardware, software, and system design, the organization starts on a new growth curve as shown in Figure 3.1.

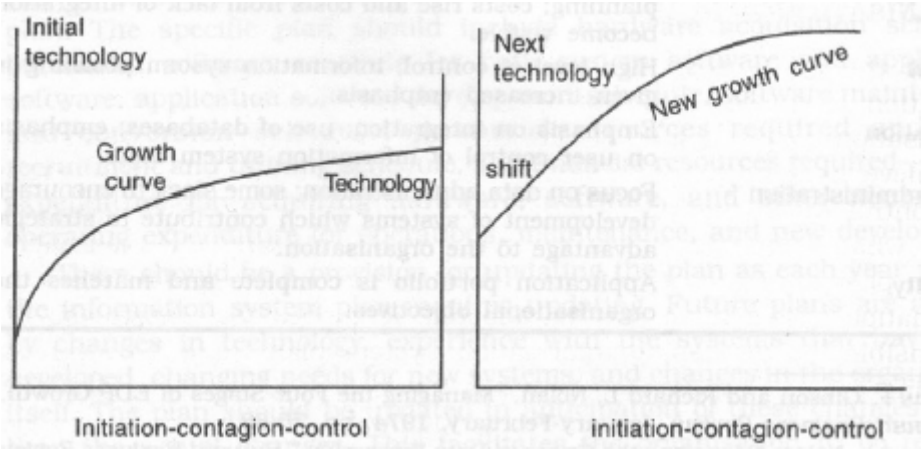


Figure 3.1: Repeating stages after technology shift.

Using Stage Model in Information System Planning

The stage model has significant relevance in information system planning. It can be used in diagnosis of current stage of growth and in planning changes in controlled way to move to the next stage. In an organization, usually, not all application subsystems grow at the same rate: for example, financial information

system may be in stage three (control) with controlled growth, while marketing may require encouragement for new applications which need more slacks. Thus. in practice, shifts in stages and their accompanying features occur gradually and at different paces. The stage model describes the logic of change and the destination that is to be achieved. It presents the logic of information system growth over different stages. However, the stage model does not specify the mechanisms of change from one stage to another stage. To that extent, the model lacks specificity. Therefore, the diagnostic measurements and prescriptive elements of the model should be viewed as general guidelines for information system planning.

3. 3 Techniques for Information Systems Planning :

A number of techniques have been proposed for information system planning. Each of these techniques tries to identify the flow of activities for developing a long-rage information system plan. These techniques are as follows:
1. Derivation of information system plan from organizational plan.
2. Strategic grid.
3. Strategy set transformation.

(1) DERIVATION OF INFORMATION SYSTEM PLAN FROM ORGANISATIONAL PLAN :

One of the most useful techniques of information system planning is derivation of information system plan from organizational plan. Every organization has some kind of plan that reflects its objectives and strategy to achieve those objectives. The implementation of strategy brings results and control system analyses whether the results are in tune with objectives: If not what additional efforts are required. By aligning the information system plan to organizational plan, objectives and strategy for developing information system plan may be adopted. It implies that those who are responsible for developing information system plan must be aware of planning process and various activities involved in it so that information systems are geared to these activities. Figure 3.2 presents organizational planning process.

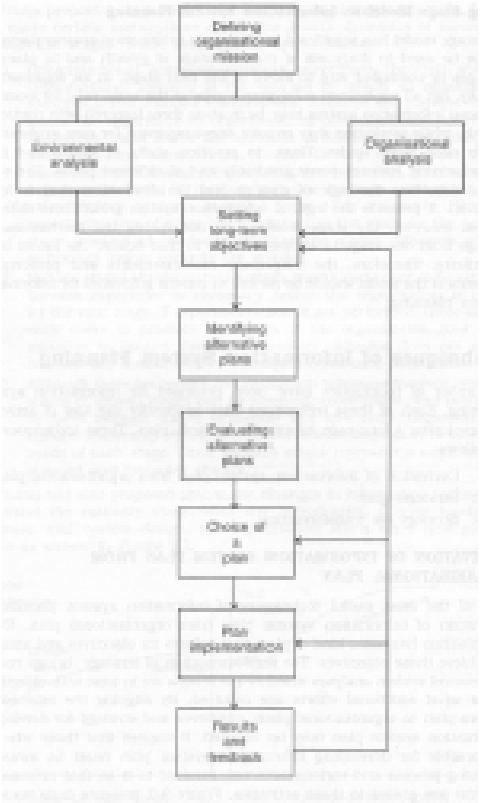


FIGURE 3.2: Organizational planning process

Various activities involved in organizational planning process should not be taken as independent activities and their flow only in one direction. Rather these should be taken in an integrated way in which two activities should be considered mutually interacting having two-way impact. The information system plan should be such that it provides relevant information at each activity level and its mutual interaction with other activities. A brief discussion of various activities of planning, process and their information requirements is presented below.

Defining Organizational Mission : Organizational mission is the fundamental purpose that explains why an organization exists and sets it apart from other organizations. It is a general enduring statement of the organization's intent and embodies the strategic decision makers' business philosophy. Organizational mission becomes the cornerstone for organizational operations. The scope of these operations is defined in terms of markets and products, that is, which markets will be served by the organization by offering which products. Organizational mission is enduring and, therefore, it changes over a long period of time depending on the environmental and internal organizational factors. Information systems play little role in defining organizational mission.
I

Environmental Analysis : The second element of organizational planning process is environmental analysis. Since an organization operates in a society, it has to interact with various factors lying in the society, such as customers,

suppliers, financiers, competitor, government, and other organs of the society. In the planning process, forecast is made about the likely future behaviour of these factors. However, this forecast is not made in vacuum rather it is based on information. Here the role of information systems is vital because that make relevant information available. If an organization scans its environment intensively, the information systems must be able to provide relevant mechanism for such scanning.

Organizational Analysis : Organizational analysis identifies the strengths weaknesses of the organization so that the organization is able to take advantages by using its strengths, and at the same time, taking measures to overcome its weaknesses. Organizational strengths and weaknesses are measured in all the functional areas-production, marketing, finance, and personnel-as well as its operating systems, procedures, etc. Here, information systems play significant role in identifying such strengths and weaknesses by collecting and analyzing internal information.

Setting Long-term Objectives : Based on organizational mission, environmental analysis, and organizational analysis, long-term objectives of the organizations are set. These long-term objectives may be set for a plan period (five years or so) or even beyond that. Some organizations define their objectives beyond a plan period which provide guidelines for setting objectives for plan periods. By analyzing the information from different sources, long-term objectives are set so that they are more realistic and meaningful.

Identifying Alternative Plans : Combination of organizational mission, environmental analysis, and organizational analysis enables the organization to generate various alternative plans which may help it achieve its long-term objectives. At this level, the aim is to generate as many alternatives as possible so that the organization has flexibility in choosing a plan for implementation. Information systems help in identifying such alternative plans by providing relevant information.

Evaluating Alternative Plans : After identification of various alternative plans, these are evaluated to find out which one is best in the given circumstances. Since all the plans cannot be implemented, it is desirable to select the one that meets the criteria of various decision factors. For evaluating different alternatives, successive step method is followed. Those plans which do not meet the initial decision criteria, (investment requirements, degree of risks, profitability, etc.) are eliminated at the first step of evaluation. The remaining plans go to the next step where the same process is repeated. Thus, screening out the plans results into only few plans which require detailed evaluation in terms of their payoff, risk involved, and so on. Information systems provide help in evaluating various alternative plans by analyzing their impact on the organization.

Choice of a Plan : When various alternative plans are evaluated, one of these plans is chosen for implementation. The chosen plan should meet the requirements of the organization as well as the personal aspirations and preferences of key decision makers. Because of these personal aspirations and preferences, sometimes, final choice of a plan does not remain fully objective. Information systems apply only objective factors in choosing a plan but do not take subjective factors into consideration.

Plan Implementation : Plan implementation involves putting a plan into action. For putting the plan into action, a detailed schedule of time is worked out, time-wise resource requirement is worked out, and finally, the plan is executed. During execution period, information systems measure the progress of plan execution in terms of time schedule as well as in terms of resource application. If there is any deviation between predetermined and actual time schedule and resource application, the information systems should have mechanisms to detect such deviation and communicate it promptly so that corrective actions are taken for the remaining portion of plan execution.

Results and Feedback : After the plan is implemented, it starts producing results. The information systems should monitor such results and provide feedback to management whether these results correspond with the desired results which were set at the time of choosing the plan. If the desired results and actual results show deviation, the information systems should detect the deviation and analyze the causes of such a deviation. Once the plan is executed, finding of actual results, comparing these with desired results, analyzing causes for deviation, and providing feedback to management become the regular function of the information systems.

Derivation of information plan from organizational plan is a good technique for information system planning because the information systems can pinpoint on those aspects on which managers need information, the time at which they need it, and the form in which they need it. However, this presents some operational problems too. *First,* those who are responsible for information system design are not well acquainted with how actually organizational planning takes place. Similarly, managers who are responsible for organizational planning are not well acquainted with how information systems work. Thus, there is likelihood of mismatch between what managers need as perceived by system designers and as perceived by the managers themselves. In order to overcome this problem, both information system specialists and managers should join hands even at the stage of planning for information systems. *Second,* in many organizations, choice of a plan does not follow the process described here. In such organizations, many plans emerge as process of mental exercise of some key decision makers. In such a case, only, the details of plan execution are worked out and working out of these details is supported by the information systems.

STRATEGIC GRID

Another technique of information system planning is the strategic grid, developed by McFarlan and McKenney, often called McFarlan-McKenney strategic grid. The strategic grid takes into account strategic impact of existing operating applications and strategic impact of planned application development portfolio. Both of these dimensions may have either high or low strategic impact on the information systems. By combining both these dimensions, four types of information system planning situations can be identified as shown in Figure 3.3.

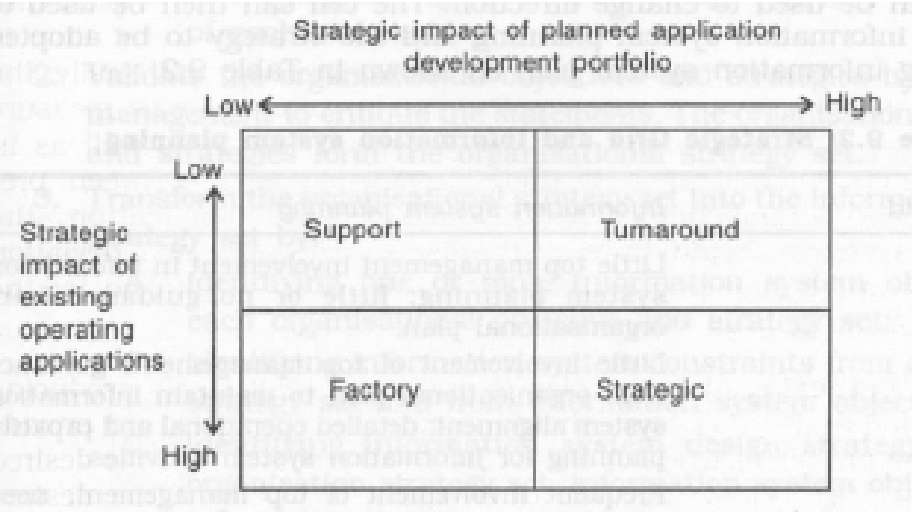


FIGURE 3.3: McFarlan-McKenney strategic grid

Each of the four cells of strategic grid defines the position of the information system activity relative to the organization as follows:

Support : When both dimensions of impact-strategic impact of existing operating applications and strategic impact of planned, application development portfolio-are low, information system applications that -support the activities of the organization are required. These systems emphasize traditional data processing applications. Information system activities are not vital to critical operations and are not included as part of future strategic directions.

Factory : When strategic impact of planned application portfolio is low but strategic impact of existing operating applications is high, factory cell of information systems is relevant. In this situation, information system applications are vital to the successful functioning of well-defined and well-accepted activities. However, information systems are not part of future strategic directions.

Turnaround : When strategic impact of planned application development portfolio is high but strategic impact of existing operating applications is low, information systems fall in turnaround cell. Turnaround is a transition state from support to strategic. The organization has had support-type applications, but is now planning for applications vital to strategic success of the organization.

Strategic : When strategic impact of planned application development portfolio as well as strategic impact of existing operating applications are high, strategic information systems are relevant. Information system activities are critical to the current competitive strategy and to the future strategic directions of the organization. Existing information system activities are part of the new strategic directions.

Strategic grid provides an analysis of current and planned portfolio status. It can be used to change direction. The cell can then be used to suggest the information system planning and the strategy to be adopted for preparing information system plan as shown in Table.

Table 9.2: Strategic Grid and information system planning

Position in grid	*Information system planning*
Support	Little top management involvement in information system planning; little or no guidance from organisational plan.
Factory	Little involvement of top management; guidance from organisational plan to maintain information system alignment; detailed operational and capacity planning for information system activities.
Turnaround	Frequent involvement of top management; need for smooth functioning of information system activities; guidance from organisational plan.
Strategic	Significant top management involvement; integration of organisational planning and information system planning.

The strategic grid of information system is a diagnostic tool to understand the role of information systems in an organization. The position in the grid explains the level of involvement of top management in information system planning and the relationship between information system planning and organizational planning. However, strategic grid suffers from one basic limitation. It merely explains what is happening rather than what should happen. If an organization desires to be more strategic in its use of information systems, the grid does not explain how this can be done.

STRATEGY SET TRANSFORMATION

Sometimes, it is not possible to derive information system objectives and plan based on organizational plan. This happens more so when organizational plan does not emerge as a sequential process and organization's strategic position is not specified clearly. In this situation, information system planning cannot derive meaningful clues from organizational plan and strategy. Therefore, strategy set transformation approach is used for information system planning. King has provided a model of strategy set transformation which helps in defining

information system objectives and the process that can be adopted for its planning.

Strategy set transformation proceeds in the following manner :
1. Explicate the organization's strategy set by :
A. Delineating the organization's stakeholders-owners, employees, suppliers, customers, etc.
B. Identifying the objectives of each stakeholder and
C. Identifying the organizational strategy to satisfy the objectives of each stakeholder.
2. Validate the organizational objectives and strategies by asking top management to critique the statements. The organizational objectives and strategies form the organizational strategy set.
3. Transform the organizational strategy set into the information system strategy set by:
A. identifying one or more information system objectives for each organizational objective and strategy set.
B. identifying information system constraints from organization strategy set and from information system objectives:
C. identifying information system design strategy based on organization strategy set, information system objectives, and information system constraints.

How strategy set transformation process can be used for information system planning can be explained by an example. Suppose an organization desires to improve its cash flow in order to pay for its creditors (stakeholder) and improve organizational profitability (meeting owners' objectives). The organizational strategy to improve cash flow is to collect from its debtors fast. Based on this, information system objective may be to improve billing.

Strategic organizational attributes relative to use *of* computerized information systems and decisions models will be reflected in information system constraints affecting the billing system. These can be expressed in information system design strategies, such as pilot projects for training, prototyping for system development, etc.

Strategic Approach for Determining Information Requirements

For information system planning, an organization has to determine its information requirements. Such requirements must be defined for the organization as a whole as well as for its different subsystems. To ensure that the information systems play effective role in generating competitive advantage to the organization, it is essential that the organization adopts strategic approach to identify its information requirements. Strategic approach *of* information requirement determination takes both environmental as well as organizational factors into account. A strategic approach for determining information requirements takes into account the following factors:

1. Critical success factors.
2. Competitive forces.
3. Value chain.

CRITICAL SUCCESS FACTORS

Critical success factor approach *of* determining information requirements argues that the information requirements *of* an organization are determined by a small number *of* critical success factors (CSFs) relevant to the organization and the industry in which it operates. CSFs are those characteristics, Conditions, or variables which when maintained and sustained, can have significant impact on the success *of* an organization competing in a particular industry. A CSF may be a characteristic such as product features, a condition such as high capital investment, or any other variable. A basic nature *of* CSFs is that they differ from industry to industry-consumer goods versus industrial goods, differentiated versus undifferentiated industries, local versus global industries and so on. The following table presents some examples *of* CSFs relevant for different industries.

Table : **Critical success factors in different industries**

Industry	*Critical success factors*
Toothpaste	Quality in terms of—form, flavor, foam, and freshness, and wide-area distribution network, high level of promotion, and brand loyalty.
Food processing	High quality product, packaging, efficient distribution network, and sales promotion.
Shoe	High quality product, cost efficiency, sophisticated retailing, flexible product mix, and creation of product image.
Automobile	Styling, strong dealer network, manufacturing cost control, and ability to meet environmental standards.
Courier service	Speedy dispatch, reliability, and price.

Using industry CSFs. managers can develop critical success factors in the form of organizational characteristics which match with industry CSFs. For example, if an industry CSF is in the form of wide-area distribution network, managers set objective in terms of developing this distribution network. Similarly, objectives can be set for all CSFs. In order to use CSF approach for identifying information requirements, managers need to generate as much information as possible by going through the following ways:

1. CSFs can be identified based on logic, heuristics, or even a rule of thumb rather than through any theoretical model. These are based on long years of

managerial experience which leads to the development of intuition, judgment, and hunch.
2. CSFs can also be identified internally in the organization by using creative techniques like brainstorming, or interviewing the key managers in the organization.
3. CSFs can be deduced from other companies' statements, expert opinions. organizational success stories. etc. When CSFs are identified, managers set objectives in these areas which, in turn, become the basis for determining the information requirements.
In fact, the basic premise in using CSF approach is that there is a small number of objectives that managers can easily identify and information systems focus on those objectives. For example, if an organization operating in toothpaste industry has set its objective to have certain rate of return on investment (first-level objective), it has to define its market share (second -level objective). In order to achieve its second-level objective, it has to define new product development (third-level objective). Since product is the source of generating revenue, product features must match the CSFs of the toothpaste industry (in terms of form, flavour, foam, and freshness).
Similarly, objectives can be set in relation to distribution network, product promotion, etc. At all these levels, different types of information are required.

Advantages of CSF Approach

There are certain advantages of using CSF approach in identifying the information requirements:
1. CSF approach produces a smaller data set to analyze for determining information requirements. Rather than going through a broad enquiry into what information is required by different managers.
CSF approach focuses on a small number of items.
2. CSI approach can be tailored to the structure of each industry, with different competitive strategies producing different information systems. It also depends on the industry position and even the geographical locations. Therefore, this approach produces systems that are more tailored to the organization.
3. CSF approach takes into account the changing environment with which the organization and its managers must deal. It forces the managers to have a look at the environment and consider how their analysis of it shapes their information needs.
4. CSF approach brings consensus among top managers about what is important to measure to gauge the organizational success. This enables the managers to focus their attention on how information should be handled.

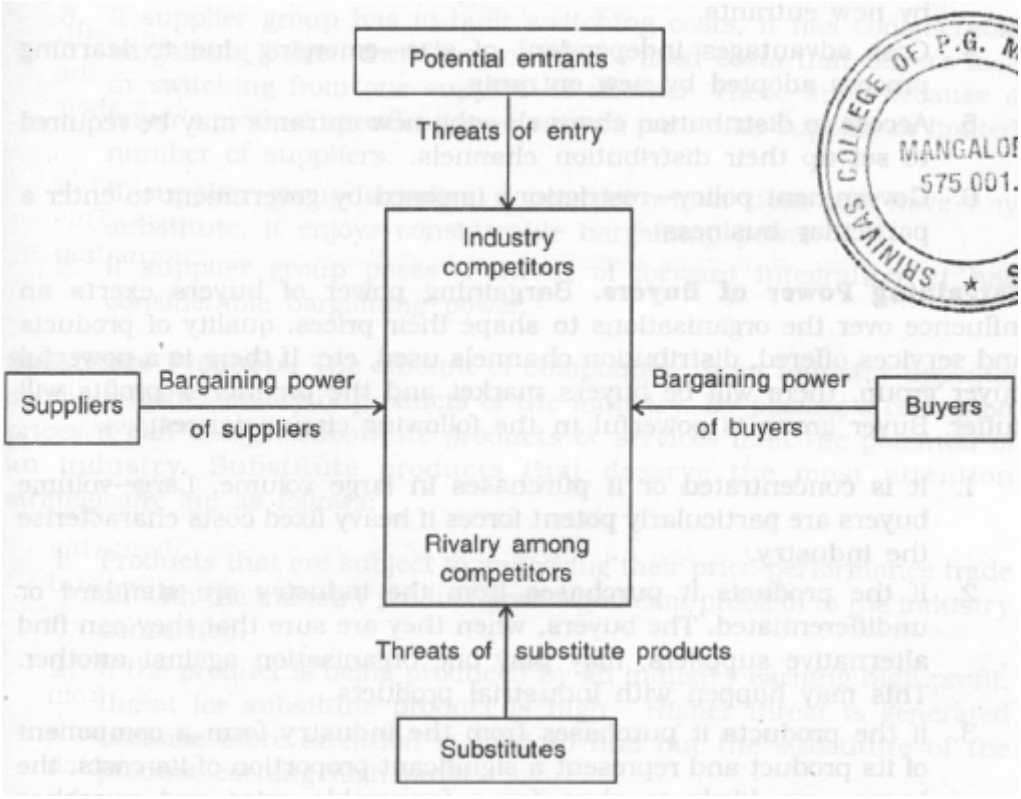
Limitations of CSF Approach
CSF approach suffers with some limitations too which are as follows:

1. There is no rigorous method of identifying CSFs either industry wise or organization-wise. Whatever factors managers may perceive as being critical

may not truly be critical. Therefore, for identifying various CSFs, managers need high-level of imagination and experience.
2, CSF approach focuses more on managers individually rather than focusing on the organization as a whole. What might be a CSF from a manager's point of view, may not be a CSF from the organization's point of view. Therefore, confusion arises as to the basis on which information requirement is to be assessed. Thus, this approach does not provide the base for aggregating individual CSFs into a clear organizational pattern relevant for information system design.
3. CSF approach is specifically useful for higher-level information systems-decision support systems and executive information systems. It assumes that transaction processing systems have already been well developed in the organization. If that is so, CSF approach is useful otherwise it leaves a vacuum.

COMPETITIVE FORCES

Many forward-looking organizations design their information systems to counter the threats generated by competitive forces and develop competitive advantage. Often competing organizations talk about the nature of competition in terms of their existing competitors. To some extent, this may be true. However, competition is not manifested only in other players in the market; it is rooted in its underlying economics, and competitive forces exist that go well beyond the establ1shed players in a particular industry. Buyers, suppliers, potential entrants, and substitute products. all are competitors in the sense that they may be more or less prominent or active depending on the nature of the industry. Michael Porter has identified five forces that shape competition in an industry as shown in following Figure.



Threats of Entry :

It is a famous saying that no business remains more attractive than others over the long run. This happens because if the industry is very profitable, there will be entry of many organizations in the field and position will become normal like any other industry. New entrants to an industry bring new capacity, the desire to gain market share, and have substantial resources. However, there are different kinds of barriers for newcomers in a field. If these barriers to the entry are high and a newcomer can expect sharp retaliation from the entrenched competitors, obviously he will not pose a serious threat of entry. There are six sources of barriers to entry.

1. Economies of scale-emerging from high volume of production, resulting into economies in production, research, marketing, financing, and other part of business.
2. Product differentiation-strategy adopted by existing players to differentiate their products from those of new entrants.
3. Capital requirements-the need to invest large financial resources by new entrants.
4. Cost advantages independent of size-emerging due to learning process adopted by new entrants.
5. Access to distribution channels-the new entrants may be required to set up their distribution channels.
6. Government policy-restrictions imposed by government to enter a particular business.

Bargaining Power of Buyers :

Bargaining power of buyers exerts an influence over the organizations to shape their prices. quality of products and services offered. distribution channels used. etc. If there is a powerful buyer group, there will be buyers market and the producers' profits will suffer. Buyer group is powerful in the following circumstances:

1. It is concentrated or it purchases in large volume. Large-volume buyers are particularly potent forces if heavy fixed costs characterize the industry.
2. If the products it purchases from the industry are standard or undifferentiated. The buyers when they are sure that they can find alternative suppliers, may play one organization against another.

This may happen with industrial products.

3. If the products it purchases from the industry form a component of its product and represent a significant proportion of its costs, the buyers are likely to shop for a favorable price and purchase selectively.
4. If buyers earn low profit, they will be more price-sensitive. In case of their high profit, they will be less price-sens1t1ve.
5. Where industry's product is unimportant to the quality of buyers' product, they will be more price-sensitive.
6. If the buyers pose a problem of backward integration, they will dominate in dealing with the industry in such a case. Such possibility is more in the case of textiles, automobiles, etc.

Substitute Products :

The amount of competition in an industry depends on the substitutability of products of the industry. By placing a ceiling on prices it can charge, substitute products or services limit the potential of an industry. Substitute products that deserve the most attention strategically are as follows:

1. Products that are subject to improving their price-performance trade off with the industry product pose significant problem to the industry concerned.
2. If the product is being produced by an industry earning high profit, threat for substitute product is high Higher threat is generated because more attention is paid to find out the substitute of the product earning high profit.

Rivalry for Position :

Various factors, discussed above, are mostly external form of competition and operate as homogenizing factors for all the competitors in an industry. Competition from within, that is among different players, is the most crucial factor which every organization should take into account. Rivalry among existing competitors takes the familiar form of jokeying for position, that is, increasing market share at the cost of competitors. Intense rivalry is related to a number of factors in an industry which are as follows:

1. There are numerous competitors in an industry and all of them are trying for the same end-result, that is, increasing their sales and capturing higher market share.

2. Often industry growth is slower as compared to the rate of growth in product supply offered by numerous competitors. With the result, rivalry becomes keen among competitors.
3. The product may lack differentiation and buyers are likely to switch over from one brand to another, based on price-performance relationship.
4. When exit barrier is high because of investment locked up in specialized assets, the companies have to keep their operation on even if they are incurring losses. In order to reduce these losses, companies may go for intense marketing.
5. Different competitors use different strategies based on pricing, product innovation, promotion, and other forms of differentiation. Each of them has different idea about how to do business, how to compete. and how to run head-on into each other.

Competitive Force Model and Information Systems
After analyzing, the competitive forces, an organization requires to develop information systems that should provide relevant information to counter the threats posed by these forces or likely to pose threats in future. Thus, an organization must have information on the following aspects:

1. Measuring performance of own products.
2. Measuring performance of competitors' products.
3. Reactions of buyers and suppliers.

Measuring Performance of Own Products : An organization requires information to measure the performance of its own products. For each product, information is required region-wise and customer-wise over a period of time to make a comparative analysis. Further, the information is required for the industry as a whole in which the organization operates to gauge the performance vis-a-vis total industry performance. If the organization has multiple products, such information is required for each product. Starting with data processing systems which provide base for structured information, the organization can design structured information systems which generate structured reports.

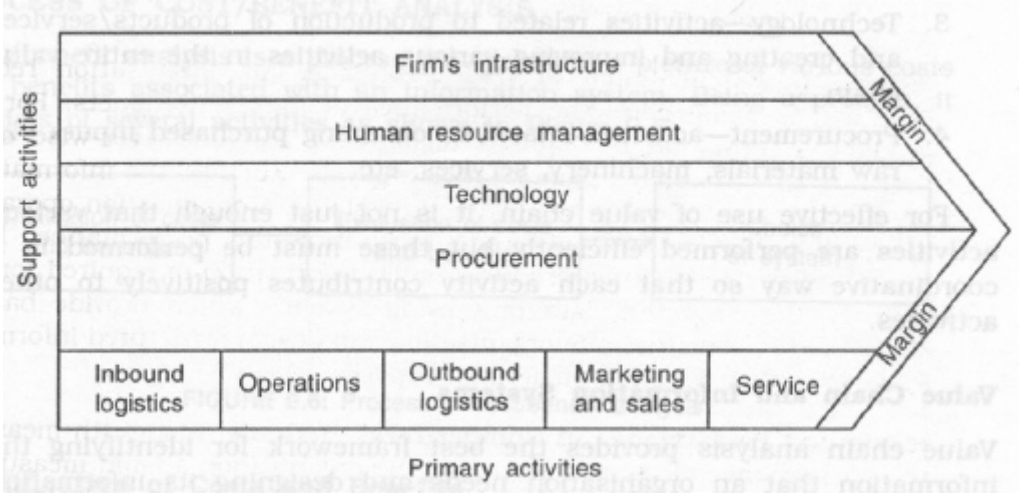
Measuring Performance of Competitors' Products : Along with measuring the performance of its own products, the organization should measure the performance of competitors' products. Though there are certain industries where concerned associations provide the information about market share of different players, information is available quite late which has more of historical relevance and less of strategic relevance. Same is the case with various marketing research agencies which publish information quite late.

In order to overcome this problem, the organization should develop its own marketing research information systems which may pinpoint what product a buyer buys and the reason why he buys. This information enables the organization to position and promote its products in a better way.

Reactions of Buyers and Suppliers : The organization is required to know the reactions of its buyers and suppliers. This can be done by developing wide area network to link buyers and suppliers so that there is continuous dialogue between the organization and its buyers and suppliers. While the number of suppliers may be limited, this may not be the case with buyers particularly in consumer products. Therefore, in such a case, the organization can link itself with distributors. Wide area network not only ensures continuous interaction with buyers and suppliers. it also enables the organization to schedule delivery and order placing.

VALUE CHAIN

Value chain analysis helps an organization to define the information which it needs to operate efficiently and thereby developing competitive advantage. Every organization performs a chain of activities. These activities are interrelated, and each activity creates a value important to the whole chain. Based on this, Porter has proposed the value chain to create more customer value. Accordingly, every organization is a collection of activities that are performed to design. Produce, market. Deliver, and support its products. The value chain identifies nine strategically relevant activities that create value in a business. These nine value-creating activities consist of five primary activities and four support activities as shown in following figure.



The value chain analysis is based on a typology of primary and support activities. Primary activities are the activities directly involved in the creation and transfer of products and services to the customers. Each value configuration has its own set of primary activities. Support activities enable and improve the performance of the primary activities and comprise procurement, technology development, human resource management and firm infrastructure (Porter, 1985).

In the *value chain* model the basic logic of value creation is the transformation of input into products, mainly through sequential processes. The evaluation of the product and related services is the source of customer value. An example is the assembly line using long-linked technology to produce standard products at low

cost. Primary activities of a value chain are inbound logistics, operations, outbound logistics, marketing & sales, and service.

3. 4. Risks in Information Systems :

Defining the values must be supplemented by assessment of the risks associated with the realization of values from the **IT** infrastructure. Broadly, there are four types of risks, namely, organizational risk, **IT** infrastructure risk, definitional risk and technical feasibility risk.

1. ***Organizational risk :*** The value of the **IT** infrastructure to the performance of the enterprise depends upon a host of environmental factors in the organization. The availability of necessary skills for implementation of information system projects and exploitation of IT infrastructure is sometimes a major constraint in the success of a information system project. Many organizations find resistance to the use of IT infrastructure within the organization, even when the necessary skills are available or are not very difficult to develop. Such a resistance, generally, is caused by the fears that might be created due to communication gap regarding implications of using IT infrastructure for a given application on the achievements of personal goals of the personnel associated with the application. For example, use of IT infrastructure in Indian banking industry faced a lot of resistance in the beginning from staff at various levels. The resistance was caused primarily due to the fear of possible retrenchments when the automation results in reduced manpower requirement.

Such resistance causes non-utilization or underutilization of IT infrastructure resulting in failures of applications in delivering the benefits of IT. The success in realization of benefits also depends upon the work culture in the enterprise. Installation of e-mail facility did not improve the communication system in the organization and the infrastructure remained grossly underutilized in some organizations where interpersonal communication was restricted. In other cases, where there existed an environment of openness in communication, it was a complete success.

2. ***IT infrastructure risks :*** Sometimes, the architecture of the existing IT infrastructure and the strategies of the on-going information systems are such that they are not in tune with the proposed information system project. Some projects have greater degree of dependence on the existing IT infrastructure. The degree of IT infrastructure risk is greater in such cases. However, if the proposed projects fit easily into the overall plan of the existing IT infrastructure, the probability of success is even higher. For example, the success of a customer information support system will depend upon the strength of the sales information system, production information system, financial accounting information system, etc. If these information systems are not mature, there is a greater risk of

customer information system not realizing the anticipated benefits. Rather, it may add more confusion to the existing chaos.

3. *Definitional risk :* The specific objectives that are sought to be achieved through the proposed, information system projects are to be defined properly or communicated to and received by the information system designers. Any ambiguity in the objectives and related details regarding the project may cause the projects not to deliver what was evaluated at the time of acceptance of the proposal. The definitional risks are greater in the case of projects that are complex in nature and relate to less tried processes. The definitional risks are lower in case of well established process, other things remaining equal. There is no dearth of cases wherein there is huge gap between what was targeted and what was finally delivered by the information systems. A market intelligence system, for example, aims at offering information regarding the rivals' plans may finally turn out to be a simple application aggregating the sales figures and analyzing trends in market shares. This may happen due to communication gap at the time of designing the application and definitional problems relating to what constitutes a market intelligence.

4. *Technical risk :* The rapid advancements in the information technology occurring in hardware; software and data organization, make the new technologies very attractive in terms of stated return to cost ratios. There is always a temptation to jump into to new technology bandwagon. In fact, adoption of new technology in most of the cases is the obvious decision as the new technology seems to be distinctly superior to the old one. However, there is always a risk of adopting new and untried technologies. The projects that involve use of untried technologies are more risky than the ones that use well established and commercially tried technologies. Thus, the process of evaluating information system proposals involves definition and measurement of values for the tangible and intangible benefits of the system. These values are matched against the potential sources of risks of failures of information systems in achieving these values.

Assignment Questions :

1. Explain all the stages of Information System Plan 12 M

2. Write a note on Nolan’s model of Information Systems Growth cycle. 12 M

3. What are the 3 techniques used for IS planning. Explain each in detail 15 M

4. What are the different factors in strategic approach for determining information requirements in an organization? Explain each. 15 M

5. Write a note on risks in Information Systems.

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CHAPTER 4

Introduction to Computers

Computer is an electronic device that can perform a sequence of automatic and / or logic operations and produce useful results, without human intervention, except in preparing the device and, possibly initiating the operations. It performs operations under the direction of step –by – step stored program of instructions.

We live in an age where computer has become a necessity. We find computers everywhere around us helping us in doing things which would have otherwise taken years to complete. To give you an example, when computerization of billing of telephone bills in Delhi was taken up, there was a backlog of more than 6 months. This was resulting in lots of losses to Delhi Telephones. If you do not send the bill, nobody will pay you. So within the next 3 months, not even the pending bills were sent, but current ones were also issued, This resulted in Delhi Telephone having surplus money within 3 months of computerization. And they invested a part of it buying out new computers.

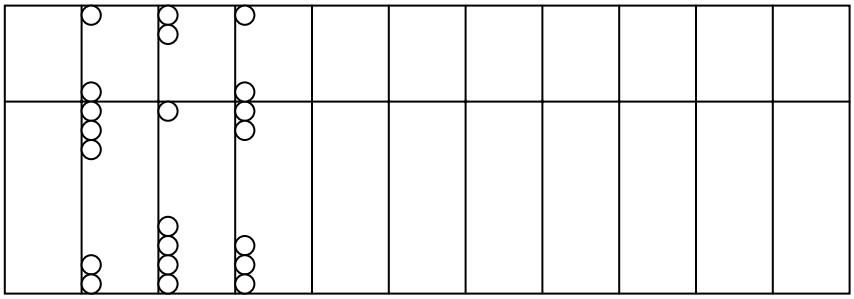
EVOLUTION OF COMPUTERS

Computers were very slow to begin with and they have gone through lots of changes over the last century. Though we are quite happy with the current generation of computers, but still we have to look back and see how the current computers have been developed over the period.

The earliest need for the counting was felt as early as stone age. Pebbles were used for this. Later on, Egyptians counted by drawing pictures on the wall. All this led to the development of Abacus by Indians and Egyptians. It was later on modified by the Chinese.

ABACUS :

The Chinese have a great fascination for the abacus. On the streets of Beijing, a few years ago, you could see them using it. It consists of 10 rods of beads. Each bead represents a number. Each rod contains 7 beads, 2 in the top section and 5 in the lower section. A bead in the lower half represents a single unit whereas a bead in the upper half represents 5. A representation is made by moving the bead towards the central rod. Thus each number is represented.



An abacus representing a number 8174260847 is shown above.

NAPIER'S BONE :

John Napier, the mathematician from Scotland, devised a set of rods for use in calculations involving multiplication. These rods were carved from bones and thus, were called "Napier's Bone".

PASCAL'S MACHINE :

It was way back in 1642 that **Blaise Pascal** developed a machine, which could not only add but also do multiplication and division. Later on, lots of modifications were done using rods, toothed wheels, bones, etc.

DIFFERENCE ENGINE

In 1823, Charles Babbage developed a machine called **Difference Engine.** This machine was based on the punch card technology developed earlier by **Joseph Marie Jacquard,** known for his invention called Jacquard's Loom.

He later improved the machine and called it **Analytical Engine.** It was based on mechanical gears. His technology of storing data and automation of it is still the base of all the modern-day computers.

This is why Charles Babbage is called the **Father of Computers.**

HOLLERITH'S PUNCHED CARDS :

In 1890, a census (counting of population) took place In USA. Herman Hollerith devised a machine of punched cards. The cards used to have holes for different answers. When these cards passed through the machine, a hole would allow the current to pass and thus it was taken as Yes and if there was no hole punched and the current did not pass, it was taken as No. Hollerith later on formed a company, which grew up and is now known as International Business Machines (IBM).

During the Second World War, the Germans developed computers known as **Z1 and Z2 machines**. These were useful for breaking the enemy codes.

ENIAC & MARK I :

In 1946, **John Mauchly** and **Presper Eckert** developed the first electronic computer known as **ENIAC.** It was based on the technology earlier developed by **Howard Aitken** and **Grace Hopper** in 1944 in the form of a machine known as **Mark 1.**

In 1936, after reading Lady Loverlace's notes Aiken begin to think that a modern equivalent of the analytical engine could be developed. So the first electro-mechanical computer the MARK 1 was developed by him in 1944 under the sponsorship of IBM. It was essentially a serial collection of electromechanical calculators and had many similarities to Babbage's analytical machine.

Dr. John W Mauchly collaborated with J Presper Eckert Jr. at the University of Pennsylvania to develop a machine that would compute tables for the US Army. The end product was the first fully operational electronic computer, which was completed in 1946 and named as ENIAC (Electronic Numerical Integrator and Computer).

Until then all computers used the movements of mechanical parts to perform their operations and store, but ENIAC, the first electronic computer used the movements of electrons do its calculations. Because pulses of electrons can be made to move much faster than the mechanical parts, the electronic computers operate much faster than mechanical ones.

This computer was actually known as first generation computer, since it was based on Valve technology. The other computers which come into this category are NIVAC. LEO, WHIRLWIND, EDVAC, etc.

But this was the first generation of computers. Later on we had the second, third, fourth and fifth generation of computers.

COMPUTER GENERATIONS :

As mentioned above the development of computer over the ages has been divided into 5 generations. These are listed below with the year when they have been around and what was the main storing method:

First Generation	:This was based on Thermionic Valve or so called Vacuum Tube	1949
Second Generation:	This was based on Transistors	1956
Third Generation	: Integrated Circuits or ICs	1966
Fourth Generation	:Microprocessors Chips	1975
Fifth Generation	: Very Large Scale Integration Systems	1990

The First Generation :

The main computer during this period was **UNIVAC** (Universal Automatic Computer). It was developed by **Mauchly** and **Eckert** for Remington Rand Corporation, and was installed in the US Bureau of the Census in 1951. Later that year, CBS news gave the UNIVAC national exposure when it correctly predicted Dwight Eisenhower's victory in the presidential election with only 5% of the votes counted.

In the first generation, vacuum tubes—electronic tubes about the size of light bulbs— were used as the internal computer components. However, because thousands of such tubes were required, they generated a great deal of heat, causing many problems in temperature regulation and climate control.

After the success of UNIVAC, IBM made a beginning and started manufacturing and marketing computers. IBM's first entry into the commercial computer market was the IBM 701 in 1953. It was IBM 650, introduced in 1954, which brought fame to IBM. The IBM 650 was designed as a logical upgrade of existing punched card machines.

The Second Generation :

Transistor, a small device that transferred electric signals across a resistor, was developed in this generation. It revolutionized electronics in general and computers in particular. Transistors were much smaller than vacuum tubes and they had numerous other advantages, they needed no warm up time, consumed less energy and were faster and more reliable.

Lots of programming languages were developed in this generation. Like FORTRAN in 1954, COBOL in 1959 and ALGOL in 1960. Along with the Assembly language, these programming languages were instrumental in the development of more computers here.

Honywell established itself as a major player in the second generation of computers.
Burrough, UNIVAC, NCR, CDC and Honywell together became the biggest competitors to IBM. Main computers in this generation were: Honywell 4000, PDP-8, IBM 7090, IBM 70941.

The Third Generation :

Silicon, a non-metallic substance found in common beach sand as well in rocks, became the most important role player in this generation. It is principally used as a semiconducting material for making Silicon chip, the integrated circuit. This element is important in the study of computers because the circuitry of the

computer is etched on a chip of Silicon. It was in 1965 at Santa Clara County. Silicon Valley, in USA, where the production of Silicon Chip (IC) was started. An integrated circuit (IC) is a complete electronic circuit on a small chip of Silicon. The chip which is less than 1/8 inch square and contains millions of electronic components. In 1965 ICs began to replace transistors in computers. The resulting machines were called third generation computers.

The beginning of the third generation was proclaimed by the IBM 360 in 1964. This computer which was based on ICs became the role model for other computers to come.

Besides IBM 360, the other computers to prosperous during this period were CDC 7600 and POP II, etc.

The Fourth Generation :

This generation of computers were based upon the development of large scale integration (LSI) circuitry. This generation was in fact, an extension of the third generation technology. The base technology was still the integrated circuit. This is not to industry has experienced a mind boggling succession of advances in the further say that two decades have passed without significant innovations. In fact, the computer miniaturization of circuitry, data communications, and the design of computer hardware and software.

This generation saw the emergence of Altair 8800 in 1975, Apple II from Apple Computer.

The Fifth Generation :

This term was coined by the Japanese to describe the powerful intelligent computers they wanted to build by the mid 1990s. Later the term became more broad to cover the several research fields too related to computer intelligence, artificial intelligence, expert systems and natural language.

But the true focus in this generation has been connectivity. The method of connecting computers called networking and its use in the development of Internet, which has really revolutionized the way we look at the computers now.

This all lead to most important computer of the century, called the Personal Computer.

PERSONAL COMPUTERS :

As mentioned above, in 1981, IBM introduced the first Personal Computers. The technology used in it was so simple that it took no time for others to copy it and make computers which are known as IBM compatible computers. They are

known as IBM clones too. Since then, IBM has brought out different versions/models with variations of floppy disks, hard disks, chips, etc., making them faster and faster.

The various versions of IBM PC compatible computers are shown below:

Model	RAM Chip	Type of Chip	Floopy D	Floopy D	H.D
PC-XT	640 K	8088	2	0	0
PC-XT	640 K	8088	1	0	20 MB
PC-AT/286	1028 K	80286	1	1	40 MB
PC-AT/386	4 MB	80386	1	1	120 MB
PC-AT/486	8 MB	80486	1	1	260 MB
PC-Pentium	16 MB	Pentium	0	1	720 MB
PC-PII	32 MB	Pentium-II	0	1	4 GB
PC-PIII	64 MB	Pentium-III	0	1	10 GB
PC-PIV	128 MB	Pentium-IV	0	1	40 GB

Note :

1 Byte = one character (0 to 9 or a to z or special characters)

Another type *of* computers which are very popular throughout the world but not in India are **Apple Computers.** All the computers are manufactured and sold by the parent company known as Apple Computer Products.

APPLE COMPUTERS :

These computers have other versions also. Version Apple HE was the first one. But later on they came up with a series of computers known as Macintosh (Mac, as is popularly known). These computers have become very popular with those people who have to use the computer for designing and artistic work, since the picture clarity is these computers in very high.

CLASSIFICATION OF COMPUTERS :

Generally, computers can be divided into 3 types.

1. Analog Computers
2. Digital Computers
3. Hybrid Computers

ANALOG COMPUTERS :

In this type of computers, numerical magnitudes are represented by physical quantities such as electric current, voltage, or resistance, mechanical movements, etc. These are machines which are designed to perform arithmetical functions upon numbers where the numbers are represented by physical quantity.

Analog computers are widely used in manufacturing units where temperatures, pressure or flow of liquids are to be monitored continuously. It is also used at petrol pump where petrol pump contains an analog processor that connects fuel flow measurements into quantity and price values.

Among the various drawbacks of using Analog computers are: They do not have the ability to store data in large quantities; They do not have the logical facilities; They can perform only arithmetical functions but are more costlier.

DIGITAL COMPUTERS :

A digital computer operates on data in the form of digits, rather than the physical quantities used in analog computers. That is, its input must be discrete rather than continuous and may consist of combinations of numbers, characters and special symbols, written in appropriate programming language.

Digital computers can be classified into two parts:

General Purpose Digital Computers
They are also known as all purpose digital computers. Theoretically they can be used for any type of applications, e.g., computers that are used for payroll, graphs, analysis, etc.

Special Purpose Digital Computers
A digital computer is 'designed to solve problems of a restricted type. That is, special purpose digital computer is designed to be especially efficient in a certain class of applications, e.g., computers installed in washing machines.

HYBRID COMPUTERS :

This type of computers are hybrid of the above two types. A hybrid computer may use or produce analog data or digital data. It can be obtained either by interconnecting a digital and analog computer via a hybrid interface or the analog unit is integrated as a part of central processor of a digital computer which ultimately helps in getting input/output directly.
Hybrid computers are generally used in scientific applications or in controlling industrial processes, in both situations the user is able to exploit the machine's ability to process both discrete and continuous data using accurate digital subroutines where necessary and the analog machines for fast integration functions.

CIASSIFICATION BY SiZE :

If we classify the computers by their sizes, we would have the following classification

1. Super Computers
2. Mainframe Computers
3. Super Mini Computers
4. Mini Computers
5. Micro Computers or Personal Computer

Super Computers :

A supercomputer contains a number of processing units which operate in parallel to make it faster. They are in fact, very large computers and are thus used for bigger applications. In India, there are many super computers, in which one such computer which is used by the Meteorological department weather forecasting.

Mainfrarne Computer :

It is again a large computer but where it differs from super computer is that it can be connected to various computers to share facilities. For example, a Systern/370 can be attached to several personal computers so that they can share programs and data. Mainframe computers are used in research organizations, large industrial banks, airlines, and railway reservations where large data base is required.

A typical application is the airline reservation system. The airlines have a main frame computer at their head office where information of all the flights is stored. Small computers installed at booking offices, are attached to the central data bank so that upto date information of all the flights is available.

The structural configuration of the main frame consists of :

1. Data communication equipment.
2. Interface equipment for a variety of high speed and low speed input/output devices.
3. Primary storage.
4. Secondary storage.
5. Central processors with multiprogramming facilities.

The main frame computers have following characteristics :

1. They are big general purpose computers capable of handling all kinds of problems whether scientific or commercial.
2. They can accept and transfer data from I/O devices at the rate of millions of bytes per second.
3. They can accept all types of high level languages.
4. They can support a large number of terminals say up to 100 or more.

5. They usually have instruction sets that give them the flexibility to operate automatically on 2 bytes (half-word) or 8 bytes (double word).
6. They have large on-line storage capacities and can support a number and variety of peripheral devices like magnetic tape drives, hard disk drives, visual display units, printers, and telecommunication terminals.
7. They routinely have high speed cache memory, which enables them to process applications faster than mini or micro computers.

The limitations of main frame computers are due to their high cost, large in size, high power consumption, requirement of skilled workers and expensive peripherals like requirement of air-conditioning etc.

Super Mini Computers :
These are cross between minicomputers and super computers. They are commonly used as dedicated computers, for one processing function at a time.

Mini Computers :
They are inferior to mainframe computers both in speed and storage. They can also support various terminals. In fact, they can support upto 100 terminals. Minicomputers have operating systems with multitasking and network capabilities enabling them to serve more than one user. They find applications in organizations having a heavy work load but finding the main-frame expensive to buy.

The most important advantage of a mini computer over the main-frame is that it is cheaper in cost, smaller in size, very rugged and reliable. It does not require air- conditioning and can be operated at room temperatures. The main use of these systems in education, in local government bodies, and also as a front end processors to a main-frame computer. It is also being used in word processing. In business, they are being used for invoicing, stock control, pay roll, sales analysis etc.

The mini computers have following characters :
1. They can accept and transfer data from I/O devices at the maximum speed of 4 MB per second.
2. They can support up to a maximum of 100 terminals.
3. They usually employ micro-processors in the CPU, both for data storage as well as data manipulation.
4. They have operating systems with multitasking and network capabilities enabling them to serve more than one user.
5. As per size, price and capabilities to support the number and variety of perifherals and terminals, they are further subclassified as (a) mini mini computers, (b) midi mini computers, and (c) maxi mini computers.

Compared to main-frame computers, mini computers are comparatively slow and their capabilities are limited.

MICRO COMPUTERS AND PERSONAL COMPUTERS :

Microcomputers are digital computers whose processing unit consist of one or more microprocessors, one or more input/output units and sufficient memory to execute instructions.

They are usually desktop or portable devices with a display, a keyboard and tape disk and diskette storage. They are designed primarily for stand-alone operation but can be used as workstation in terminal emulation mode.
The advantages of micro-computers are :

1. They use very little power.
2. They are less costly.
3. They are portable.
4. They are stable and reliable, once tested and proved to work, they can go on working for years.

Compared to main-frame and mini computers, they are slow and have limited capabilities but they provide good value for money.

Personal computer is a type of microcomputer primarily intended for stand-alone use by an individual. PCs are designed primarily to give independent computing power to a single user and are inexpensively priced for purchase by individuals or small business. IBM introduced the first personal computer called IBM-PC on 12/02/1981.

INTRODUCTION TO MICROPROCESSORS :

Microcomputer is so called because it uses the microprocessor chip. Basically all the microcomputers consist of 3 main chips: microprocessor chip, input/output chip and memory chip. A microprocessor chip can be further divided into control unit and arithmetic logic unit. It is here that all the processing of the computer takes place.

Each personal computer has been based on certain chip of the likes of 8088, 80286, 80386, etc. These chips have been introduced by Intel Corporation.

CENTRAL PROCESSING UNIT (CPU) :

As mentioned above this is the unit where all the processing takes place. It can be further divided into: **Main Memory, Control Unit** and **Arithmetic Logic Unit.**

Memory :

The memory unit can be defined as the brain of the computer. But, it does not store the information for long, It has the information only for the time when it is processing it. Once processed it passes on the information and gets the new information for processing.

There are two types of memory: **Non volatile memory** and **Volatile memory.**

Non Volatile Memory

In it the memory chip always retains the data which holds even when the computer turned off, e.g., ROM. One of the main reason of having ROM is to tell the computer is do when it is turned on. There are two main parts of non volatile memory: **PROM** (Programmable Read Only Memory) and **EPROM** (The Erasable Programmable Read Only Memory).

Volatile Memory

As the name suggests it is volatile in nature and loses its contents when the computer is shut off. It is called RAM (Random Access Memory). The main purpose of this memory is to hold programs and data which are under processing.

Capacity of RAM

The capacity of RAM is stated in terms of the number of bytes it can store. Memory capacity is usually stated in terms of Kilobytes (KB), which is equivalent to 1024 (2^{10}) bytes of storage, and in terms of megabytes (MB) which is 1,048,576 (2^{20}) bytes.

Note that 1 KB is about 1000 and 1 MB is about 1,000,000, thus the origin of the prefixes kilo (thousand) and mega (million). Occasionally you will see memory capacities of individual chips stated in terms of Kilobits (Kb) and megabits (Mb).

There are several types of memory that can be implemented in a given machine. **Dynamic Random Access Memory** (DRAM) is the most common low-cost and flexible RAM available. DRAM is now usually implemented using **SIMM** (Single In-line Modules) packs and SIMM slots. **Static RAM** (SRAM) is much faster, but also much more expensive. DRAM is usually used in the cache portion of the machine because of speed requirements.

Static Memory is made up of flip-flops and it stores a bit as a voltage. Dynamic Memory is made up of MOS transistor gates and it stores a bit as a charge. The advantage of dynamic memory is that a large number of transistor gates can be placed on a memory chip: thus it has high density and is faster than static memory. The disadvantage is that bit information stored gets leaked, so the information needs to be read and written again after every few msec. This is called refreshing the memory.

Function of RAM

RAM provides the processor with temporary storage for programs and data. All programs and data must be transferred to RAM from an input device or from secondary storage before programs can be executed or data can be processed.

RAM space is always at a premium; therefore, after a program has been executed, the storage space it occupied is reallocated to another program awaiting execution. The input message is interpreted and the processor initiates action to retrieve the appropriate program and data from secondary storage.

This is a non-destructive read process, i.e., the program and data that are read, reside in both RAM (temporarily) and secondary storage (permanently). The data are manipulated according to program instructions and an information is received at output.

A program instruction or a piece of data is stored in a specific RAM location called an address. Addresses permit program instructions and data to be located, accessed and processed. The content of each address is constantly changing as different programs are executed and new data are processed.

Bubble Memory

If the surface of a non-magnetic material is coated with a thin layer of magnetic material which is magnestised in the opposite direction away from the surface. These bubbles can be moved around and used to represent the binary digits. Bubble memories can not replace the main memory (CMOS) because they are too slow. However they can contain a great deal of information in a small space and may be used to replace the magnetic disk eventually, as they have the advantage of no moving parts.

Flash Memory (Flash RAM)

These memory chips are non-volatile and are therefore a true replacement for disk storage. The contents of the flash memory can be altered by the computer, and the data can still be retained when the power is turned off.

Access to data in flash memory is not as fast as a RAM, but is still many times faster than retrieving data using a disk drive (secondary storage). Because flash memory does not use any moving parts that draw power, it is used when power consumption must be kept to a minimum. This is particularly good for portable computers relying on batteries.

The first common application of flash memory will probably be replacing hard disks in laptop and notebook computers. Next, you will be able to plug your laptop's memory card into your PC to transfer programs and data between them easily. Flash chips are currently being used in cellular phones and cockpit flight recorders and they are replacing disks in some handheld computers.

Flash memory chips are being produced in credit-card like packages, which are smaller than a disk drive and require only half the power, that is whey they are being used in notebook computers and handheld personal digital assistants.

FACTORS AFFECTING PROCESSING SPEED

Registers

The size of a register (16-bit register or 32-bit register) which is also called the word size indicate the amount of data with which the computer can work. The bigger the size of register, the faster the computer can process a set of data. Registers retain information on a temporary basis.

They are not considered part of main memory. Registers have the ability to receive information, hold it temporarily and then pass it on as directed by supervisory control unit.

There are several type of registers:

Instruction Register : It holds the instruction which is being executed.

Address Register: It holds the storage location address.

Accumulator: It collects results.

Memory and Computing Power

More RAM make the computer run faster. The computer does not necessarily have to load an entire program into memory to run it, but the more of the program it can fit into memory, the faster the program will run. The computer loads only the most essential parts into memory. When it needs access to other parts of the program on the disk, it can unload, or swap out non essential parts and swap in program code or data it needs.

Computer's Internal Clock

Every microcomputer has a system clock made up of quartz crystal. The molecules in the crystal vibrate millions of times per second which is constant. The system uses the vibration of the crystal (quartz) in the system clock to time its processing operations. The clock speed is measured in hertz. Pentium CPU today have clock speed from 200 MHz to 400 MHz.

Bus

The system bus carries bits between CPU and only one peripheral at a time. In computer terminology bus refers to the paths between the components of a computer.

There are three main **buses:**

1. Data bus
2. Address bus and
3. Control bus.

Data Bus

It is an electrical path that connects the CPU, memory and other devices on the motherboard, tn real sense bus is a group of parallel lines. The number of lines in the bus affects the speed at which data can travel between hardware components. Since each wire can transfer one bit at a time, a 16-wire bus can move 16-bits at a time, which is 2 bytes. Similarly a 32-bit bus can transfer 4-bytes at a time.

In computer industry a data bus with 16-bit wide is called **as Industry Standard Architecture** (ISA) bus. A 32-bit bus is known as **Extended Industry Standard Architecture** (EISA) bus.

Address Bus

It connects only the CPU and memory and helps in locating memory address faster. The number of lines in It determines the maximum number of memory addresses, Today most CPUs have 32-bit address buses that can address 4GB (over 4 billion bytes) of memory.

Control Bus

It controls the direction, flow, origin and destination of data. It comprises of various single tines that carry synchronization signals. Control bus are individual lines that provide a pulse to indicate an CPU operation.

The CPU generates specific control signals for every operation it performs. These signals are used to identify a device type with which the CPU intends to communicate.

Cache Memory

A cache is similar to RAM except that it is extremely faster compared to normal memory. The cache speeds up processing storing frequently used data or instructions in its high-speed memory. Whenever the CPU requests information from RAM, the cache controller intercepts the request and searches its own memory for the requested information. If the information is not there the CPU retrieves the required data from the memory (RAM) and also sends a copy back to the cache. The next time the CPU needs the same information, the cache finds that information and quickly sends it to the CPU leaving RAM out of the loop.

Math Coprocessor

When the computer has to do a lot of floating-point arithmetic (viz; in spreadsheet, drawing programs or CAD programs) the presence of a math coprocessor either built into the CPU (viz: 486 DX-2 or Pentium, onwards) or added on the motherboard (viz; in 286, 386- in these 287 and 387 chip act as math coprocessor) can speed up processing considerably.

So math coprocessor is a chip or part of a chip that is specially designed to handle complicated mathematical operations.

Flash Memory

A long-standing speed problem has been the rate of accessing data from a secondary storage device such as a disk, a rate significantly slower than internal computer speeds. To overcome this, flash memory (non-volatile RAM) can be used. Since data and instructions will be ever-closer to the microprocessor,

conversion to flash memory chips would have a pivotal impact on a computer's processing speed.

CONTROL UNIT :

It is the center of all the activities of the computer. The control unit contains circuitry that uses electrical signals to direct the entire computer system to carry out or execute stored program instructions.

The control unit does not execute instructions itself, but it tells others what to do.

Arithmetic Logic Unit :

It executes all the arithmetic and logical operations. The arithmetic operations can be Addition, Subtraction, Multiplication, and Division. The logical operations can be: Equal to, Less than and Greater than.

SEMICONDUCTORS

Consisting *of* very small silicon chips these are mainly used *for* memory of the computer. They are different types varying in terms of speed and reliability.

INTEGRATED CIRCUIT

They are nothing but the electronic circuits on a small silicon chip. This chip is capable performing a variety of functions as a substitute for different electronic components of the computer.

HARDWARE

Computer hardware is a collective term used to define the various parts of the computer you can see and touch with your hands. The various components of these are the Monitor, Keyboard and Central Processing Unit.

One can have additional hardware like printer, scanner attached to the computer too.

SOFTWARE

A program is a set *of* instructions given to the computer to perform a certain task. It is known as the software of the computer. There are two main types of software:

System Softwore

The software used to operate and maintain a computer system and also used by a programmer to develop application software is known as System Software. Various software under this category are:DOS, Windows, etc. System Software is further classified as (a) Operating system software and (b) language software.

Applicotion Software

The software which performs specific tasks, like railway ticketing, telephone billing, salary and wages calculation, etc., is called the application software.

DATA

It is the raw form of information which is given to the computer for processing. Data is
name given to the basic facts such as name, age. address, telephone number, etc.

INFORMATION

It is the collection of data in a meaningful form. So all data which has some meaning is
called information. Please remember Data and Information is not the same thing. Data is raw but information is organized form of data.

PROCESSING

When the data is put into the computer to give some results, the work which the computer performs is called Processing.

BIT

It is the smallest storing space in the computer.

BYTE

A group of 8 bits form a Byte. A computer's capacity is measured in terms of bytes. It is required to store a character—numeric (0 to 9), alphabetic (a to z) or (A to Z) and special characters like these: ! @ # £ % h & * f etc.

But certain large computers can perform operation in parallel, i.e., it can process two or more sets of data simultaneously.
Before an instruction can be executed, program instructions and data must be placed into memory from an input device or a secondary storage device.
CPU Performs the following steps for each instructions:
1. The control unit fetches the instruction from memory (RAM) or cache memory and located to the program register and then to decoder.

2. The control unit decodes the instruction and directs that the necessary data to be moved from memory to ALU.

These first two steps together are called instruction time or I-time

3. The ALU executes the arithmetic or logical instruction.
4. The ALU stores the result of this operation in the appropriate memory position or register

These two steps together are called execution time or E-time. Each ALU unit has an internal clock that produces pulses at a fixed rate to synchronize all computer operations. The repetition of the instruction/execution cycle continues until all the

instructions have been processed. The speed of processing depends on the clock speed of the computer hardware.

The time taken by control unit to process one instruction is called a machine cycle—a Combination of two cycles, i.e., fetch and decode cycle, and execute cycle.

In the fetch and decode cycle phase the control unit obtains an instruction from primary storage(RAM) and stores it in an instruction register and then it decodes the instruction by looking up the instruction's operation code in a table.

Each type of CPU can only understand a particular type of instruction set.

In the execute cycle phase the supervisor control unit executes the instruction by actually performing the task indicated.

Sometimes the instruction simply requires the transfer of data value from one primary Storage location to another, e.g., increment a particular variable. Such type of task does not require the ALU.

MOTHEBOARD

The most important part of the CPU is Motherboard. As the name suggests it is the mother of all boards. All other boards are secondary to it. All instructions pass through this first.

Various components on the motherboard are:

Memory : These slots are there for putting the memory chips. Most of the new motheboards have capacity for 128 MB of RAM.

CPU : This is the main slot for the PC.

Additional : These are there for putting additional attachments like Video card, etc.

BIOS : Basic Input Output Instructions chip which is fixed on the motherboard to run the PC.

Clock This chip is there for providing the running dock within the PC to give you the time and date.

Ports : Most PCs now-a-days come with 2 parallel and 2 serial ports where j can put your mouse, printer, etc.

IDE : These are used for connections to floppy disk, hard disk, CD-ROM drive, etc

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Assignment

1. Write a historical note on evolution of computers ?
2. Write a note on various generations of computers with example ?
3. How computers are classified based on (i) nature of electronic circuits involved ? (ii) by their size ?
4. What are the different blocks of a computer explain the functions of each block ?

CHAPTER 4(b)

PROGRAMMING LANGUAGES

INTRODUCTION

The Software is generally classified into two categories on the basis of application suitability of the programs:

1. System Software
2. Application Software

System Software :

System Software referrers to all programs which make the computer work and commonly supplied by the manufacturers of the Hardware. System Software is the Software required for the basic operations of the Computer which consists of a large number of functions which are specific to the hardware devices constituting a particular computer system.

I System Software is further classified as
   1. Operating system Software
   2. Language Software

II Language software comes in four forms
   1. Assembler
   2. Compilers
   3. Interpreters
   4. Editors.

COMPUTER LANGUAGE

A language is a system of communication. A programming language is the language used to communicate with computer. The programming language are part of the Software or programming aids provided by the manufacturer. All computer languages can be classified in following broad categories:

1. Low level Languages
   a. Machine level Language
   b.. Assembly Language
2. High level Languages

MACHINE LANGUAGE

The computer understands nothing but 0s and I s (machine language) is also referred to as an absolute language. These machine instructions are divided into two parts.

1. Operation (code)
2. Operand (address)

In the early stages of programming, the programmer was required to write his program in strings of 0s (zeros) and Is and also calculated and allocated the core storage locations for his data and/or instructions. This was really very tedious and great proportion of his time was wasted in these routine jobs. Later on it was found that the capabilities of the computer can themselves be used to

relieve the programmer of these strenuous routine jobs. Operations such as translating a program into detailed machine codes, allocating storage place inside the computer, organising, establishing and accounting for sequences for short jobs are precisely the high grade clerical work the computer can handle. It is therefore, only rational to expect the machine to do it. This provided the motivation for the birth of programming languages.

The instructions to the computer are provided with the help of a programming language by preparing a program. The language whose design is governed by the circuitry and the structure of the machine is known as Machine language consisting of instruction codes in the format.

OPERATION CODE	OPERAND (ADDRESS)

The operation code denotes the operation which is to be performed (e.g. add, multiply; write onto output device etc.), and the power of a computer is the number of operations that it can execute (i.e., the number of instructions in an instruction set). The operand part of the instruction code gives the specific location address of the data to which the operation code is to be applied (remember that the CPU main store is divided into thousands of identifiable address locations). If the \ data requires more than one address location its length is also indicated, thereby identifying (without numbering each one) the next sequential location address(es) that contain the rest of the data.

ADVANTAGES OF MACHINE LANGUAGE

1. Machine Languages make efficient use of storage – language instructions and their storage in computer memory can be controlled.
2. Instructions of a machine language program are immediately executable. They require no compilation or translation steps.
3. Machine language instructions can be used to manipulate the individual bits in a byte of computer storage.

DISADVANTAGES OF MACHINE LANGUAGE

1. machine languages are machine dependent.
2. Although easily used by the computer, machine languages is difficult to program. It is necessary for the programmer either to memorize the dozens of code numbers for the commands in the machine's instruction set or to constantly refer to a reference card.
3. It is difficult to correct or modify machine language programs. Checking machine instructions to locate errors is about as tedious as writing them initially.

ASSEMBLY LANGUAGE:

The language which substitutes letters and symbols for the numbers in the machine program is called an assembly language or symbolic language. A

program written in symbolic language that uses symbols instead of numbers is called an assembly code or symbolic program. The translator program that translates an assembly code into the computer's machine code is called an assembler. The assembler is a system program which is upplied by the computer manufacturer. It is written by system programmers with great care. It is so called because an addition to translating the assembly code into machine code, it also assembles the machine code into the main memory of the computer and makes it ready for execution. A symbolic program written by a programmer in assembly language is called ***source program.*** After the source program has been converted into machine language by an assembler, it is referred to as ***object program.***

In the 1950's mnemonic operation codes and symbolic addresses were developed. First introduced in the second generation computers, the word mnemonic (pronounced nemonik) refers to a memory aid. Letter symbol mnemonics were substituted for the numeric machine language operation codes. Each computer has a mnemonic code although the actual symbols vary among different makes. Machine language is still used by the computer as it processes data, but assembly language program first translates the specified operation code symbol into its machine language equivalent.

ADVANTAGES OF ASSEMBLY LANGUAGE

1. It is not required to keep track of memory locations.
2. Insertions and deletions are quite easy.
3. Revision of complete program is quite easy.
4. Requires fewer instructions to accomplish the same result.
5. Assembly language is easier to understand and because mnemonics are used instead of numeric op-codes and suitable names are used as data.
6. While writing programs in assembly language, fewer errors are made, and those that are made are easier to find and correct because of the use of mnemonics and symbolic field names.
7. Assembly language programs are easier for people to modify than machine language programs.

DISADVANTAGES OF ASSEMBLY LANGUAGE

1. Programs based on such languages cannot be executed on small sized computers.
2. Programs take longer to code because of the more complex nature of the language.
3. Lack of portability of programs between computers of different makes.

HIGH LEVEL LANGUAGES

To overcome the low level language difficulty of machine dependency, high level problem-oriented (or machine independent) languages were developed. Such

programming languages, with an extensive vocabulary of words and symbols, are used to instruct a computer to carry out the necessary procedures, regardless of the type of machine being used.

High level languages do to have the one instruction to one instruction relationship which is a feature of symbolic languages. Instead one high level language instruction language instruction (a macro instruction) may generate a number of machine code instruction. This allows the programmer to abandon the two part format of low level instructions and as he can work relatively independently of the machine the programming task is considerably eased. High level languages are constantly being developed and improved and as more and more systems capable of on line and real time operation languages were designed for interactive use via a terminal.

Interactive languages provide facilities for the programmer to make corrections and /or changes to his program during its compilation and execution. The increasing availability of mini computers and micro computers has speeded up this process of developing languages that enable the user to obtain maximum use of the computer, without undergoing an extended period of special training or incurring the considerable post of employing a computer programmer.

ADVANTAGES OF HIGH LEVEL LANGUAGES

1. Machine independence: High level languages are machine independent. This is a very valuable advantage because it means that a company changing computers even to one from a different manufacturer will not be required to rewrite ail the programs that it is currently using.

2. Easy to learn and use: These languages are *very* similar to the languages normally used by us in our day lo day life. Hence they are easy to learn and use. The programmer need not learn anything about the computer he is going to use.

3. Easier to maintain: Programs written in high level languages are easier to maintain than assembly language or machine languages program.

4. **Fewer Errors**: In case off high level languages, since the programmer need not write all the small steps carried out by the computer, he is much less likely to make an error.

5. ***Lower program preparation cost****:* Writing programs in high level languages requires less time and effort which ultimately leads to lower program preparation cost.

6. ***Better documentation****:* A high level languages is designed in such a way that its Instructions may be written more like the language of the problem.

7. High-level programs may be used with different makes of computer with little modification. Thus, reprogramming expenses are greatly reduced, when new machines are acquired.

8. Higher-level language programs are much shorter than machine language or assembly language programs. A single line in a higher level language program may translate into five or ten or even hundreds of machine language instructions.
9. Writing of source programs in these languages does not require the knowledge of the internal structure of the computer.
10. Modification, if required, in programs written in these languages are quite easy and straight forward.
11. Prograrnmers can move to different installations using high level languages without having to learn new languages.
12. They are more user friendly.

DISADVANTAGES OF HIGH LEVEL LANGUAGES

The disadvantages of using a high level language as opposed to a low level language are:

1. **Lack of flexibility**: Because the automatic features of high level languages always occur and are not under the control of the programmer, they are less flexible than assembly languages.

2. Runs slower due to the generality of the statements and the fact that they are potable between different machines provided a suitable compiler is available. Such languages are machine independent.

3. A source of program written in a high level language *needs* a complier which is loaded into the main memory of the computer and thus occupies enough of memory space. The memory available for a source program is greatly reduced. Hence these languages are machine independent.

4. Lower efficiency: As the programs written in a high level languages take more time to run and require more main storage, they tried to be less efficient in the use of the CPU and other facilities.

LANGUAGE TRANSLATORS:

As discussed earlier, any program that is not written in machine language has to be translated before it is executed by the computer. Language translators perform the translation of high level languages or assembly language into machine language. In addition they check for some types of errors that may be present in the program being translated.

There are three types of translator programs:

1 compilers
2 Assemblers and

3. Interpreters

COMPILERS

Compiler is a standard program written and supplied by the computer manufacturer translating the program written in a high language (viz. Fortan, Cobol etc.) to the equivalent machine code of the computer. This process of translation called compilation. The compilation process consists of first loading the computer with the compiler and then inputting the source program via punched card called compilation. The compilation process consists of first loading the computer with the compiler and then inputting *the* source program via punched card magnetic tape. As such, the compiler produces an object program on a deck punched cards or magnetic tapes and also a print out of the program instruction.

The operating system calls a compiler for a particular language from the secondary storage and load if info the primary storage. The compiler checks each coded instruction lo see that It follows the rules for that language, uses proper spelling and syntax. All acceptable Instructions *arc* translated into the machine language and stored. In case of errors in the program, it communicates this information to the programmer in the form of diagnostic messages. These messages appear on the printer or the designated devices along with a listing of program instructions. The program can be executed only after it is found to be error free during the compilation run. Though an assembler also performs the same hob as is done by a compiler, still there is a basic difference between the two. The assembler translates symbolic address into actual core storage locations. Each mnemonic instruction is normally converted into a machine code instruction on a one for one basis. Compiler, on the other hand, is far more complex to design and write as each source program instruction in a high level language such as Cobol generates a number of machine code instructions. Also, compiler occupies more storage space and takes more processing time than an assembler.

The various tasks that the compiler has to accomplish during compilation are as follows:

1. Read each line of the source program and convert it into machine language.
2. Allocate space in memory for the storage location as defined in the pro gram to be executed.
3. Combine the machine code generated with the appropriate subroutines from the library.
4. Identify the proper order of processing, so that execution is as fast as possible and minimum storage space in memory is required.

Complier have been written for many of the commonly used computer languages such as BASIC, FORTRAN, C, AND PASCAL. The complier translates an entire program from the source of code, i.e., the program written in a high level language, to object code, i.e., machine code. These machine instructions can then be run on the computer to perform the particular task as specified in the high level language program.

REMARK: The complier can diagnose the following kinds of errors in a source program:

a. Illegal Characters
b. Illegal combination of characters
c. Improper sequencing of instructions in a program.

A source program containing an error diagnosed by the compiler will not be compiled into an object program. The compiler will print out a suitable message indicating this, along with a list of coded error messages which indicate the type of errors committed. The error diagnostics is an invaluable aid to the programmer.

ASSEMBLER

Assembler translates a program written in assembly language in to machine language. Apart from the fact that it deals with a low level language rather than a high level language, and thus has less of a gap to bridge in translation, are assembler operates in the same way as the compiler does. It translates complete source program into an object program, identifying any errors along the way. The assembler will list or display these errors as well as the complete source and object pr*ogr*a*m*s, If the program is error free, the job control program will let run immediately, or save the object program so that it may run it later without translating it again.

Assembler is supplied by the computer manufacturer.

INTERPRETER :

Interpreter *is* another type of translator used translating high level languages into machine code It takes one statement of a high level language and translates it into a machine instruction which is immediately executed. Translation and execution alternate for each statement encountered in the high level language problem. In other words, are interpreters translates one instruction and the control unit executes the resulting interpreters translates one instruction and the control unit executes the resulting machine code, next instruction is translated, and the control unit executes the resulting machine code instruction, and so on.

INTERPRETER	**COMPILER**
1. translates the program line by line	Translates the entire program
2. Requires less main memory	Requires more main memory

3. Each time the program is executed every line is checked for syntax and then converted to equivalent machine code	Converts the entire program to machine code, when all the syntax errors are removed and executes the object code directly
4. Source program and the interpreter are required for execution	Neither source nor the complier are required for execution
5. Good for fast debugging and at testing stage	Slow for debugging and testing
6. Execution time is more	Execution time is less
7. No security of source code	Security of source code.

EDITORS:

These programs are used to compose and modifying other programs. They are primarily text editing programs that allow programmers to add, delete, insert and edit the text of instructions which will be subsequently compiled or assembled, depending on the language used. Examples are Turbo 'C' editor, Norton editor Turbo Pascal editor, WordStar, Excel.

Editors are interactive programs that are stored in memory and allow the user to write a program, generate text, or make wide variety of changes and additions inn either of these. If for example, a source program needs correction because it has failed to compile properly, an editor can be used to make the necessary changes to the program. Once the final program is error free, it may be compiled and the editor can be asked to store the final text in a file. The final text can also be stored on an external storage medium such as tape or disk or output to a printer. The editor is normally stored on some external mass storage media and whenever required called into the RAM.

Before a program can be executed, it must be placed on the main storage. Special programs able to read programs from input or storage devices and place them into the main storage are called loaders. In modern computer, the loader is permanently stored in ROM and is fixed part of the computer itself. Thus, it is easy to load any external program on to the computer's main memory. Closely related to the loader is another utility lo assist the assembly process called the linkage editor. The linkage editor allows independently written assembly language program to share data and variables by linking them together when they are loaded into computer memory and run.

APPLICATION SOFTWARE

An application program is a program written for or by a user to perform a particular job. It can be categorized in to two ways.

a. General purpose application Software
b. Specific purpose application Software

Genera] purpose application Software such as an electronics spread sheet, word processors, graphics have wide variety of applications. Specific purpose application software, such as pay role, sales analysis, Inventory management is

used only for the application for which it is designed. Application Programmers write these programs.

Assignment Questions :

1. What is a computer language ? How it is classified ? Explain the features, advantages and disadvantages of each type ?
2. What are the different types of language translators ? Explain each in detail ?
3. What is software ? How it is classified ? Give any four differences between interpreter and compiler ?

Introduction to Database Management Systems

WHAT IS A DATABASE?

A database is a collection of logically related data that are organized in such a way, so as to facilitate easy accessing and processing of data. Databases contain data, not information. By itself database is meaningless and worthless, but through proper design and use of the database, it can be an essential tool for producing information for making management decisions.

Database is a collection of data designed to be used by different people. It is a collection of interrelated data stored together, with controlled redundancy to serve one or more applications in an optimal fashion. The data are stored in such a fashion that they are independent of the programs of people using data. A common and controlled approach is used in adding new data and modifying and retrieving the existing within the database.

Database management systems (DBMS) are support programs that work in conjunction with the operating system to create, store, process, retrieve, control and manage the data. The DBMS acts as an interface between the application program and the data in the database.

Data are binary computer representations of stored logical entities. Relationships represent a correspondence between the various data elements. Constraints *are* predicates that define the correct database states where the schema describes the Organization of data and relationships within the database. The schema defines the various views of the database for database management system component's use and for applications' security. A schema separates the physical aspects of data storage from the logical aspects of data representation.

The internal schema defines how and where data are organized in a physical data storage. The conceptual schema model defines the stored data structures in term of the database model used.

The external schema defines a view or views of the database for particular users. A database management system provides services for accessing the database while maintaining the required correctness and consistency features of the stored data.

WHY A DATABASE?

Why should an organization choose to use an integrated database to store its operational data? A general answer to this question is that a database system provides the organization with centralized control of its data. This is in sharp contrast to situation that prevails in many enterprises, where typically each application has its private files in its own tapes and disk, so that the data is widely dispersed therefore difficult to control.

Deficiencies of pre-database :

Deficiencies of pre-database information processing include (but not limited to) the following :

- Encoded data (data hard-coded in the application)
- Interdependence between programs and data files
- Data repetition or redundancy
- Data inconsistency
- Lack of data integrity
- Ad hoc representation of relationships
- Ad hoc data management techniques
- Lack of coordination across applications using common data
- Lack of data security mechanisms
- Inability to manage concurrent access to data
- Non-uniform back-up and recovery methods

OBJECTIVES OF DATABASE :

The objectives which management should keep in mind as they design and organise a database are :

(a) Provide for mass storage of relevant data.

(b) Make access to the data easy for the user.

(c) Provide prompt response to the user requests for data.

(d) Make the latest modifications to the database immediately.

(e) Eliminate redundant data.

(f) Allow multiple users to be active at one time.

(g) Allow for growth in the database system.

(h) Protect the data from physical harm and unauthorized access.

ADVANTAGES OF DATABASE :

The advantages of having data in a database is summarized below;

1. Redundancy can be reduced In non-database systems, each application or department has its own private files resulting in a considerable amount of redundancy of the stored data. Thus, storage space is wasted. By having a centralize most of this can be avoided. We do not say or suggest that all redundancy should be eliminated. Sometimes there are sound business and technical reasons for maintaining multiple copies of the same data. In a data base system, however, this redundancy can be controlled.

2. Inconsistency can be avoided This is really a corollary to the above point. When the same data is duplicated and changes are made at one site, which is not propagated, to the other site, it gives rise to inconsistency. Then the two entries regarding the same data will not agree. At such times, the data is said to be inconsistent. So, if redundancy is removed, the chances of having inconsistent data is also removed.

3. Data can be Shared : The existing applications can share the data in a database.

4. Standards Can be enforced : With the central control of the database, the database administrator can enforce standards.

5. Security : restrictions can be applied with complete authority over the operational data, the database administrator can ensure that the only means of access to the database is through proper channels. He can define authorization checks to be carried out whenever access to sensitive data is attempted. Different checks can be established for each type of access (retrieve, modify, delete, etc.) to each piece of information in the database.

6. Integrity : can be maintained. Integrity means that the data in the database is accurate. Centralized control of the data helps in permitting the administrator to define integrity constraints to the data in the database.

7. Conflicting requirements can be balanced. Knowing the overall requirements as opposed to the individual requirements, the database can be structured to provide an overall service that is best for the organization.

CHARACTERISTICS OF DATA IN A DATABASE

The data in a database should have the following features.

1. Shared - Data in a database are shared among different users and applications.
2. Persistence - Data in a database exist permanently in the sense, the data can live beyond the scope of the process that created it.

3. Validity/Integrity/Correctness - Data should be correct with respect to the real world entity that they represent.
4. Security - Data should be protected from unauthorized access.
5. Consistency - Whenever more than one data element in a database represents related real-world values, the values should be consistent with respect to the relationship.
6. Non-redundancy - No two data items in a database should represent the same real-world entity.
7. Independence - The three levels in the schema (internal, conceptual and external) should be independent of each other so that the changes in the schema at one level should not affect the other levels.

File Pointers :
File pointers establish linkage between records and are a basic part of the file organization of all data base models except the relational model. A pointer is placed in the last field of record. A pointer is the address of another, related record that is "pointed to" and the pointer directs the computer system to that related record. File pointers are used with many database organizations.

Linked Lists :

A linked list is a group of data records arranged in an order, which is based on embedded pointers. An embedded pointer is a specific data field that links one record to another by referring to the other record. The field is embedded in the first record, i.e., it is a data element within the record.

Linked list often have a head, which is a pointer to the first record. It has a tail, which points to the last record. One can start at head and follow the list to the tail, or one can start in the middle and follow the list to the tail. The user can not start in the middle and go back to the head. In other words, the linked list is a one-way street.

The following figure shows a linked list of customer records. Each row is a record. The records are arranged sequentially using customer number as the key. Each record includes a data element, which identifies assigned salesperson. In the right most field of record there is a pointer (a link) that chains together all customers records for a particular salesperson say salesperson 23. It can be assumed that customer 23694 is at the head of the list. The pointer links this record to a record for customer 25410 and so on until the tail for customer 30111 is encountered. The asterisk in the link indicates the tail of the list.

This chaining feature is very powerful. The application program can initiate a search at the beginning of the file looking for first customer assigned to salesperson 23. When that record is found, the salesperson links enable the program to follow the chain and process records only for salesperson 23. It is more convenient method than searching through the entire file.

Customer				Salesperson Number	Salesperson link\
22504					
23694				23	25410
24782					
25409					
25410				23	30102
26713					
28914					
30004					
30102				23	30111*
30111				23	
30417					
31715					

Components of DBMS

A DBMS has 3 main components

(a) Data dictionary system (DDS)

(b) Data definition language (DDL)

(c) Data manipulation language (DML)

(a) Data dictionary system (DDS) : The data dictionary system is an encyclopedia of information concerning each data element. It describes the data and its characteristics, such as location, size and data type. It also identifies the origin, use, ownership and also the methods of data access and data security. When it exists in a file, special software is necessary to create it, maintain it and make it available for use. Such software is called a data dictionary system. A good data dictionary would ensure consistent definitions of data across different databases. If there were to be a change to the data, it would also identify all the databases affected by the change.

(b) Data Definition Language (DDL) : The data definition language is used to create the data, describe the data and define the schema in the DBMS. It serves as an interface for application programs that use the data. Once the data dictionary has been created, its definitions must be entered into the DBMS. The primary functions of DDL are :

1. Describes the schema and subschemas.
2. Describes the fields in each record and record's logical name.

3. Describe the data type and name of each field.
4. Indicate the keys of the record.
5. Provide for data security restrictions.
6. Provide for logical and physical data independence.
7. Provide means for associating related records or fields.

For example, if a payroll program needs the employment number of an employee, the DDL defines the logical relationship between the employment number and the other data in the database, and acts as an interface between the payroll program and the files that contain the employment numbers.

(c) Data Manipulation Language (DML) : A data manipulation language is a language that processes and manipulates the data in the database. It also allows the user to query the database and receive summary reports and / or customized reports. DML enables the user to access, update, replace, delete and protect database records from unauthorized access.

The functions of DML are :

1. Provide techniques for data manipulation such as deletion, replacement, retrieval, sorting, or insertion of data or records.

2. Allows user and application programs to process data on logical basis rather than physical location basis.

3. Provide access which is independence of programming languages.

4. Provide for use of record relationships.

WHAT IS A DATABASE MANAGEMENT SYSTEM?

A database management system (DBMS) is a software that provides services for access a database, while maintaining all the required features of the data. The major components of a DBMS are shown in the figure (a) & (b).

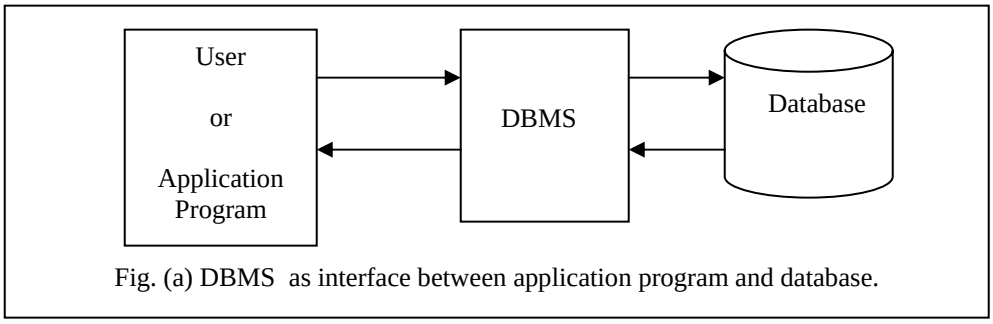
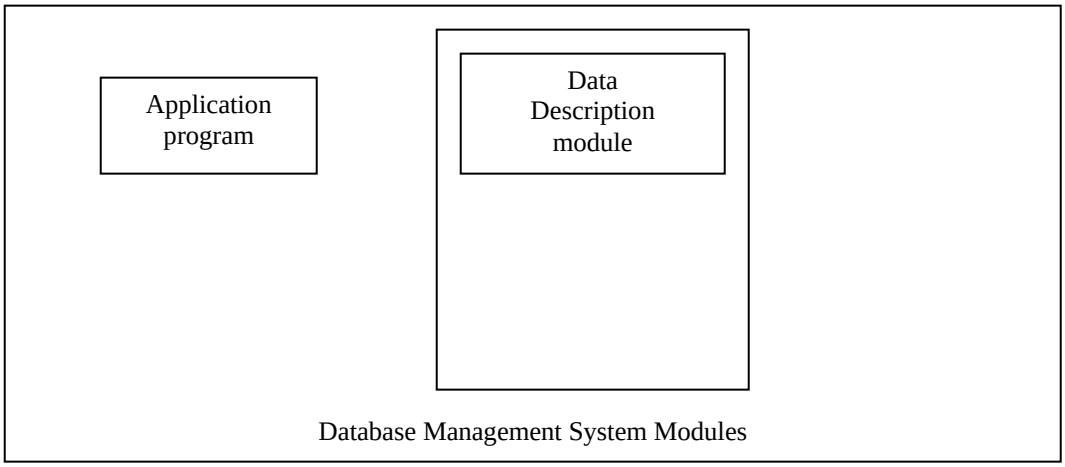


Fig. (a) DBMS as interface between application program and database.



Some of the services provided by a DBMS are given below :
A transaction is a sequence of database operations that represents a logical unit of work. It accesses a database and transforms it from one state to another. A transaction can update a record, delete one, modify a set of records, etc. When the DBMS does a 'commit', the changes made by the transaction are made permanent. If you don't want of make the changes permanent you can rollback the transaction and the database will remain in its original state.

Concurrency *management* Concurrency management is the database management activity of coordinating the actions of database manipulation that operate concurrency access shared data and can potentially interfere with each other. The goal of an ideal concurrency management mechanism is to allow concurrency while maintaining the consistency of the shared data.

Recovery The objective of recovery in a database is to ensure that the aborted or failed transactions do not create any adverse effects on the database or transactions. Recovery mechanisms in a DBMS make sure that the database

returned to a consistent state after a transaction fails or aborts. Recovery is very much related to concurrency in the sense that, the more the more concurrency, the more is the chance of an aborted transaction can affecting many other transactions.

Security :Security refers to the protection of data against unauthorized access. Security mechanisms of a DBMS make sure that only authorized users are given access to the data in the database. The level of access for each user and the operate each user can perform on the data will be monitored and controlled by the DBMS depending on the access privileges of the users.

Language interface The DBMS provides support languages used for the definition and manipulation of the data in the database. The data structures are created using the data definition language commands. The data manipulation is done using the data manipulation commands. By providing language support for data definition manipulation the DBMS create an environment where the users can do their without worrying about the physical implementation.

Data *Catalog:* Data Catalog or Data Dictionary is a system database that contains the descriptions of data in the database (metadata). It contains information about relationships, constraints and the entire schema that organize these features unified database. The data catalog can be queried to get information about the structure of the database.

Storage management : The DBMS provides a mechanism for the management permanent storage of the data. The internal schema defines how the data should be stored by the storage management mechanism and the storage manager interfaces with the operating system to access the physical storage.

WHY DBMS?

A DBMS provides a secure and survivable medium for the storage and retrieval of data. If the users and applications do not share data among themselves and if the longevity of the data is only till the end of the process or application that created it, then there is not much need for a DBMS. But in real world, the data is shared and is persistent (that a, the data has a life beyond the boundaries of the programs and applications that created it). Also, the real world data have a structure. It is related to one another and has constraints. These features are well represented and can be efficiently managed using a DBMS. Also, the different users of the data need to create, access and manipulate the data. The DBMS provides mechanisms to achieve these objectives without compromising the security and integrity of the data. Therefore, if the data is shared, if it is persistent, if the users want it be secure and easy to access and manipulate, then use of a database management system is the best available alternative.

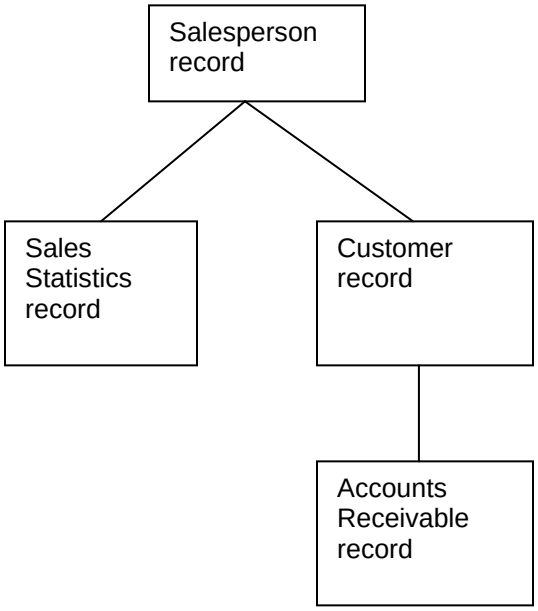
TYPES OF DATABASE MANAGEMENT SYSTEMS

Database Models

A database model is the method of organizing data and represents the logical relationships among data elements in the database. The most popular database models are

(a) Hierarchical model
(b) Network model
(c) Relational model
(d) Object-oriented model

(a) **Hierarchical model** : This structure helps to establish logical relationships among various data elements of multiple files and arrange the elements in a hierarchy. Each box in the model is a record and is sometime referred to as a node. In such a model, each record on one level can be related to multiple records on the next lower level. A record that has subsidiary records is called a parent and the subsidiary records are called children. Data elements in this model are well suited for a one to many relationships with other data elements in the database. The figure below provides an example of the hierarchical model



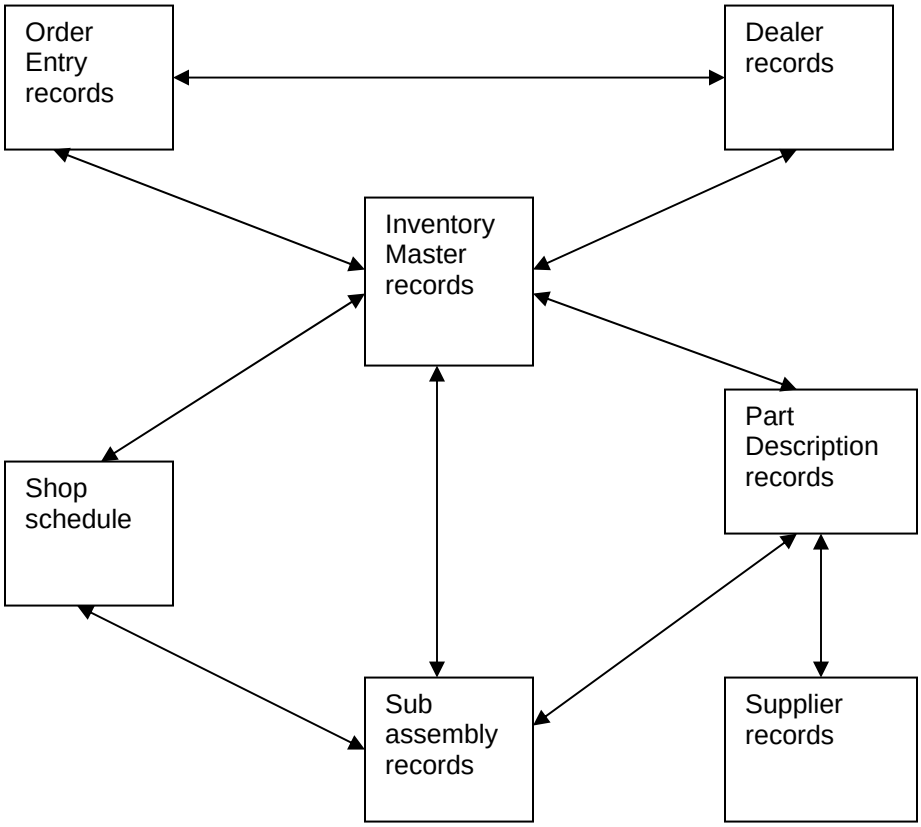
In the figure above, link fields establish the logical relationships. The links are represented by the thin lines, that connect data elements of the various records in the lower portion. Once a salesperson record is retrieved, the link

in that record can lead to another record that is logically related to that salesperson. A link field in the second record leads to the third record and so on, thereby creating a chain reaction through an entire set of files.

This model is ideally suited for problems in which the data elements have a natural hierarchical structure. The disadvantage is that it is necessary to identify the groups of files that must be logically integrated before the database. Hence, a hierarchical data model may not always be flexible enough to accommodate the dynamic needs of an organisation.

(b) **Network model** : In the network model, each record in the database can have multiple parents, ie; the relationships among data elements can have a many to many relationship. The figure below shows a network model for an inventory system.

In the network model, databases can be translated from hierarchical model to network and vice versa. The main difference between the network model and hierarchical model is that in a network model, a child can have a number of parents whereas in a hierarchical model, a child can have only one parent.



The advantage of the network model is that it promotes flexibility and data accessibility, since data elements at a lower level can be accessed without

accessing the data elements above them. This model is efficient, easy to understand and can be applied to many real world problems that require routine transactions. The disadvantage is that

(i) it is complex to design and develop
(ii) it has to be fine tuned frequently so that relationships among different pieces of data are true representations of the real world.
(iii) it requires that the relationships among all the data elements be defined before development starts, and changes often demand a major programming efforts
(iv) for large databases, operations and maintenance of the network model are time consuming and expensive

(c) **Relational model** : In this model, data is represented using two dimensional tables called relations, which are made of columns and rows. Each column represents a field, also referred to as an attribute, each row represent a record, also referred to as a tuple. Relational databases are a popular way of organizing data for business needs because of their flexibility. Relational databases use three fundamental operations : select, project and join. The select operation is a horizontal cut so that only selected rows (records) are included in the query results. The project operation creates a subset of columns (or a new table) designed to meet the information needs of the user. The join operation joins, or links two or more tables, if the information requested by the user is not found in one table.

The advantages of a relational model are that it enables a computer system to accommodate a variety of file inquiries in an efficient manner. Also additional indexes can be constructed at a later point of time as new data processing requirements dictate. The major disadvantages of the relational model are that the index portion of the file must be created and maintained along with the file records. In some cases the index portion of the file may be larger than the file itself resulting in wastage of storage space. Also the file index must be searched sequentially before the actual file records are obtained, resulting in wastage of time.

Relationships within a data model

To understand the relationships concepts, we have to understand the terms used in explaining the same. They are : entity, attributes, values, key attributes and records

(a) **Entity** : The entity is a place, person, thing, event etc about which the information is recorded. Examples are customer, bank account etc
(b) **Attributes** : The attribute characterize the entity or describe the entity meaningfully. Example is that if house is an entity, then its attributes are color, number, owner etc
(c) **Values** : Each attribute of an entity has a value and is known as a data value. The data value could be quantitative or descriptive, depending upon the attributes. That is, the size of the house will be the area and

hence quantitative while the construction quality would be qualitative. The attributes could have a single value or multiple values.

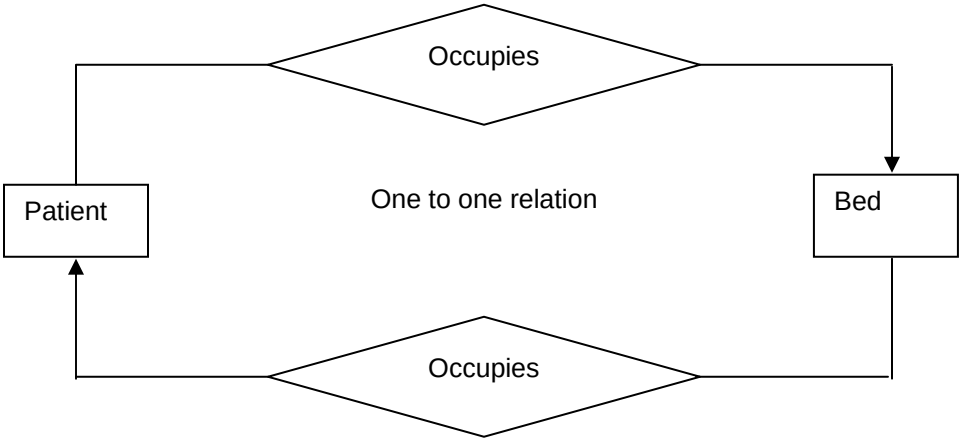
(d) **Key attributes** : Some attributes can be a key attributes of an entity. Using this key attribute, we can find the values of other attributes. For example, customer number is an attribute of an entity "customer". From this key, we can find the name of the customer, his address and account balance.

(e) **Record** : The record is a collection of the attributes of an entity. The set of the attribute values is called as a record.

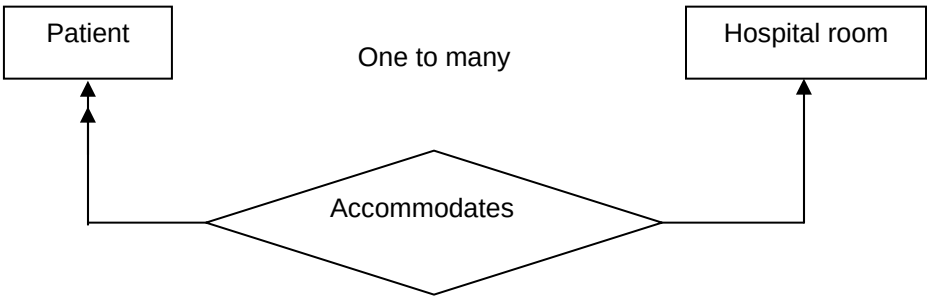
There are 3 types of relationships between entities. They can be shown in an entity-relation diagram. Also known as E-R diagram.

(a) one-to-one
(b) one to many
(c) many to many

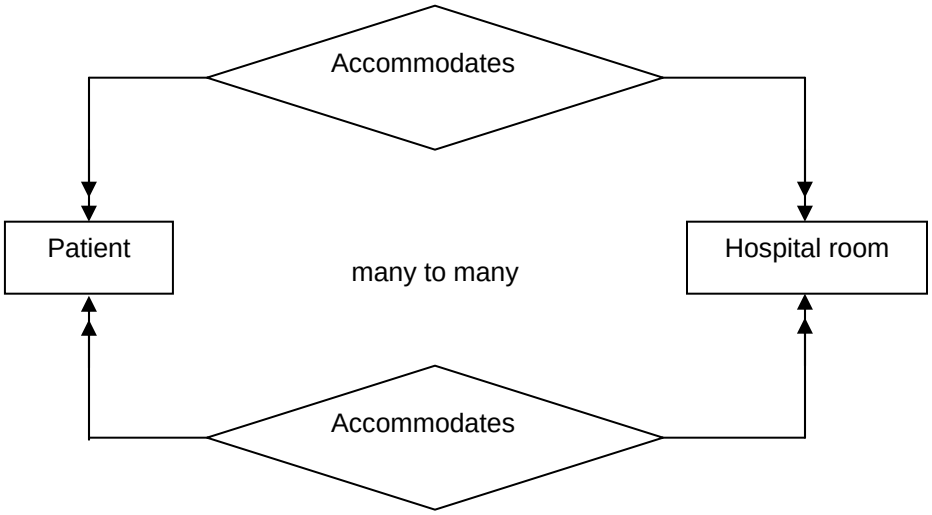
Let us take the hospital environment to understand the relation types. The patient, bed, hospital room and surgeon are the entities in the environment and their relations are as shown below :



At a given point of time, a patient occupies a bed or a bed is assigned to a patient. Since the patient cannot occupy more than one bed, the relationship is one to one.



At a given point of time, one or more patients are assigned to a hospital room, hence the relationship between the hospital room and the patients is one to many.



A surgeon operates on many patients or a patient may have been operated upon by many surgeons. Hence, the relationships both ways is many to many.

The relationships are built on the assumption that the patient, hospital room, surgeon and hospital bed have unique key as the identifiers.

Recent developments in databases

The recent developments in database technology are

(a) Distributed databases
(b) Client server architecture
(c) Object oriented databases
(d) Multi media databases

(a) **Distributed databases** : A distributed database is a database distributed over single or multi vendor computer hardware located in different geographic areas. Some examples are network of libraries, network of corporate offices in the country etc. The distributed databases have become popular because of two main reasons. First, in the earlier days, many organisations created individual databases for different applications such as payroll, personnel data, employee benefits etc Unfortunately, many of these databases could not communicate with each other because they were created on different systems. Distributed databases provide a way to overcome this problem. Second, the business units of an enterprise may be geographically dispersed and the information needs and demands of each location may be different. Distributed databases help to store the data where it is most needed or used, and help to customize the data to meet the needs of individual business units.

(b) **Client server architecture** : A computing paradigm based on client server architecture makes it possible to inter operate among different database management systems, among a network of heterogeneous hardware and

software platform. Here the load is optimally distributed among clients and servers. Typically, servers are high end performance machines supporting heavy transaction processing processes called server processes, the clients are likely to be low end PC class machines with rich graphical user interface and end user driven. With client server architecture, a network user can initiate several client processes in many windows among many servers; they could be heterogeneous hardware and a software running on machines that are geographically dispersed. Yet the user feels that he is being served by all the servers.

(c) Object oriented databases :

Object-oriented model represents an entity as a class. A class represents both object attributes as well as the behavior of the entity. For example a book class will have not only the book attributes such as ISBN, Title, Author, Publisher, Year of Publishing, Distributor Price, etc. but also procedures that imitate actions expected of a book such as Update price, etc.

Instances of the class - object - corresponds to individual books. Within an object, the class attributes takes specific values, which distinguish one book from another. However the behavior patterns of the class is shared by all the objects belonging to the class.

The object-oriented model does not restrict attribute values to the small set of native data *types* usually associated with databases and programming languages, such as integer, numeric, character, etc. Instead the values can be other objects. For example, one of the attributes of a book can be distributor and the value of that attribute can be a distributor object corresponding to the distributor who is distributing the book.

The object-oriented model maintains relationships through logical containment. Consider the book-distributor example. You find the distributor of a particular book as one of its attributes. Since distributor is an object in its own right, you can recursively examine its attributes. The distributor object can have a title attribute.

(d) **Multimedia databases** : The traditional databases were limited to a few data types like numeric (integer and real) and character string. However, the increasing complexity of database applications calls for handling more complex data objects like scanned images (maps, pictures, photographs etc), audio and video images. Databases to handle such complex data objects are known as multimedia databases. Until recently, databases were limited to hold ASCII data only. Most of the real life applications however need an ability to handle information, which is rich, such as images, audio images, video clippings etc. A new generation of databases is being built to accommodate multimedia. OOP is a promising technique to handle multimedia databases.

Three Types of Data Descriptions : (Three types of schema) :

In DBMS, the data is described in three ways :
1. From the application programmers view point – a description of subschema.
2. From the global logical view point – a description of the schema.
3. From the physical view point – a description of the physical records and their linkages.

Subschema is the application programmer's view of the data in a database.

Schema is an overall conceptual or logical view of relationships between the data in a database.

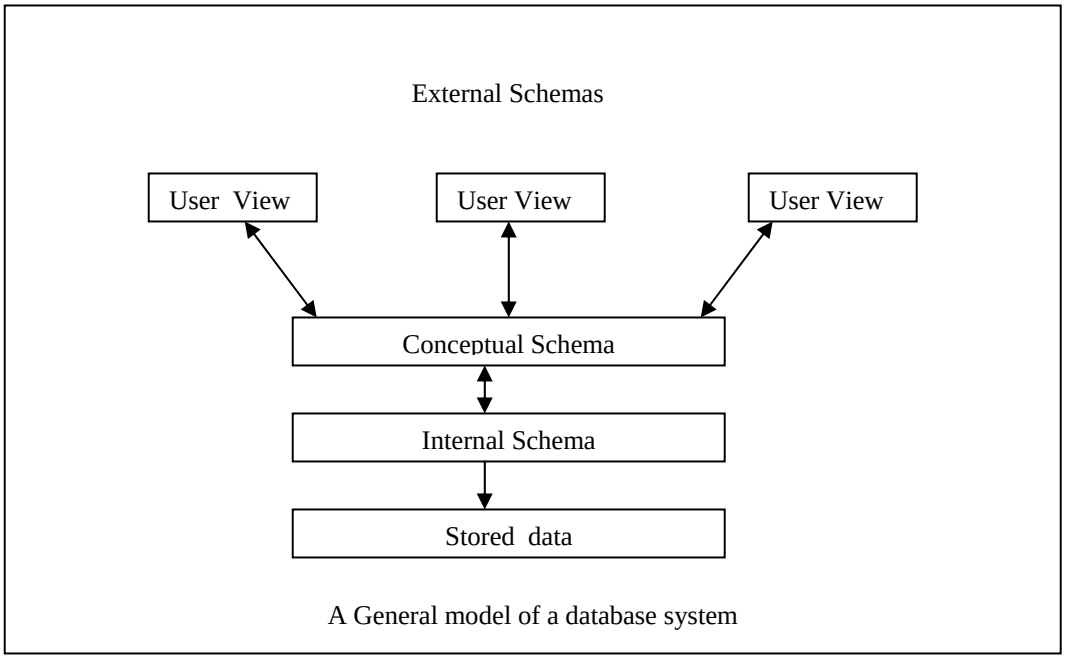
The different schemas used to reflect different views of the database are :
1. External schema or user schema is user's view of a part of database.
2. Conceptual schema is the overall logical view of the database.
3. Internal schema or data storage definition is the way the data is physically organized in a database.

Each user of a database is concerned with only a small portion of the database. Each user is interested in only a part of the entities in the database, only a part of the attributes of those entities, and certain relationships among them.

The conceptual schema represents the real entities and their relationships. It contains integrity rules and authorization rules, but it does not contain information about how the data items are stored.

The internal schema (or physical data model) describes how the database is organized for physical storage and access. It includes information on ordering of records, block sizes, storage indexes, use of pointers, and access strategies being used.

Following figure shows the general model of database system.



A General model of a database system

Normalization :

It is a process of simplifying the relationship between data elements in a record. Through normalisation, a collection of data in a record structure is replaced by successive record structures that are simpler and more predictable and therefore more manageable. The reasons why it is carried out are :

(i) To structure the data so that any pertinent relationships between entities can be represented.
(ii) To permit simple retrieval of data in response to query and report requests.
(iii) To simplify the maintenance of the data through updated inventories and deletions.
(iv) To reduce the need to restructure or recognize data when new application requirements arise.

Normal forms are groups of mathematical rules that can be used to test decisions, when arranging attributes to form entities and when selecting keys during the database design process. The process of applying rules of normal form is called Normalisation.

As a part of designing database, systems analysis and design techniques include "Data Analysis". Data analysis uses the **normalization** procedure which simplifies entities, removes redundancies from the system data and finally builds a data model, which is both flexible and adaptable to the future requirements of the organization.

The degree of Normalization includes :

1. First Normalization Form (1NF)
2. Second Normalization Form (2NF)
3. Third Normal Form (3NF)
4. Boyce –Codd Normal form which include
    1. Fourth Normal Form (4NF)
    2. Fifth Normal Form (5NF).

Each greater degree of normalization includes the lesser degrees. For example, data that is in the Third Normal Form is also in the Second Normal Form and the First Normal Form. However, it may or may not follow the values of the Boyce-Codd Normal Form.

1. First Normal Form :

This is the lowest level of normalisation. It states that data is in first normal form, if the pool of valid values that may appear in an attribute contains only Atomic Values (Atomic values can not be decomposed into smaller values).

2. Second Normal Form :

Data is in Second Normal Form if it is in 1NF and every non-key is functionally dependent on the primary key. (An attribute is a non-key if it is not part of the primary key). The purpose of 2NF is to eliminate repeating groups and to ensure that the remaining attributes belong to this entity.

An attribute is functionally dependent on a key if the attribute contains only one value which depends on that key. For example, the attribute SALARY contains only one value which depends on the key NAME. One way to eliminate repeating groups is to create a new attribute (field) for each value expected as shown in following figure. However, this has two disadvantages :

1. It limits number of groups that may be stored.
2. It uses too much space.

If an arbitrary limit of five dependents is made in this example, we can not handle an employee who has six or more dependents. On other hand, if an employee does not have any dependents, the space allocated is wasted.

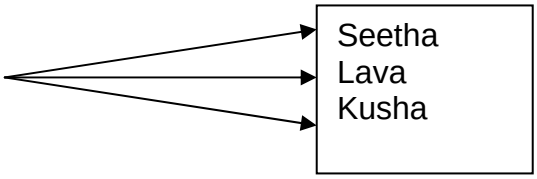
Name	Salary	Dependent
Rama	10,000	Seetha
		Lava
		Kusha

Unnormailsed data representing group

Name	Salary	Dependent 1	Dependent 2	Dependent 3
Rama	10,000	Seetha	Lava	Kusha

1 NF – Separate entities

Name	Salary (Rs.)
Rama	10,000



2 N F -Multiple fields

Third Normal Form (3NF) :

Data is in Third Normal Form (3NF) if and only if it is in 2NF and every non-key attribute is non-transitively dependent on the primary key. The purpose of 3NF is to ensure that attributes directly belong to the entity.

Transitivity is a mathematical principle that states that if a relation is true between the first value and the second and the third, then the relationship must also be true between the first and the third.

The following are the examples of transitivity :
If A < B and B < C, then A < C
If A > B and B > C, then A > C
If A = B and B = C, then A = C

Or

If A is functionally dependent on B and If B is functionally dependent on C, then A is functionally dependent on C.

For example, an employee record may have the name and salary of the supervisor as attributes. The supervisor's salary is functionally dependent on the supervisor's name and the supervisor's name is functionally dependent on the employee's name. Therefore, the supervisor's salary is transitively dependent on the employee's name. To correct this problem, the attributes directly dependent on the supervisor should kept as a separate entity.

Name	Salary	Supervisor	Sup. Salary
Rama	15,000	NARAYANA	30,000
Krishna	18,000	NARAYANA	30,000
Hari	22,000	NARAYANA	30,000

2 N F but not in 3 N F transitively dependent

NAME	SALARY
NARAYANA	30,000

Supervisor

NAME	SALARY
RAMA	15,000
KRISHNA	18,000
HARI	22,000

Separate entities3 N F

Comparison between File Management and Database Management :

File management means traditional approach to managing data stored in files. It involves application programs using input / output routines to open, read, write and close data files. The difference between file management and database management are listed in following table. Neither approach is better than the other. Thus trade offs are involved in selecting an approach.

TOPIC	File Management	Database Management
Data redundancy	High	Low
Data independence	Low	High
Application maintenance	Higher maintenance cost	Low maintenance cost
Integrity control	Provided by programmer	Provided by DBMS
Unanticipated queries	A custom program has to be written	A query language can be used.
Data relationship	Handled by application	An integral part of DBMS
Overhead	Little CPU and storage overhead	More processing power and storage is needed
Database ownership	Applications may have their own private data	All data belongs to the DBMS
Database design	More files may be designed as needed	More time and effort is spent to develop database
Database administrator	Not needed	Needed to coordinate user community.
Availability of trained programmers	Most programmers are trained to use file management	The average programmer needs training to use database.

Networking :

A computer network is a collection of computers and terminal devices connected together by communication system. The set of computers may include large-scale computers, medium scale computers, mini computers and micro-computers.

Types of Networks :-

Based on the structure, the computer networks are divided into four types as :

(1) Local Area Networks (LAN)
(2) Wide Area Networks (WAN)
(3) Metropolitan Area Networks (MAN)
(4) Storage Area Networks (SAN)

(1) Wide Area Networks (WAN) :-

A WAN covers a large geographical area with various communication facilities such as long distance telephone service, satellite transmission, and under-sea cables. The WAN typically involves best computers and many different types of communication hardware and software. Examples of WAN are interstate banking networks and airline reservation systems. Wide area networks typically operate at lower link speeds (about 1 Mbps).

Following are the salient features of WAN :

(i) Multiple user computers connected together.

(ii) Machines are spread over a wide geographic region.

(iii) Communications channels between the machines are usually furnished by third party (a Telephone company, a public data network).

(iv) Channels are of relatively of low capacity.

(v) Channels are relatively error-prone (error rate of 1 in 10^5 bits transmitted).

(2) Local Area Networks (LAN) :-

LAN covers limited area. A typical LAN connects as many as hundred or so computers that are located in a relatively small area, such as a building or several adjacent buildings. Organizations have been attracted to LAN because they enable multiple users to share software, data, and devices. Unlike WAN which use point – to - point links between systems, LANs use a shared physical media which is routed in the whole campus to connect various systems. LANs use high speed media (1 Mbps to 30 Mbps or more) and are mostly privately owned and operated.

Following are some salient features of LAN :

(i) Multiple user computers connected together

(ii) Computers are spread over a small geographic region

(iii) Communication Channels between the machines are usually privately owned. Channels are relatively high capacity.

(iv) Channels are relatively error free (bit error rate of 1 in 10^6 bits transmitted)

The critical reasons that LAN has emerged as popular are :

1. Security
2. Expanded PC usage through inexpensive workstations
3. Distributed processing
4. Electronic Mail and Message Broadcasting
5. Organizational benefits like cost, maintenance etc.
6. Data management benefits

(3) Metropolitan Area Networks (MAN) :

A MAN is somewhere between LAN and WAN. The term MAN is sometimes used to refer networks which connect systems or local area networks within a

metropolitan area. MANs are based on fiber optical transmission technology and provide high speed (10 Mbps or so) between sites.

A MAN can support both data and voice, cable television networks are examples of MANs that distribute television signals. A MAN just has one or two cables and does not contain any switching elements like WAN.

(4) A Storage Area Network (SAN) : SAN is a dedicated, centrally managed, secure information infrastructure, which enables any-to-any interconnection of servers and storage systems. A SAN :

(a) Facilitates universal access and sharing of resources.
(b) Supports unpredictable, explorative information technology growth.
(c) Provides affordable 24 hours x 365 days availability.
(d) Simplifies and centralizes resource management.
(e) Improves information protection and disaster tolerance.
(f) Enhances security and data integrity of new computing architectures.

NETWORK STRUCTURE OR TOPOLOGY

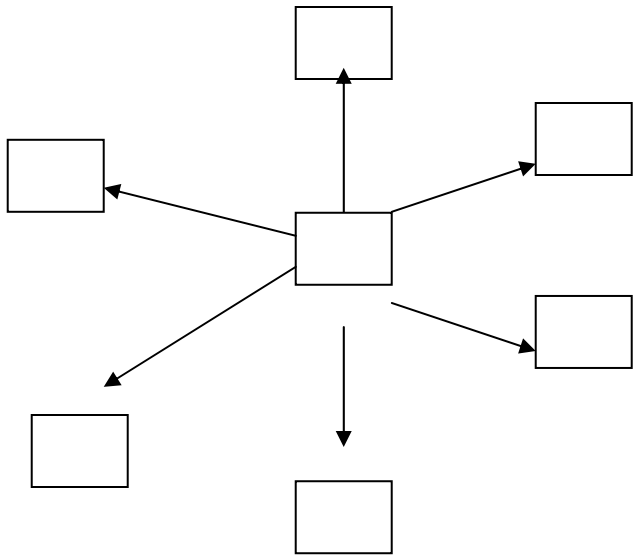
The geometrical arrangement of computer resources and communication facilities is known as network structure. There are four basic network structures :

1. Star network
2. Bus network
3. Ring network
4. Mesh network

1. Star Network :-

In this system, numbers of terminal computers are connected to a central computer as shown below. In this system, if it is desired to transmit information from one computer to another, it can be done only by sending the details through central computer.

A star network is particularly appropriate for organizations that require a centralized processing facility. For example, a star network may be used in banking for centralized record keeping in an on-line branch office environment.



Advantages :

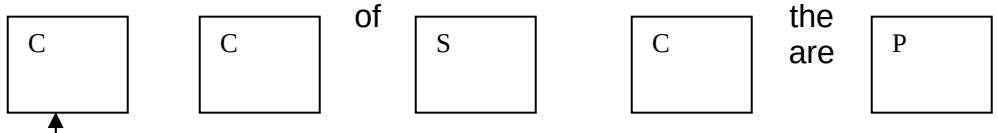
(a) It is easy to add new and remove computers from central computers.
(b) A single branch computer failure does not bring down the entire network.
(c) It is easier to diagnose network problems through a central hub.

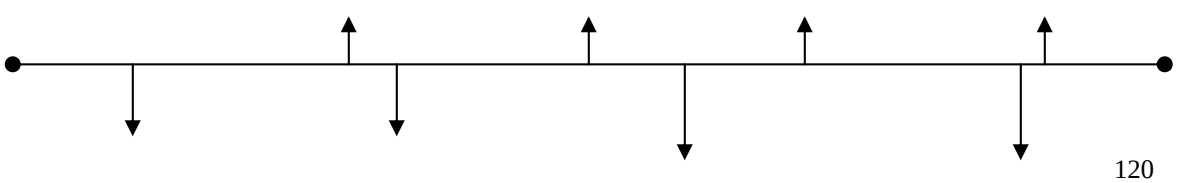
Disadvantages :

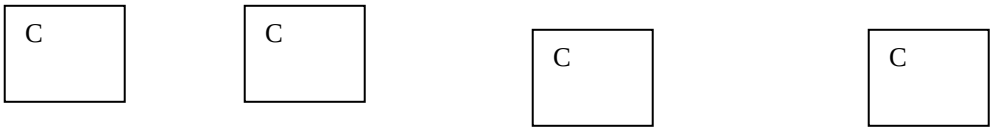
(a) If the central computer fails, the whole network ceases to function.
(b) The cable cost is more in case of star network compared to any other networks.

2. Bus Network :-

This structure is very popular for local area networks. In this structure, a single network cable runs in the building or campus and all computers are linked along with this communication line with two endpoints called the bus or backbone. Two ends of the cable are terminated with terminators.







Advantages :

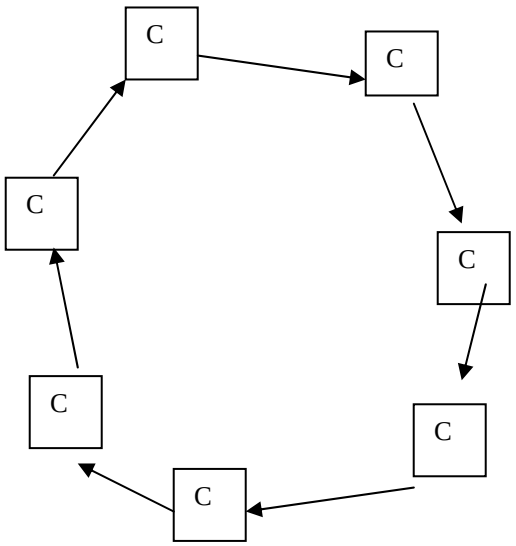
1. Reliable in very small networks as easy to use and understand.
2. Cabling requirement is least compared to all other type of network structures.
3. Easy to extend. Two cables can be easily joined with a connector, making a longer cable for more computers to join the network.

Disadvantages :

1. Heavy network traffic can slow a bus considerably.
2. Each connection between two cables weakens the electrical signal.
3. The bus configuration is difficult to trouble shoot.

3. Ring Network :-

This is another structure for Local Area Network. In this structure, the network cable passes from one computer to another until all computers are connected in the form of a loop or ring. There is a direct point-to -point link between two neighbouring computers. These links are unidirectional which ensures that transmission by a computer traverses the whole ring and comes back to that particular computer.



Advantages :
1. Ring networks offer high performance for a small number of workstations or for larger networks where each station has a similar workload.
2. Ring networks can span longer distances than other types of networks.
3. Ring networks are easily extendable.

Disadvantages :
1. Relatively expensive and difficult to install.
2. Failure of one computer in the network can affect the whole network.
3. It is difficult to trouble shoot a ring network.
4. Adding or removing computers can disrupt the network.

4. Mesh Network :-

In this structure, the computers are randomly connected using communication links.

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Assignment Questions :
1. What is a database? Why it is used ? Give the objectives, characteristics, and advantages of database in database Management system ?

2. What is a database management system ? Why it is used ? What are its components ? What are different types of databases used in practice ?

3. What are the three types of data descriptions in a database management system ? Differentiate between conventional file management system and database management system ?

4. What is a computer network ? Based on the structure how they are classified? Explain the silent feature of each type ?

5. What are the different structural arrangements of computers in a network ? Explain each with suitable block diagram ?

MIS Chapter 5

Decision Making Process in MIS

1. Introduction :

2. Decision Making Process :

3. Decision Supporting Systems :

1. Introduction to Decision Making :

Decision making is an indispensable component of management process and managers' life is filled with making decisions after decisions. Managers see decision making as their central job because they constantly choose what is to be done, who is to do, when to do, where to do, and how to do.

William Moore has equated it with management when he says that "management means decision making".

The word decision has been derived form the Latin word *'decidere'* which means a cutting away or a cutting off. Thus, a decision involves a cut of alternatives between those that are desirable and those that are not desirable. The decision is a kind of choice of a desirable alternative. Decision making is a process to arrive at a decision; the process by which an individual or organization selects one position or action from several alternatives.

Shull et al. have defined decision making as follows: "Decision making is a conscious process involving both individual and social phenomena based upon factual and value premises which concludes with a choice of one behavioral activity from among one or more alternatives with the intention of moving toward some desired state of affairs."

Decision making thus, is an act of projecting one's own mind upon an opinion or a course of action. In decision making, three aspects of human behaviour are involved: (1) cognition-activities of mind associated with knowledge; (2) conation-the action of mind implied by such words as willing, desire, and aversion; and (3) affection-the act of mind associated with emotion, feeling, mood, and temperament. Based on the above concept of decision making, its features can be derived as follows:
1. Decision making implies that there are various alternatives and the most desirable alternative is chosen to solve the problem or to arrive at expected results. A problem situation which does not have alternatives is not really a problem requiring a solution though the problem may be quite injurious.

2. Existence of alternatives suggests that the decision maker has freedom to choose an alternative of his liking through which his purpose is served.
3. Decision making may not be completely rational but may be judgemental and emotional in which personal preferences and values of the decision maker play significant role.
4. Decision making is a goal-directed process. It implies that the decision maker attempts to achieve some results through decision making.

2. TYPES OF DECISIONS

Decision making is involved in every walk of life; it is relevant in organisational as well as non-organisational context. In organizational context. decisions may vary from major ones like determination of organisational objectives or deciding about major projects to specific decisions about day-to-day operations. Therefore, there are different decisions which are made by managers in the organisations.

There are different ways in which decisions may be classified. One way of classifying these decisions is to group them into routine and nonroutine. In another way, these decisions are classified as programmed and non-programmed. These are further classified as strategic and tactical or operational decisions. Strategic decisions are non-programmed and nonroutine while tactical (also known as operational) decisions are mostly routine and programmed.

Programmed Decision

A programmed decision. also known as structured decision. is routine and repetitive and is made within the framework of organisational policies and rules. These policies and rules are established well in advance. to solve recurring problems in the organisation. For example. the problem relating to promotion of employees is solved by promoting those employees who meet promotion criteria. These criteria are established by promotion policy and the managers have just to decide which employees meet promotion criteria and the decision is made accordingly. Programmed decisions are comparatively easier to make as these relate to the problems which are solved by considering internal organisational factors. Such decisions are made by managers at comparatively lower levels where the factors affecting decision making are static and well-structured.

Non-programmed Decision

A non-programmed decision. also known as unstructured decision is relevant for solving unique/unusual problem in which various alternatives cannot be decided in advance. For such a decision. the situation is not well-structured and the outcomes of various alternatives cannot be arranged in advance. For example, if an organisation wants to take actions for growth, it may have several alternative routes like going for a grass-route project or taking over an existing company. In each situation. the managers have to evaluate the likely outcomes of each alternative to arrive at a decision. For evaluating the likely outcomes of these alternatives. The managers have to consider various factors, many of which lie outside the organisation. A common feature of non-programmed decisions is that

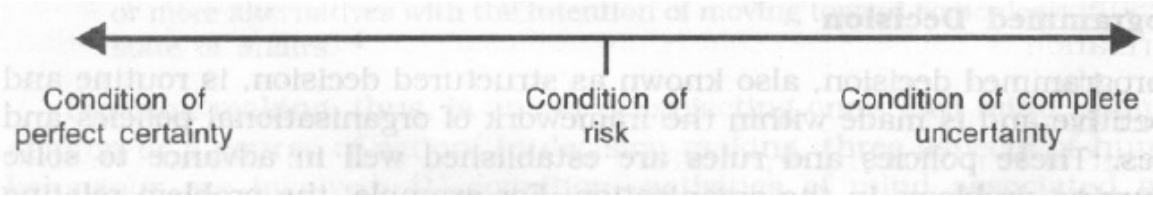
they are novel and non-recurring and, therefore, readymade solutions are not available. Since these decisions are of high importance because of their long-term consequences, these are made by managers at higher levels in the organisation.

Semi-programmed decisions :

In these types of decision, at least one but not more than two of the above stages can be handled by a well defined preset procedure. An example of such a decision is the intelligence phase, which is well structured, having diverse kinds of variance analysis. Here a comparison with a budget is undertaken in a well defined way to indicate the need for a decision. Subsequent stages of design and choice are, however, not handled by any set procedure.

3. DECISION-MAKING CONDITIONS

Decision making involves selection of an alternatives which is put into action and whose impact is known in future period. Thus, the decision maker makes the decision for future conditions. In fact. a decision is not a process of making the future decision but a means of reflecting the future in today's decision. The future conditions for a decision vary along a continuum ranging from condition of perfect certainty to condition of complete uncertainty as shown in Figure 5.1.



In each of these conditions, knowledge of outcome of the decision differs. An outcome defines what will happen if a particular alternative or course of action is chosen and implemented. Knowledge of outcome of each decision alternative is important when there are multiple alternatives and only one alternative is to be chosen. In the analysis for decision making, three types of knowledge with respect to outcomes are usually distinguished as shown in Table.

Table 5.1 : **Outcomes in different decision-making conditions :**

Conditions	*Nature of outcomes*
Certainty	Complete and accurate knowledge of the outcome of each alternative as there is only one outcome of each alternative.
Risk	Multiple outcomes for each alternative can be identified and probability of occurrence can be attached to each outcome.
Uncertainty	Multiple outcomes for each alternative can be identified but there is no knowledge of the probability to be attached to each outcome.

Since there is variation in the knowledge of outcomes of different alternatives in different decision-making conditions, decision making strategy differs in each case.

Certainty

When the decision maker knows exactly which nature of state will occur, a condition of certainty exists. This means that the decision maker will be able to make perfectly accurate decision time after time. Such a condition exists when decision involves action in immediate future, and the decision maker has made such a decision a number of times with the same results. Under this condition, the information required for decision making is highly structured and structured decision-making techniques are applied.

Usually. such structured decisions are made at lower management in the organisation at which level, personnel are engaged in routine and repetitive functions.

Risk

Most of the major organisational decisions, particularly involving high investment. are made under the condition of risk in which only some information is available but that is not sufficient to answer overall question about the outcome of the decision. In such a condition, the decision maker has to decide two things- amount of risk involved in a decision and amount of risk that the organisation is ready to assume. Amount of risk involved can be calculated by risk analysis while the organisation's propensity to take risk depends on its risk taking ability and risk taking attitudes. Thus. in the condition of risk, part of the information can be in structured form while part of the information may be in unstructured and qualitative form. Thus, the decision cannot be perfectly structured but it cannot also be perfectly unstructured but it is semi-structured. Usually, semi-structured decisions are made at higher middle and top levels of the organisations. Since many qualitative information is used for making semistructured decisions, these are influenced by personal preferences of the decision maker.

Uncertainty

If a decision involves a condition about which the decision maker has no information about the relative chances of any single outcome, he is said to be operating under condition of uncertainty. Since the decision maker does not have any information on which he can develop any analysis for decision making, the best he can do is to be aware that he has no chance of predicting the events. Thus, the type of information that the decision maker can use is highly unstructured and even fragmented. Thus, it can be seen that a decision may be either structured, semistructured, or unstructured and not only structured or unstructured.
Further, the degree of structuring in a decision can be seen in terms of continuum in which degree of structuring varies as shown in Table :

Table 5. 2: **Managerial decisions, level of structuring and support systems**

Manage-ment level	*Nature of decision*	*Level of structuring*	*Support systems required*
Top ↑	Strategic ↑	Low ↑	Strategic information systems/Executive support systems/Expert systems
			Decision support systems
			Structured information systems
Lower	Operational	High	Transaction processing systems

4. DECISION-MAKING PROCESS
When a manager makes a decision, it is, in effect, the organisation's response to a problem. As such, a decision should be thought of as a means rather than an end. Every decision is the outcome of a dynamic, process which is influenced by multiple forces. However. what are the different stages of this process, there is no unanimity. Herbert Simon, an expert on decision making has proposed three phases of decision making intelligence, design, and choice. As against these phases, Rubenstein and Haberstroh have proposed five phases-recognition of problem or need for a decision, analysis and statement of alternatives, choice among the alternatives, communication and implementation of decision, and follow-up and feedback results of decision.

For our further analysis, three phases of decision making as proposed by Simon will be taken in which the fourth phase of decision implementation is added because mere choice of an alternative does not complete decision-making process unless managers as decision makers commit resources for implementing a decision. Based on this, decision making process has been presented in Figure 5.2.

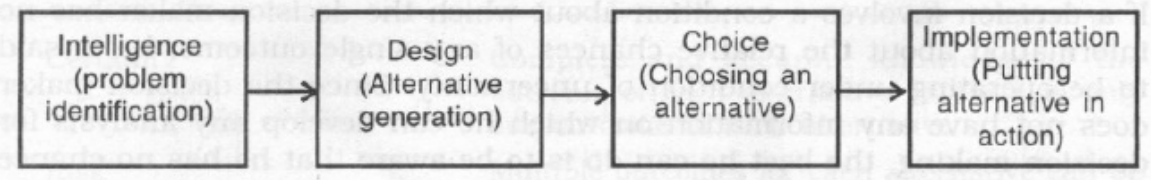


Figure 5.2 : Phases in decision-making process.

Various phases of decision-making process presented in Figure 5.2 are more relevant for non-programmed decisions. Problems that occur infrequently are unstructured and are characterized by a great deal of uncertainty regarding the outcomes of various alternatives, require the managers to utilize the entire process. For frequently occurring structured problems, it is not necessary to consider the entire process because decision rules are developed to handle such problems and it is not necessary to develop and evaluate various alternatives each time such a problem arises.
Let us now discuss the various phases, problems involved there in, and the type of information systems required to furnish information to overcome these problems.

(a) Intelligence Phase :
Intelligence phase of decision-making process involves searching the environment for conditions calling or decisions. This is related with the identification and formulation of the problem which is to be solved by the decision. A problem is the gap between present state of affairs and desired state of affairs on the subject-matter of decision. Problem finding is a difficult proposition as a famous writer, Charles Kettering, suggests when he observes, "it is not that people, can't see the solution; it is that they can't see the problem." Problem finding is just like the diagnosis of a patient by a doctor. When the doctor makes a diagnosis, he has a normal, healthy person in his mind and he also has fairly clear concept of what a healthy person is. With this model as the desired result, he looks for disparities in the patient's actual state of health or factors which indicate whether his future health will fall short of normal. In the case of organizational decision making, however, a decision maker cannot rely on a commonly accepted norm such as a healthy person. In organizational context, a problem exists whenever one faces a question whose answer involves doubt and uncertainty. In order to overcome this doubt and uncertainty, the manager, as a decision maker, develops some models of what is desired, differences between desired and reality are identified, and differences are evaluated to find out-whether they constitute a problem.

Pounds has identified four types of models that produce expectations against which reality is measured:
1. Historical models in which the expectation is based on an extrapolation of past experience.
2. Planning models in which the plan is the expectation.

3. Models of other people in the organization, such as superiors, subordinates, other departments, etc.
4. Extra organizational models in which expectations are derived from competition, customers and professional organizations.

When a problem is identified, it remains vague at the initial stage. In order to make it more clear and specific, problem formulation is required so that design and choice phases operate on the right problem. At this stage, the problem identified earlier, is defined more precisely and some complexity is reduced.

MacGrimmon and Taylor have suggested four strategies for reducing complexity and formulating a problem:
1. Determining the boundaries (clearly identifying what is included in the problem).
2. Examining changes that may have precipitated the problem.
3. Factoring the problem into smaller sub-problems.
4. Focusing on controllable elements.
For this phase of decision making, information requirement is in the form of exception reporting, that is, what kind of deviation exists between desired state of affairs and actual state of affairs. Such type of information is provided by structured information- systems that deliver a wide variety of detailed information.

(b) Design Phase :

Design phase of decision making involves generation of possible alternatives through which the problem can be solved. A problem can be solved in several ways, however, all the ways cannot be equally satisfying. Further, if there is only one way of solving a problem, no question of decision arises. Therefore, the decision maker must try to find out the various alternatives available in order to get the most satisfactory result of a decision. Identification of various alternatives not only serves the purpose of selecting the most satisfactory one, but it also avoids bottlenecks in operation as alternatives are available if a particular decision goes wrong. However, it should be borne in mind that - it may not be possible to consider all alternatives either because some of the alternatives cannot be considered for selection because of obvious limitations of the decision maker or information about all alternatives may not be available. Therefore, while generating alternatives, the concept of limiting factor should be applied. A limiting factor is one which stands in the way of accomplishing a desired objective. If these factors are identified, managers will confine their search for alternatives to those which will overcome the limiting factors. For example, if an organisation has limitation in raising sizable finances, it cannot consider projects involving high investment.

A decision maker can use several sources for identifying alternatives his own past experience, practices followed by others, and using creative techniques. Past experience. applied in most cases of decision making, takes into account

the actions taken by the decision maker in the past with obvious differences between the former challenges and the present one. The successful action of the past may become an alternative for the future. This is a very simple approach but has obvious limitations because there may be so much chances in the decision context that old action becomes totally irrelevant. Copying from the experiences of others is another way of generating alternatives. Thus, alternatives used by successful decision makers can be thought of as alternatives of decision making. This is also practiced by many organizations after making suitable amendments in the light of changed decision context. Importing of technology from foreign countries with suitable changes is good example of this type of alternatives. The third method of generating alternatives is through creative process where various exercises are taken to generate entirely new ideas.
The design phase of decision making may require more intelligence so that the manager can decide if a particular alternative is suitable for solving the problem. This phase may entail more carefully specified and directed information activities which are, generally, provided by decision support systems as they operate on simple models and can be operated with limited data.

(c) Choice Phase :
Choice phase of decision making involves choice of an alternative which can be put into action to solve the problem. For choosing an alternative which aims at solving the problem in the most appropriate way in a given situation, the manager must evaluate all the alternatives generated at the design stage. However, all alternatives available for decision making will not be taken for detailed evaluation because of the obvious limitations of managers in evaluating all alternatives. The energy of managers is limited and psychologically most of them prefer to work on plans that have good prospect of being carried out. In narrowing down the number of alternatives, two approaches can be followed-constraint on alternatives and grouping of alternatives of similar nature. The decision maker develops a list of limits that must be met by a satisfactory solution. He may treat these limits as constraints, that is, he may check proposed alternatives against limits, and if an alternative does not meet them, he can discard it. In the second approach, various alternatives can be grouped into classes on some specific criteria important to decision making. A representative alternative from one group may be selected for further analysis. After identifying the group that shows up the best, decision maker can concentrate on alternatives within this group. This method is very helpful in decision making regarding the location of plant. Warehouse, etc.

Having narrowed down the alternatives which require serious consideration, the decision maker will go for evaluating how each alternative may contribute towards the solution of the problem or objectives supposed to be achieved by implementing the decision. Evaluation of various alternatives dissects an alternative into various tangible and intangible factors. Tangible factors are those which can be quantified because they are quite obvious like the cost per unit investment required, output to be received, etc. Such factors can be measured

easily though their happening may not be measured with certainty; for example, demand projection at a given price in a particular alternative. As against these, intangible factors are mostly qualitative and cannot be measured in terms of quantity. Therefore, some definitions can be used for such factors. For example. in a plant location various non-economic factors like psychological problem arising out of displacement of persons from the plant site, ecological balance, etc. have to be taken into account which cannot be quantified. In evaluating an alternative, both these factors have to be taken into account.

Evaluation of various alternatives presents a clear picture as to how each of these contributes to solution of the problem. A comparison is made among likely outcomes of the various alternatives and the most appropriate one is chosen. Choice aspect of decision making is, thus, related to deciding the most acceptable alternative which fits with the organizational objectives. It may be seen that the chosen alternative should be acceptable in the light of organizational objectives, and it is not necessary that the chosen alternative is the best one. At the choice phase of decision making, the manager requires information tools that can keep track of the consequences, costs, and opportunities by each alternative generated at the design phase. The manager requires a larger decision support system to develop more extensive data on a variety of alternatives and to use complex analytical models to account for all the consequences.

(d) Implementation Phase :

Once an alternative is chosen. it is implemented, that is, it is put into action. Truly speaking, the actual process of decision making ends with the choice of an alternative through which the objectives can be achieved. However, decision making, being a continuous and ongoing process, must ensure that the problem has been solved and the objectives have been achieved by the chosen alternative. Unless this is done, managers will never know what way their choice has contributed. Therefore, the implementation of decision may be seen as an integral aspect of decision. Once the creative and analytical aspects of decision making through which an alternative has been chosen are over the managerial priority is one of converting the decision into something effective. This is the implementation aspect of decision making. The basic difference between decision making as an analytical process and implementation is that the former requires the use of conceptual skills since it translates the abstract ideas into reality. For example, suppose that there is a change in consumers tastes. This change is very abstract and cannot be seen unless some specific techniques and measurements are applied. How this change can provide opportunity to the organization is mostly a conceptual exercise requiring managers to interpret what changes are taking place and what products or services w1ll be preferred in the changed situation.

Implementation. on the other hand, relates to putting a decision into practice so that objectives of decision are achieved. This practice will provide further

feedback for evaluating the soundness of the decision and if need be, a change in the decision. Implementation of a decision requires the communication to subordinates, getting acceptance of subordinates over the matters involved in the decision, and getting their support for putting the decision into action. The decision should be effected at appropriate time and in proper way to make the implementation more effective. The effectiveness of implementation is important because it is only effective action through which organizational objectives can be achieved. When a decision is put into action, it brings certain results. These results provide indication whether decision making and its implementation is proper. Therefore, managers should take follow-up action in the light of feedback received from the results. If there is any deviation between objectives and results this should be analyzed and factors responsible for this deviation should be located. The feedback may also help in reviewing the decision when conditions change which may require change in the decision.

At the implementation phase, managers can use structured information system that provides routine reports on the progress of a solution. This system should also indicate the difficulties that arise, resource constraints, and possible corrective actions. For this purpose. information systems may -range from integrated management information systems to much smaller systems as well as project planning software operating on microcomputers.

Table 5.3 presents the summary of decision-making phases. Information requirement. and supporting information systems.

Table 5.3: Decision-making phases. Information required and supporting information systems

Decision-making phase	*Information required*	*Supporting information systems*
Intelligence	Exception reporting	Structured information systems
Design	Specified and directed information	Decision support systems and executive support systems
Choice	Information for evaluation	Large models of decision support systems
Implementation	Graphics and charts for monitoring	Integrated information systems, microcomputers and mainframe decision aids

METHODS OF DECIDING AMONG ALTERNATIVES

There are different methods to evaluate various alternatives through which a problem can be solved. In evaluating alternatives, an attempt is made to find out the likely outcome of each alternative so that the alternative which is likely to

provide maximum outcome is chosen. In evaluating the likely outcomes of various alternatives, generally, following methods are used:
1. Optimization techniques.
2. Pay-off matrices.
3. Decision tree.
4. Game theory.
5. Elimination by aspects.
6. Decisional balance sheet.

5. Decision Supporting Systems (DSS) :

DSS are an application of Herbert Simon model. In this mode, there are 3 phases ie; intelligence, design and choice. The DSS basically helps the information system in the intelligence phase where the objective is to identify the problem and then go to the design phase for solution. The choice of selection criterion varies from problem to problem. Therefore, it is required to go through these phases again and again till a satisfactory solution is found. These systems are helpful in making a decision and also its performance evaluation. These systems can be used to validate the decision by performing the sensitivity analysis on various parameters of the problem.

In decision making, programmed decisions, because of its rule base structure, can be computerized, as inputs, processing methodology, analysis and choice of decision making are predetermined. DSS can be built around the rule in case of programmed decision situation, while in non programmed decisions, the rules are not fixed or predetermined and requires the user to go through the decision making cycle as indicated in the Herbert Simon model, every time.

5.1 DSS definition

The term, decision support system refers to a class of systems, which support the process of decision making. The emphasis is on support rather than on automation of decisions. DSS allows the decision maker to retrieve data and test alternative solutions during the process of problem solving.
DSS can also be defined as a set of well integrated, user friendly, computer based tools that combine data with various decision making models – qualitative and quantitative – to solve semi structured and unstructured problems.

5.2 DSS characteristics

The following are the desirable characteristics for a DSS :
- DSS helps the decision maker in the decision making process
- DSS is designed to solve semi structured and unstructured problems
- DSS supports decision makers at all levels, but is most effective at the tactical and strategic levels

- DSS makes general purpose models, simulation capabilities and other analytical tools available to the decision maker
- DSS is an interactive, user friendly system that can be used by the decision maker with little or no assistance from an MIS professional
- DSS can be readily adapted to meet the information requirements for any decision environment
- DSS provides the mechanisms to enable a rapid response to a decision makers request for information
- DSS has the capability to interface with the corporate database
- DSS is not executed in accordance with pre-established production schedule
- DSS is flexible enough to accommodate a variety of management styles
- DSS facilitates communication between levels of decision making

5.3 Types of DSS

The different types of decision support system are as follows :
(a) **Status inquiry systems** : The number of decisions in the operational management and some at the middle management are such that they are based on one or two aspect of a decision making situation. It does not call for any elaborate computations, analysis, choice etc for decision making. If the status is known, the decision is automatic ie; status and solution is a unique relation.
(b) **Data analysis systems** : These decision systems are based on comparative analysis and makes use of a formula or an algorithm. But, these processes are not structured and therefore, vary. The cash flow analysis, inventory analysis and the personnel inventory systems are examples of the analysis systems. The use of simple data processing tools and business rules are required to develop this system.
(c) **Information analysis system** : In this system, the data is analysed and the information reports are generated. The reports might be having some exceptions as a feature. The decision makers use these reports for assessment of the situation fro decision making. The sales analysis, accounts receivables system, market research analysis are examples of such systems.
(d) **Accounting Systems** : These systems are not necessarily required for decision making but they are desirable to keep track of the major aspects of the business or a function. The content of these systems is more of data processing, which leads to formal reporting, with exceptions if necessary. These systems account items such as cash, inventory, personnel and so on, and relate it to norms developed by the management for control and decision making.
(e) **Model based systems** : These system are simulation models or optimization models for decision making. These decisions, generally are one time and infrequent, and provide general guidelines for operation or management. The product decision mix decision, material mix, job scheduling rules, resource or asset or facilities planning systems are the examples.

5.4 Components of DSS

There are three main software components of a DSS. These are
(a) database management system (DBMS)
(b) model management system
(c) support tools.

(a) **Database Management Systems** : To solve a problem, the necessary data may come from internal or external databases. In an organization, internal data are generated by systems such as TPS and MIS; external data come from a variety of sources such as newspapers, online data services, databases (financial, marketing, manufacturing, human resource etc). Some examples of external data are government regulations, tax codes, census figures, competitors, market shares, economic indicators, interest rates, and inflation. The data in the DSS database are managed by the DBMS, which covers compilation of data, manipulation of data, data generation, data updating, data maintenance and dissemination of data.

(b) **Model Management Systems** : Model management system stores and accesses models that managers use to make decisions. Such models are used for designing a manufacturing facility, analyzing the financial health of an organization, forecasting demand for a product or service, and determining the quality of a particular batch of products. Although most models are quantitative, decision makers use qualitative models also to make decisions.

The model builder, a component of many model bases, provides a structured framework for developing models by helping decision makers identify the variables and the interrelationships among the variables in the model. A model builder creates, identifies, processes, stores, updates, and maintains different decision making models and ensures that these models are consistently applied when decisions are made. The model builder also contains a model dictionary for consistency in the definitions and uses of models. Some models that decision makers use to make decisions are: statistical models, production models, marketing models, human resource models, financial and accounting models, and strategic models. These models are extensively used in different functional areas of a business.

(c) **Support Tools** : Support tools like online help, pull down menus, user interfaces, graphical analysis, error correction mechanisms, facilitate the user interactions with the system. Interfaces are an important support tool especially in the case of a DSS. Better the interface, the greater will be the chances of system being accepted by the user. Although managers recognize the power and potential of DSS, the main problem to its adoption is a lack of people with training in computer technologies. In such an environment, good interfaces can make or break the system.

5.5 Functions of DSS

There are five functions of a DSS facilitating managerial decision making. They are

- Model building
- 'What if' analysis
- Goal seeking

- Risk analysis
- Graphical analysis.

(a) **Model building**: This allows decision makers to identify the most appropriate model for solving the problem on hand. It takes into account input variables, interrelationships among the variables, problem assumptions and constraints. For example, a marketing manager of a television manufacturing company is charged with the responsibility of developing a sales forecasting model for color TV sets. A model builder uses a structured framework to identify variables like demand, cost and profit, analyze the relationships among these variables, identify the assumptions, if any (e.g., assume the prices of raw materials will increase by 5% over the forecasting period), and identify the constraints like the production capacity of the plant. All this information is then integrated by a system into a decision making model, which can be updated and modified whenever required.

(b) **'What-if' analysis** : This is the process of assessing the impact of changes to model variables, the values of the variables, or the interrelationships among variables. This helps managers to be proactive, rather than reactive, in their decision making. This analysis is critical for semi-structured and unstructured problems because the data necessary to make such decisions are often either not available or incomplete. Hence, managers normally use their intuition and judgment in predicting the long-term implications of their decisions. Managers can prepare themselves to face a dynamic business environment by developing a group of scenarios (best-case scenario, worst-case scenario and realistic scenario).

(c) **Goal seeking** : It is the process of determining the input values required to achieve a certain goal. For example, house buyers determine the monthly payment they can afford (say for example, Rs. 5,000) and calculate the number of such payments required to pay the desired house.

(d) **Risk analysis** : It is a function of DSS that allows managers to assess the risks associated with various alternatives. Decisions can be classified as low risk, medium risk, and high risk. A DSS is particularly useful in medium risk and high risk environments.

(e) **Graphical analysis** : This helps managers to quickly digest large volumes of data and visualize the impacts of various courses of action. S L Jarvenpaa and G W Dickson studied the relative advantages and disadvantages of tabular and graphic output. They recommended the use of graphs when:

- Seeking a quick summary of data
- Detecting trends over time
- Comparing points and patterns at different variables
- Forecasting activities
- Seeking relatively simple impressions from a vast amount of information.

The researchers suggested that a tabular presentation be used when it is necessary to read individual data values.

Jarvenpaa and Dickson has also offered the following tips when choosing between the various types of graphs:

- Line or bar charts are preferred for summarizing data.
- Grouped line or bar charts are good for showing trends over time.
- Grouped bar charts are better than pie charts for presenting parts of a whole.
- Grouped line or bar charts are good for comparing patterns of variables.
- Use horizontal rather than vertical bars when comparing variables.
- Use single line or bar charts to compare individual data points between variables
- Put data values on the top of the bars in a bar chart for easier reading.

Note :

Types of decisions

There are three types of decisions

- Programmed decisions
- Non programmed decisions
- Semi programmed decisions

(1) **Programmed decisions** : The decisions in which a problem is solved by a predefined procedure or algorithm. These decisions are repetitive and routine in nature and are capable of being modeled mathematically in their entirety.

The examples of such decisions are :

(i) preparation of pay in accordance with the laid out regulations

(II) inventory ordering.

To arrive at the programmed decisions, a solution manual to problems is prepared to help the users. Some characteristics of such decisions are :

(i) These decisions can be delegated

(ii) The cost of solving a problem is low compared to non-programmed rules

(iii) Such decisions can be made with the help of the computer system.

(2) **Non programmed decisions** : These decisions are unstructured, occasional, of high consequence, complex and involve major commitments. There is no predefined program or set decision rule or algorithm available to solve these problems automatically.

The examples of such decisions are :

(i) advertising budget

(ii) new product decisions

(iii) acquisition of capital projects

Some characteristics of such decisions are

(i) These decisions are novel and difficult to structure in logical mathematical terms.

(ii) These decisions cannot be delegated, and are based on management direction, thinking and deliberations, e.g., purchase of scarce and capital items under fluctuating price conditions cannot be delegated

(iii) Computers cannot be used directly for such decisions. However, they may be used to process large volumes of necessary data.

(3) **Semi programmed decisions** : In these types of decision, at least one but not more than two of the above stages can be handled by a well defined preset procedure. An example of such a decision is the intelligence phase, which is well structured, having diverse kinds of variance analysis. Here a comparison with a budget is undertaken in a well defined way to indicate the need for a decision. Subsequent stages of design and choice are, however, not handled by any set procedure.

Assignments :

1. What is decision making ? What are the types of decisions ?
2. What do you mean by decision support system ? What are their characteristics, types, components and functions ?

CH -6
Approaches for System Development

System development includes those activities that go into producing an information system solution to organizational problems or to take advantages of environmental opportunities. System development consists of two broad phases- analysis and design. System analysis includes analysis of a problem which the organization will try to solve with an information system. It is a phase of system development process in which the system analyst or system development team determines what the new system should accomplish.

System design provides details of how a system will meet the information requirements as determined by the system analyst/system development team. It is a phase of system development process in which the general requirements defined in the analysis phase are converted into detailed specifications for the new system.
Different approaches can be used for system development which can be classified as follows :
1. System development life cycle.
2. Prototyping.
3. Rapid application development.
4. End-user development.

In some of these approaches, top-down method is followed while in some others, bottom-up method is followed. Further an integrative method can be followed by integrating the top-down and the bottom-up methods.
Therefore,, before going through the details of system development approaches, it is desirable to go through top-down, bottom-up, and integrative methods.

Top-down Method. Under top-down method, the development of an information system starts from the identification of organisational objectives, its environment, and constraints under which it operates. On the basis of these, following steps are followed :
1. The strategic and tactical decisions are made for achieving organisational objectives.
2. Major functions and activities are identified which are relevant for carrying out these decisions.
3. From the functions and activities. the major information requirements are determined.
4. Based on information requirements, model of information flow in the organization is developed which acts as a guide for designing the information systems.
5. By using the model of information flow. various information subsystems are defined. Each subsystem comprises various modules. A module is a basic unit

for information system development. The selection of a module for developing the system is made on the basis of priority assigned to various modules.
6. Various subsystems and their modules are coordinated and integrated. The information system so developed is viewed as a total system fully integrated rather than being a collection of loosely coordinated subsystems.

In top-down method. top management of the organization takes initiative in formulating organizational objectives and strategies and communicates these down the line to middle and lower management levels for translating these into performance results. Managers at the middle and lower levels seldom play any role in objective and strategy formulation: they focus their attention on strategy implementation and operational control.

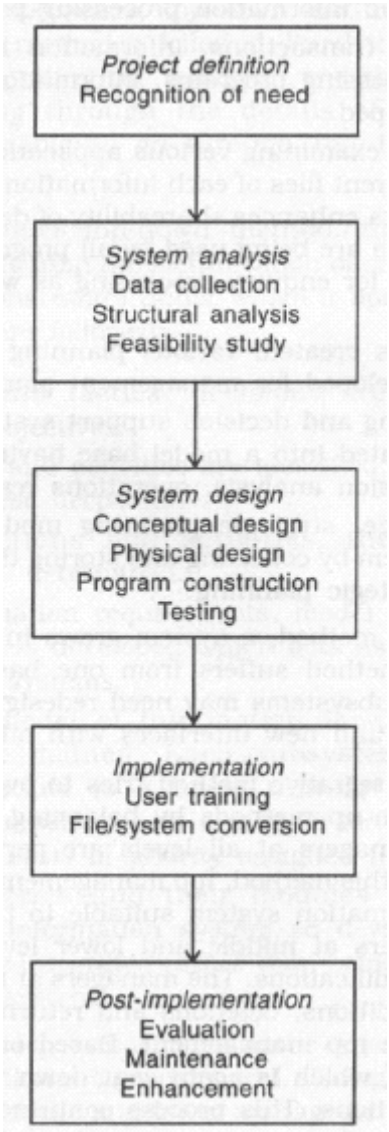
Bottom-up Method. In bottom-up method. the development of information system starts from the identification of life stream systems which are essential for the day-to-day business operations. For example, payroll, sales order, inventory control etc. Initially, information systems for these life streams are developed which are in the form of transaction processing systems. Other systems are developed subsequently based on the user needs. Following steps are followed in bottom-up method of system development:
1. For each life stream, basic transactions, information file requirements, and information processing programs are identified.
2. Based on basic transactions, information file requirements, and information processing programs, information system for each life stream is developed.
3. After thoroughly examining various applications, files, and records, data kept in different files of each information system are integrated. Integration of data enhances shareability of database. It also ensures that uniform data are being used by all programs and also provides added capability for enquiry processing as well as ad hoc requests for reports.
4. After database is created, various planning and decision support systems are developed for management planning and control.
5. After the planning and decision support systems start functioning, these are integrated into a model base having a variety of models including regression analysis, operations research models etc.
6. At the last stage, strategic planning models are added to the information system by collecting and storing the external information relevant for strategic planning.
Thus, in bottom-up method, a system grows in real response to user needs. However. this method suffers from one basic limitation that is integration of various subsystems may need redesigned system due to the changing requirements and new interfaces with other subsystems.

Integrative Method: Integrative method tries to overcome the limitations of top-down and bottom-up methods by balancing both the methods. In integrative method, managers at all-levels are permitted to play role in system development. In this method, top management initiates the structure and design of the

information system suitable to the organization which is presented to managers at middle and lower levels for soliciting their views and necessary modifications. The managers at these levels are advised to suggest changes, additions, deletions and return the design along with their suggestions to the top management. Based on these suggestions, a revised design is drawn which is again sent down the line for comments and necessary modifications. This process continues till a system design is finalized which is satisfactory to personnel at all the levels.

System Development Life Cycle

System development life cycle (SOLC), or simply called system life cycle (SLC), is based on the life cycle stages of natural systems. Natural systems go through the four stages of life cycle-birth, growth, maturity, and decay. In the same way an information system, which is a man-made system, passes through different stages though it is not necessary that these stages exactly resemble the stages of natural systems. An information system development life cycle has different stages as shown in Figure 1.



System development life cycle stages.

The system developer may progress from one stage to another methodologically solving the problems involved and achieving the desired results. However, there is a need for caution in isolating various stages of SOLC. These stages have been isolated in a sequence for learning purpose and in actual practice they may overlap. Each stage may act as a basis for modifying earlier actions. For example, based on performance criteria a particular proposed system has very high ranking but if it requires a hardware system which is not feasible, the system may not be considered useful for further action and fresh system development process may begin.

Therefore, various stages of SOLC should be taken in this perspective. They are :
Project Definition : Project definition stage determines whether or not the organization has a problem and whether or not the problem can be solved by

launching a new system. Thus, at this stage, the need for a new system is recognized. The basis for a new system is the recognition of a need for improving an information system or a procedure. This need leads to a preliminary surveyor an initial investigation to determine whether an alternative system can solve the problem. It entails looking into the duplication of effort, bottlenecks, inefficient existing procedures, or whether parts of the existing system need computerization. If the problem is serious enough, the management may want to have an analyst to look at it. Such an assignment implies a commitment specially if the analyst is hired from outside the organization. In larger organizations, where, formal procedures are the norm, the analyst's first job is to prepare a statement specifying the scope and causes of the problem. He may then review it with the users for accuracy.

System Analysis : At this stage, an analysis of the problems of the existing system is undertaken and how the new system is likely to overcome these problems is specified. For this purpose, a system analysis is undertaken which is a detailed study of various operations performed by a system and their relationship within and outside the system. During analysis, data are collected about the available files, decision points, and transactions handled by the existing system. There are various tools which are used for analysis, such as data flow diagrams, questionnaires, interviews, on-site observations, etc. Once this analysis is completed, the analyst has a firm understanding of what can be done to overcome various problems. Various alternative systems are evolved and feasibility study is undertaken to determine their suitability.

System Design : System design is the most creative and challenging phase of system life cycle. System design describes how a chosen system will be developed. It prescribes the technical specifications (analogous to the -- engineer's blueprints) that will be applied in the chosen system. It also includes the construction of program and program testing. System design involves certain steps. The first step is to determine how the input is to be produced. The second step involves designing input data and database that meet the output requirements. Data processing phases are handled through program construction and testing. including the list of the programs needed to meet the system's objectives and complete documentation.

Implementation. System implementation phase is less creative than the design phase. It is basically related to user training, site preparation, and file conversion. Depending on the nature of the new system, user training is planned and conducted. Site preparation is required when the new system is quite different as compared to earlier one like the use of communication network by the new system. Conversion from old to new system takes place either at the time of user training or little later.

Post-implementation. After the new system is installed and user staff is adjusted to the changes created by the new system, post-implementation stage begins which consists of mainly evaluation and maintenance.

Evaluation involves an analysis of how the new system is achieving its objectives originally envisaged. Users and technical staff may go through a formal post-implementation audit that determines how well the new system is working and if not what kind of changes are required.

Maintenance involves maintaining hardware, software, and other devices with a view to have their optimum life. Post-implementation may also involve enhancing the capacity of the present system either by'-updating hardware and software or by adding balancing equipment or both.

Once the new system is in place it will work through its useful life and reach to the level of maturity and finally decay yielding place to another system. How much time the system takes from maturity to decay depends on its capability and the information requirements of the organization.

Following table presents information about approximate percentage of effort required by each stage of system life cycle.

Table 11.1: Effort required by different stages of SDLC

Life cycle stage	*Activity*	*Effort required (%)*	*Range of effort (%)*
Project definition		Pre-system development activity	
System analysis	Data collection	15	10–20
	Feasibility study	5	3–10
System design	Conceptual design	5	3–7
	Physical design	20	15–30
	Program development	25	20–35
	Procedure development	10	5–15
Implementation	Conversion and training	15	10–20
Post-implementation	Post-audit	5	3–6
	Maintenance	On continuous basis	

Advantages of System Life Cycle

System life cycle approach of developing information systems is the most conventional and traditional though it offers certain advantages in developing transaction processing systems and structured information systems that are well defined. In these cases, system life cycle approach offers the following advantages:

1. Since the information requirements can be expressed in structured form, system life cycle approach provides chronological stages in developing the required information systems.
2. Project scheduling and its execution can be determined well in advance to ensure that the required information systems are developed well in time.
3. Once a system is developed and is in place, enhancement in its capability can be achieved on continuous basis, though to a limited extent only, without unnecessarily disturbing the system.

Considering the above advantages, business organizations use this approach for developing transaction processing and structured information systems. This approach is also appropriate for complex technical systems, such as space satellite launches, air traffic control refinery operations, etc. Such systems need a rigorous and formal information requirement analysis, pre-defined specifications and tight control over system development process.

Limitations of System Life Cycle

System life cycle approach has some serious limitations. particularly for developing semi-structured and unstructured information systems. These limitations are as follows:

1. System life cycle approach is ill-suited for developing decision oriented systems. Decision making may be unstructured and fluid particularly for strategic and other non-programmed decisions. For such decisions, information requirements change constantly and decisions have no well-defined models or procedures. Lack of this specification may inhibit the system developers from exploring and discovering the problem structure and they may not be able to proceed in right direction for system development.

2. System life cycle approach is quite rigid and inflexible. It allows for revision of the system to ensure that information requirements are met. However, when information requirements are incorrect or an error is encountered, the sequence of life cycle can be repeated but that generates volumes of additional documents, thereby increasing development time and cost. Because of the time and cost to repeat the sequence of life cycle activities, this approach encourages freezing of specifications early in the development process.

3. Life cycle approach is very resource intensive. Tremendous amount of time is required in gathering information and preparing specifications. This involves very high cost. Sometimes, time taken in system development is such that by the time the system becomes operational, information requirements change necessitating a new system. This possibility is more for those organizations that operate in fluid environment like financial services, consultancy, etc. In order to overcome the limitations of system life cycle approach some other approaches have been in use for system development. These are prototyping, rapid application development, and end-user development.

Prototyping

Prototyping is an approach for developing information systems quickly as compared to long-drawn process adopted in system life cycle approach. Prototyping is the process of developing an experimental information system quickly and inexpensively for demonstration and evaluation so that end users can better determine information requirements. The prototype endorsed by the users can be used as template to develop the final system. Prototype is a working version of an information system or part of the system but it is meant to be only a

preliminary model. Once, this becomes operational, it is further refined until it conforms precisely to users' requirements. For many applications, a prototype is extended and enhanced over and over again before a final design is accepted. Once the design is accepted, the prototype is converted to a polished information system.

Prototyping process is iterative approach of system development because the steps required to develop a system can be repeated over and over again. It has been said that prototyping replaces unplanned rework with planned iteration with each version more accurately reflecting users' requirements. Prototyping process presented in following Figure consists of basically four steps-identification of basic information requirements. developing the initial prototype. using the initial prototype, and refining and enhancing working prototype to the extent that it becomes acceptable to be operational prototype.

Identification of Basic Information Requirements. At the first step the system designer works with users to understand their basic information requirements. The system developer is an information system specialist. He discusses with different users about their information requirements and the forms in which the information is required.

Developing the Initial Prototype. Based on the understanding of user information requirements and the forms in which the information is required the system developer develops the initial prototype quickly mostly by using fourth generation languages and microcomputer tools, such as Natural.

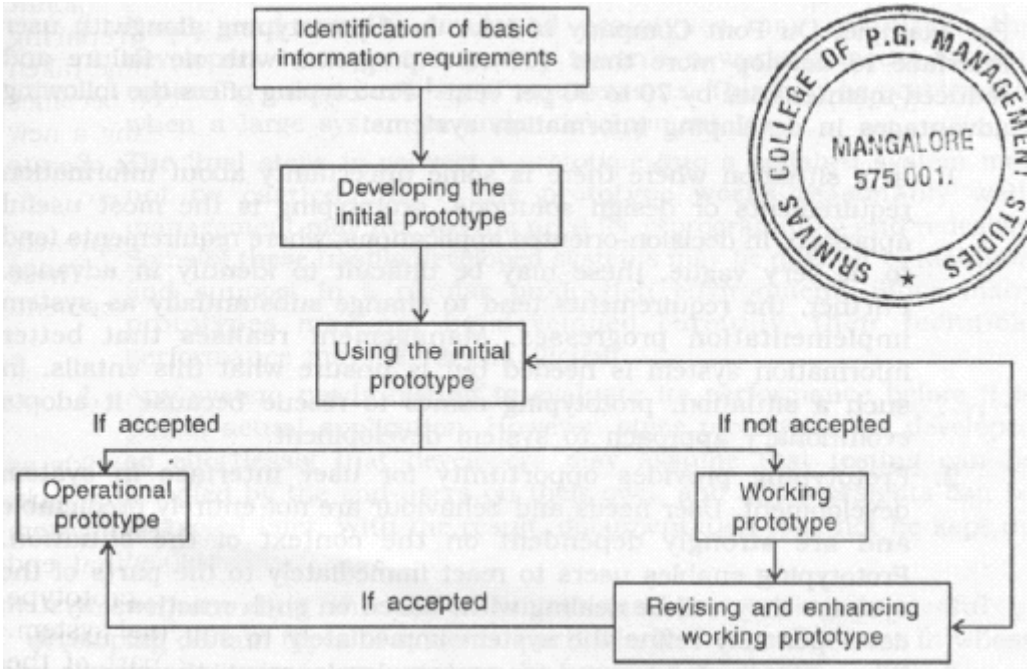


FIGURE 11.2: Prototyping process for system development

Focus. -Structured Query Language along-with spreadsheets, word processing, etc. Besides these, some features of computer-aided software engineering can be used supported by multimedia software tools that present users with interactive storyboards that sketch out the tasks of the proposed system for evaluation and modification.

Using the Initial Prototype. After the initial prototype is ready, it is put to operation to determine what refinements are required. Users are encouraged to use the prototype as extensively as possible and are encouraged to give their suggestions for refinements. Since the initial prototype may perform only the most important functions of the proposed system or it may contain the entire system with a restricted file. Refinements are required frequently.

Refining and Enhancing the Prototype. If the initial prototype is not acceptable, that is, it does not meet the users' requirements. This is treated as a working prototype requiring further refinement and enhancement. After the prototype is refined and enhanced, the system development cycle returns to step 3, that is using the refined prototype. This process is repeated until the prototype becomes acceptable and usable as operational prototype that furnishes the specifications for the application or is adopted as the production version of the system.

Advantages of Prototyping

Certain types of information systems can be developed more efficiently and effectively using prototyping than using the traditional system life cycle.

For example, Du Pont Company of USA used prototyping along-with user interface to develop more than 400 new programs with no failure and reduced maintenance by 70 to 90 per cent. Prototyping offers the following advantages in developing information systems:

1. In a situation where there is some uncertainty about information requirements or design solutions. prototyping is the most useful approach. In decision-oriented applications, where requirements tend to be very vague, these may be difficult to identify in advance.

Further. the requirements tend to change substantially as system implementation progresses. Management realizes that better information system is needed but is unsure what this entails. In such a situation, prototyping comes to rescue because it adopts evolutionary approach to system development.

2. Prototyping provides opportunity for user interface in system development. User needs and behaviour are not entirely predictable and are strongly dependent on the context of the situation. Prototyping enables users to react immediately to the parts of the systems they will be dealing with. Based on such reactions, system developer may refine the system immediately to suit the users.

3. When prototyping is used for system development. the morale and satisfaction of users remain high because of their- active involvement in system development and its refinement. Because of higher morale and satisfaction, users not only accept the new system but also show enthusiasm in making the system successful.
4. A system can be developed quickly by using prototyping. It eliminates the excess costs of system development and design flaws that occur when information requirements are not fully captured the first time around.

Limitations of Prototyping

Prototyping may not be suitable for all types, of applications. It may neither substitute careful information requirement analysis, structured design methodology or thorough documentation, nor totally replace system life cycle approach. Systems that are based on batch processing or systems that rely on heavy calculations and complex procedural logic are generally unsuitable for prototyping. In these situations, prototyping has the following limitations:

1. For using prototyping, large systems must be divided so that a prototype can be developed for one part at a time. However, subdividing a large system may not be possible without a thorough information requirement analysis by using the conventional approach, since it may be hard to see how different parts will affect each other.

2. Easily and rapidly developed prototypes may encourage the developers to move too quickly towards a working model without capturing even a basic set of requirements. This may be problematic when a large system is under development.

3. The final steps to convert a prototype into a polished system may not be carried out. If the prototype works reasonably well, management may not see the need for reprogramming and redesign. Some of these hastily developed systems may be difficult to maintain and support in a regular production environment. Since many prototypes may not be developed carefully their technical performance may be very inefficient.

4. Any system needs testing to evaluate its performance before it is put in actual application. However. since prototypes are developed so effortlessly that developers may assume that testing can be handled by the end-users on their own. and any oversights can be corrected later. With the result. documentation may not be kept up to date.

Notwithstanding the above limitations, prototyping is useful in developing certain types of systems, particularly the smaller ones in whose case information requirements can be assessed in stages.

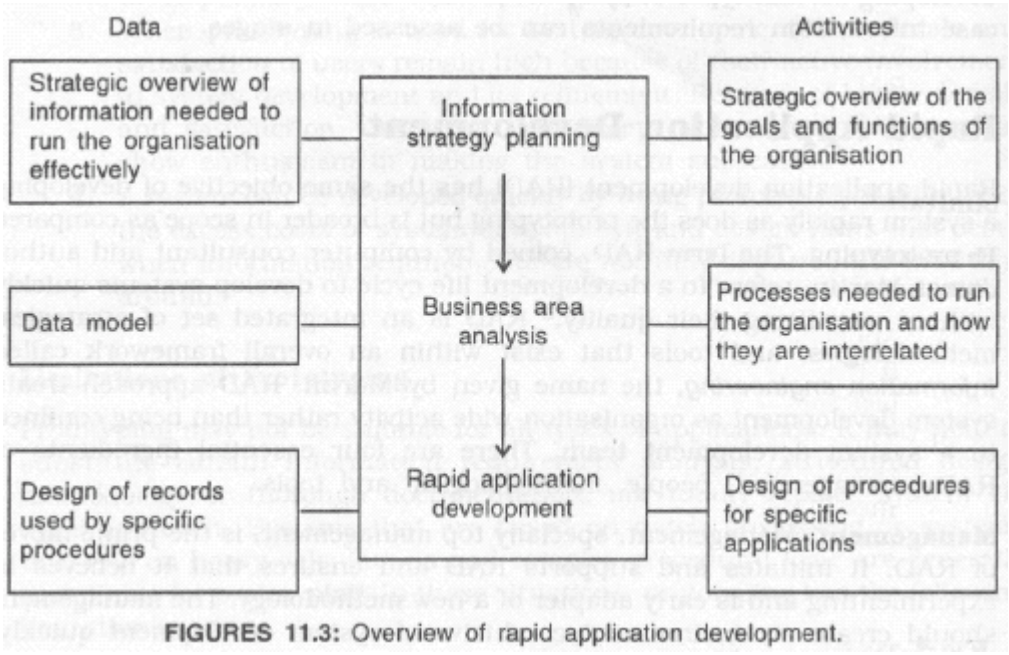
Rapid Application Development

Rapid application development (RAD) has the same objective of developing a system rapidly as does the prototyping but is broader in scope as compared to prototyping. The term RAD, coined by computer consultant and author James Martin, refers to a development life cycle to develop systems quickly without sacrificing their quality. RAD is an integrated set of strategies. methodologies and tools that exist within an overall framework called i*nformation engineering* the name given by Martin. RAD approach treats system development as organization-wide activity rather than being confined to a system development team. There are four essential ingredients of RAD-management, people, methodologies, and tools. Management, specially top management is the prime mover of RAD. It initiates and supports RAD and ensures that it believes in experimenting and is early adapter of a new methodology. The management should create an environment conducive of system development quickly People. In RAD, variety of people contribute to system development.

Rather than constituting a single team of system developers as is done in conventional life cycle, RAD emphasizes the constitution of several teams with each team working in its specialized area only. Thus, there may be teams for requirement planning, user design construction, user review, and cutover. Members of these teams are specialists in the methodologies and tools that are required to perform their specialized tasks. Martin has called these teams as SWAT team with SWAT standing for 'skilled with advanced tools'.

Methodologies : The basic methodology used in RAD is known as RAD life cycle which consists of four phases-requirement planning, user design, construction, and cutover. These phases like the system development life cycle reflect the systems approach in system development. In this approach end-users play key role in all phases participating with information specialists.

Tools : RAD tools mainly consist of fourth-generation languages and computer-aided engineering (CASE) tools and facilitate prototyping and code generation. Fourth-generation languages enable information specialists or users to generate computer code without using conventional programming languages. Following Figure presents information engineering that provides overall framework for rapid application development.



FIGURES 11.3: Overview of rapid application development.

Figure illustrates the top-down nature of overview of rapid application development involving data (left-hand side) and activities involved (right-hand side). The process begins at the strategic level with strategic information resource planning that is applied to the entire organization. Martin has called strategic information resource planning as information strategy planning. At the next stage, business area analysis is conducted for each business unit of the organization to define the activities or processes and data that are necessary to operate the unit efficiently.

After business area analysis, rapid application development proceeds in four steps-requirement planning, user design, construction, and cutover. These steps are quite similar to system development life cycle with a major difference, that is, in RAD, many specialized teams are involved in the development process against the single team involved in SDLC.

Advantages *of* Rapid Application Development :

There are many advantages of RAD as compared to SDLC or even prototyping. RAD can be applied for developing systems in which requirements are precisely defined in advance as well as those systems in which such requirements cannot be defined in advance. The major advantages of RAD are as follows:

1. The system development is completed in comparatively much lesser time as compared to SDLC. This is possible because system development activities are divided among a number of teams rather than assigned to one team.

2. Since each team performs the activities relevant to its specialized area only, the contribution of each team becomes quite relevant which helps in achieving high system performance.

3. RAD can be applied for developing all types of systems. Thus, it has very wide applicability.

Limitations *of* Rapid Application Development :
There are some problems in applying RAD though these problems are of operational nature. These problems are as follows:

1. Application of RAD requires active support of the top management. If the top management is change resistant, this support may be lacking and RAD may not be applied successfully.

2. There is high need of interaction and coordination among various teams involved in RAD. If the organization does not have mechanisms for this interaction and coordination, RAD may not contribute positively.

End-user Development
In end-user development, information systems are developed by the end-users themselves with or without little assistance from technical specialists. End-user development has been made possible because of fourth-generation languages and other tools. Even though these tools are less computer efficient than conventional programming languages, decreasing hardware costs have made them technically and economically feasible. With fourth generation languages, graphic languages, and microcomputer tools-word processing software, spreadsheets, data management software, and integrated software packages, end-users can access data, create reports, and develop an entire information system on their own without professional system analysts or programmers. Alternatively, end-users may seek technical support from information system specialists and perform many system development activities on their own. Such activities might have been undertaken by the information system department in the past. Many of these end-user-developed systems can be created more rapidly than by using conventional system life cycle as shown in following Figure.

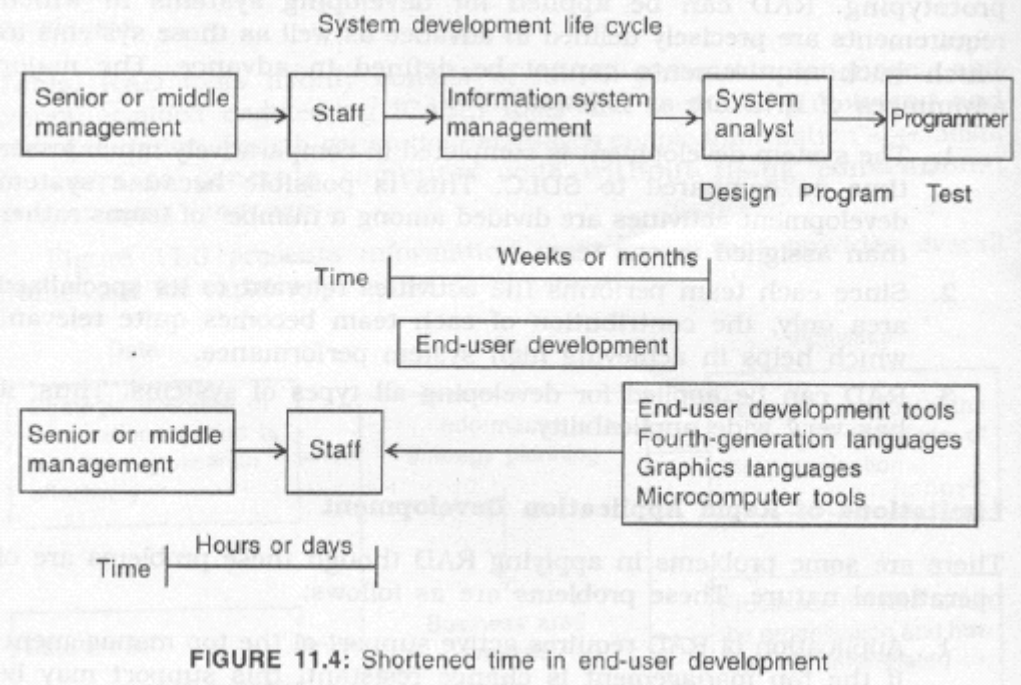


FIGURE 11.4: Shortened time in end-user development

Requirements for End-user Development :
There are certain requirements which must be fulfilled for making end-user development feasible. These requirements are connectivity, information centre, and procedures to manage end-user computing.

Connectivity : For end-user development, it is essential that end-users are provided connectivity to central database which stores different types of data that can be used by end-users. Normally, in end-user development, emphasis is put on manipulating the existing data for generating information to make decisions. Thus, effective database management systems and client/server computing and networking are pre-requisites of end-user development.

Information Centre : Information centre is a special facility that provides training and support for end-user computing. An information centre has hardware, software, and technical specialists that supply end-users with tools, training. and expert advice so that users can create information system applications on their own. Information centre hardware may consist of mainframes, minicomputers, microcomputers, workstations or a combination of these. Typical software tools in information centre include word processing software, planning or modeling software, desktop database software, graphics software, report generators, user-friendly fourth generation languages for queries or simple applications and high-level programming languages for fourth-generation application development. Technical specialists combine expert knowledge of hardware, software, and databases for end-user applications with strong interpersonal skills. They function primarily as consultants to users though they may also take part in the

analysis, design, and programming of complex applications. A typical information center, provides the following services to the end-users:

1. Training in high-level languages and development tools.
2. Assistance in accessing and transferring data.
3. Assistance with applications, queries. and reports requiring highlevel programming languages.
4. Consultation on appropriate tools and methodologies for developing applications.
5. Assistance in establishing quality assurance standards and controls.
6. Generation and modification of prototypes.

Procedures to Manage End-user Computing : The organization should ensure that end-user development is not random but organized so that these developments are incorporated in organization's overall information systems. Therefore, the organization should provide procedures and policies for such developments. The organization should also develop controls on end-user development that should include the following:
1. Cost justification of end-user development.
2. Organization-wide standards for microcomputers. word processing software, graphics software, and query and reporting tools.
3. Quality assurance review.
4. Controls for end-user development applications covering testing, documentation, accuracy, and completeness of input and update, backup, recovery, and supervision.

Advantages of End-user Development :
Many organizations have achieved appreciable gains through end-user development because it offers following advantages:
1. End-user development produces customized systems which serve the needs of end-users in a better way. These systems focus directly on the information requirements of end-users.
2. Systems can be developed instantly in many cases which ensures timely availability of information. Time value of information is very high in decision making. .
3. End-users have direct control over the systems developed by them. This phenomenon provides them more satisfaction.

Limitations of End-user Development :
End-user development has its own problems and limitations which are as follows:
1. End-user development can be used only in limited applications, particularly for manipulating small files. Thus, applications with extensive procedural logic and updating requirements cannot be handled by this method.

2. If end-user development takes place at a massive scale. there would be numerous systems: These may generate coordination problem, and if these are

not properly coordinated. there may be confusion and chaos. Taking into account the advantages and limitations of end-user development, it can be concluded that it cannot replace the more elaborated system development methods like the ones discussed earlier but can be used to develop applications in a limited way.

Following Table summarizes the major advantages, limitations, and suitability of alternative approaches of system development.

Table 11.2: Advantages, limitations, and suitability of different approaches

Approach	*Advantages*	*Limitations*	*Suitability*
System life cycle	Methodological and orderly	Time-consuming and massive paper work	Large systems having well-defined requirements
Prototyping	Rapid and inexpensive	Gloss over steps in analysis, documentation, and testing	Smaller systems
Rapid applications development	Rapid, use of different specialists	Coordination problem	Large systems
End-user development	Rapid, high involvement of end-users	Proliferation of uncontrolled systems	Smaller systems for specific applications

Organizations may adopt anyone of these approaches or a combination of two or more approaches as the need may be. to develop their information systems. However. before going through the process of developing their own information systems. they may consider a question-should they develop their own systems or should they go for outsourcing these systems from outside? The answer of this question lies in analysis of outsourcing.

Outsourcing Information Systems :

If an organization does not want to develop and operate its own information systems, it can hire an external agency that specializes in these services to do the work. The process of turning over the organization's computer centre operations, telecommunications networks, and application development to external vendors is known as outsourcing. The decision of outsourcing information systems is like a make or buy decision. In a make or buy decision, two types of factors are taken into consideration-cost factors and non-cost factors. In cost factors, the organization compares costs of making and costs of buying. If costs of making are more than costs of buying, it can go for buying from outside. However, make or buy decision does not solely depend on cost consideration but non-cost factors sometimes become more important. These non-cost factors are quality, regularity of supply, reliability of supply, etc. Thus, cost and non-cost

factors must be considered in making decision about outsourcing information systems.

When to Outsource :
With outsourcing becoming an acceptable norm, organizations, be startups or well-established, are under constant pressure to outsource cost-effective and quality information systems. However, before going for outsourcing, the organization must decide what to outsource and what not to outsource because information system outsourcing is not like a product outsourcing; an information system requires confidentiality which is of paramount importance to the organization. Therefore, the organization must define the type of' role that the information systems are expected to play in the organizational functioning. Based on this criterion, there may be a number of circumstances under which outsourcing is useful. These are as follows:

1. Criticality of Information Systems : Some information systems or applications may be critical to the organization while others may not be so critical. Those systems that have limited potential for the organization to generate competitive advantage may be considered as non-critical. Clermont has developed a matrix combining two factors-penalty for problems and reward for excellence-to identify the systems that can be outsourced.

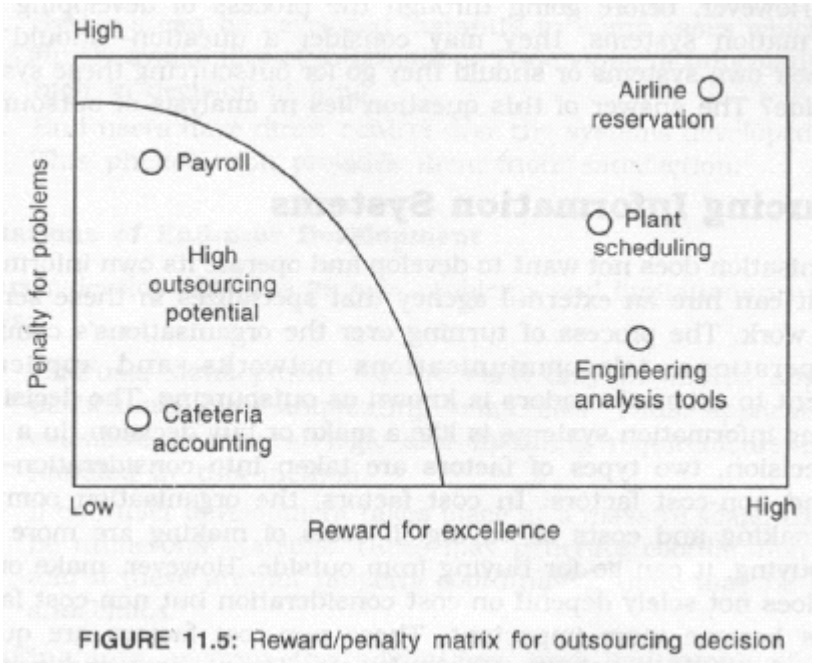


FIGURE 11.5: Reward/penalty matrix for outsourcing decision

Thus, those systems which do not have high reward for excellence and low penalty for problems like cafeteria accounting (accounting of different varieties excluding management accounting) may be outsourced easily. Even systems having somewhat higher penalty for problems but low reward for excellence like payroll may also be considered for outsourcing. The basis idea is that even if excellence is achieved in these areas, there may not be much gain, As against

these. airline reservation. plant scheduling, engineering analysis tools, etc. which have high reward for excellence may be developed in-house because they are critical to the organization.

2. Interruptions in Information Systems : When interruptions in information systems are not critical to the organization, these can be outsourced. For example. interruptions in insurance claim processing systems are not critical to the organization and it can work without these for few days. When .interruptions in information systems are critical to the organization like computerized banking, airline reservation system, etc. they may require in-house development and operation.

3. Capabilities of Existing Information Systems : When organization's existing information systems have limited capabilities, or they are ineffective or technically inferior, outsourcing may be better alternative. Some organizations use outsourcing to revamp their information system technology. For example, organizations may use outsourcing to make the transition from traditional mainframe computing to client/server computing.

Managing Outsourcing :

Outsourcing of information systems requires effective managing because there are many issues which must be solved carefully. For managing outsourcing, the organization can do the following things:

1. Af*ter* deciding what is to be outsourced, the organization must choose the vendor from whom to outsource. Choosing a vendor is the most critical issue. While choosing a vendor, quality, reliability of supply, and regularity of supply besides costs should be taken into consideration.
2. A good working relationship between the organization and the vendor should be developed which must be based on mutual trust and respect so that both the parties understand the positions of each other.
3. Contract between the organization and the vendor should be worked out explicitly so that what each party expects from another is made very clear. Provisions must exist in the contract for incorporating the changing requirements of the organization. The contract should also contain the clause relating to information security and penal provisions for breaching this clause.
4. The organization should constantly re-evaluate its vendors and decisions to outsource in the light of changing business conditions and the growing pool of vendors.

Advantages of Outsourcing :

Outsourcing is becoming popular because many organizations perceive it as being more cost effective than developing and operating their own information systems because outsourcing offers following advantages:

1. Economy : Outsourcing is economical as compared to in-house development and operation of information systems. Economy emerges from the vendors' side because of two reasons. *First,* vendors are information system specialists that help to do a job better with lesser amount of effort.

Second, vendors produce Dame type of systems in huge volume thereby they have. economy of scale. Therefore, they can provide same service and value for less cost than the cost of an internal organization. For example, Loh and Venkatraman have observed that while some outsourcing vendors offer reduction of 50 per cent in information technology costs, saving of 15-30 per cent is more common.

2, Flexibility : An organization's business growth, and consequently more information needs, can be accommodated through outsourcing without making changes in its information system infrastructure. As information technology permeates the entire value chain of a business, outsourcing may provide superior control of the business and its costs and capabilities can be adjusted to meet changing business needs.

3. Cost Predictability : In outsourcing, costs of information and its related services can be predicted in advance as the costs are settled before the supply commences. In in-house development and operation, such costs cannot be predicted accurately in advance. If information costs constitute a significant portion of the total costs of products/services, cost predictability is quite useful in decision making for offering these products/ services.

4. Making Fixed Costs Variable : In the case of in-house development and operation of information systems, most of the costs-hardware costs, software costs, and personnel costs-become fixed. Even if the organization is not using these resources to the full extent, these costs have to be borne by the organization. In the case of outsourcing, these costs remain variable as costs are determined in terms of per unit of services. The organization is required to pay only costs of those services that have been utilized.

5. Freeing up Financial Resources : One of the main advantages of outsourcing is that the organization is able to free up its financial resources that might be required for in-house development and operation' of information systems. In many cases, costs of setting up computer centers and developing, programs are quite high. If the organization is able to deploy its freed financial resources in an alternative use, it can enjoy more benefits than tying-up with information systems which otherwise can be outsourced.

Disadvantages of Outsourcing :

Outsourcing is not free from limitations and disadvantages which limit the extent of taking various advantages. These disadvantages are as follows:

1. **Loss of Control :** In outsourcing, the organization loses its control over information systems. Outsourcing places the vendor in an advantageous position where the client organization has to accept whatever the vendor does. If a vendor becomes the organization's only alternative for developing and operating its information systems, the organization has to accept whatever technologies the vendor provides.

2. **Vulnerability of Strategic Information :** In outsourcing, there is a possibility of information system vulnerability. Trade secrets and other information of strategic use may be leaked to organization's competitors.

This may be quite harmful to the organization and it may lose its competitive advantage in the process. Therefore, it is desirable to process such information in-house.

3. **Dependency.** Because of outsourcing, the organization is dependent on its vendor and. to some extent, its fate is tied up with the vendor. If something goes wrong with the vendor, the client organization is also affected adversely. Considering the advantages and the disadvantages of outsourcing, it may be concluded that an organization should not fully depend on outsourcing. It may outsource only those information systems which have lesser strategic importance.

DISCUSSION QUESTIONS

1. What do you mean by system development? What are the steps involved in top-down, bottom-up, and integrative system development?
2. What are the different approaches for system development? Discuss their advantages, disadvantages, and suitability.
3. What are the stages of system development life cycle? Describe these stages briefly. What are the advantages and limitations of system development life cycle?
4. What is prototyping approach of system development? What are its advantages and limitations?
5. What is rapid application development approach of system development? What are its advantages and limitations?
6. What is end-user development approach of system development? Discuss its advantages. limitations, and suitability. ,
7. What do you mean by outsourcing information systems? What are its advantages and limitations? Discuss the precautions which should be taken in outsourcing information systems.

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MIS Chapter 7

Form Design

1. Introduction :

Information system not only involves computer but also the manual systems and both the systems must be compatible. Even in a fully computerized system, some manual operations are needed. Computer data entry is a manual operation. So ease of data entry is one of the major considerations in the design of information system. Forms are used for entering data. Data entry or for that matter any computer operation, involve some interaction with computer. The computer system is designed to respond user's commands and input data in a manner that makes it easier to operate and use. Codification of items becomes necessary for computerized system. Codes should be designed to facilitate data entry, reduce data entry errors and also make it easy for user to relate it to items.

2. Principles :

A form is it surface for presenting or entering information in a specified format. An organization uses form for variety of purposes such as employee bio-data, leave application, traveling allowance, deposit and withdrawal of money, material requisition, work order1 purchase order, material inspection report, performance appraisal report, self appraisal report and so on.

Though the paper is the traditional and still the most widely used medium, the use of video screen for directly entering data and presenting information is rapidly increasing. Many of the principles which apply to the design of paper documents are also equally applicable to screen documents. A good format enables relevant information to be obtained, transmitted, stored, retrieved and interpreted in a better manner at minimum cost and effort.

Form design is sometimes considered as a low-level activity and not given much importance. The defects in many forms can be attributed to this attitude. Badly designed forms can impede collection of correct information and also increase the chances of misrepresentation and misinterpretation. Good form design is not possible without proper system analysis. The purpose of a form cannot be considered in isolation from the objectives of the organization. The occasion for form design may arise as part of a system study. Also request for a new form sometimes leads to study and modification in the system.

3. Controls :

The content, layout, makeup, printing and paper are the main considerations in form design.

1. *Content :* The content of the form consists of all the words, spaces, boxes, etc, including the title of the form, detailed headings and instructions if any for its use. The title should be brief and meaningful to the users. Also, item headings should

be self-explanatory. If an instruction is critical, such as 'USE CAPITAL LETTERS', it should appear before the space where the entry is to be made. If there are more number of instructions, then these may be numbered in relation to the headings.

2. *Layout:* Layout is concerned with those aspects that enhance the appearance of form and make the form more comprehensible. It involves deciding the font and size of letters, spacing, paragraph margins and positioning of contents to fit on the size of paper.

3. *Make-up:* The term 'make-up' denotes all the physical features of a form other then printing and paper. It includes features such as sets of forms are to be made in pads or to be used as continuous stationery, use of interleaved carbons or chemical coating for making multiple copies, all multiple copies are to in single color or different colors, any punching or perforations required or not. Make-up sometimes costs more than both paper and printing. A comparison needs to be made between the additional cost of make-up and the benefits derived due to decrease in time, stationery wastage, and errors.

4. *Printing:* Forms should be so designed that will facilitate printing. The quality of printing is decided based on its use and volume. Those who are in charge of printing may be' consulted on this matter. Sometimes the layout of form may have to be amended to facilitate printing.

5. *Paper:* Forms should be on standard size of paper. The weight and thickness of paper are also important criteria.

MIS Chapter 8

Charting Techniques

1. Introduction :

2. Performance Indices :

3. Flow Charting : Definition and Uses :

4. Flow Charting Symbols :
   (a) For Systems :
   (b) For Programming :

5. Information Oriented System Flow Charts :

6. Process Oriented System Flow Charts :

7. Flow Chart Data Flow Diagrams :

Flow Charting

Programming Process :

The set of detailed instructions which outline the data processing activities to be performed by a computer is called a program.

The computer programming process may be subdivided into six separate phases:

1. Program analysis
2. Program design
3. Program coding
4. Program debugging
5. Program documentation
6. Program maintenance

In program analysis phase, one can use algorithms, flow charts and Data flow diagrams.

Algorithm :-
A list of instructions specifying a sequence of operations that give answer to any problem of a given type is called an algorithm.

For example, the procedure for adding two signed numbers a and b :

1. If a and b have the same sign, go to step 5
2. Subtract the smaller magnitude from the larger magnitude
3. Give the result the sign of number with larger magnitude.
4. Stop
5. Add the magnitude of numbers a & b
6. Give the result the sign of number a
7. Stop

Flow Charts :-

For many applications a simple list of steps (algorithm) is sufficient for stating the problem in a clear manner. But in complex problems, a flow chart is required.

A flow chart contains the sequence of steps involved in solving a problem. A flow chart helps to avoid the accidental omission of intermediate steps.

Flowchart can be divided into 4 categories :

1. System outline charts (Global map).
2. System flowcharts (National map).
3. Run flowcharts (State map).
4. Program flowcharts (District map).

1. System outline charts : -

These charts merely lists inputs, files, processes, and outputs required without considering any sequence.

For example, chart of sales order processing :

2. System Flowchart :-

System Outline Charts

Title *Sale Order Processing (SOP)*	*System* *S*	*Document* *3.1*	*Sheet* *1*
Inputs Customer Order Details		Processes Order entry (clerical) Order acknowledgement (computer) Despatch (clerical) Despatch update (computer)	
Files Product Catalogue Customer Index Cards Doubtful Cost List Delivery Cost List Factory Stock List Customer N/A Card Product Card file Outstanding Order File Product Order Book Order Ledger		Outputs Error reports Balance Order Set Advice Notes Set Invoice Details Tape	
Notes, Cross references			
Issue : Date :			

It presents an overview of the data flow through all parts of a data processing system.

It also represents flow of documents, the operations or the activities performed.

The system flowchart for a computer system consists of :

1. The sources from which input data is prepared and the devices used.
2. The processing steps or sequence of operations involved.
3. Intermediary or final output prepared and the device used for their storage or printing.

Example : PAYROLL

Payroll data -> Compute monthly compensation -> Pay cheques & payroll reports.

An example of a system flowchart is given below :

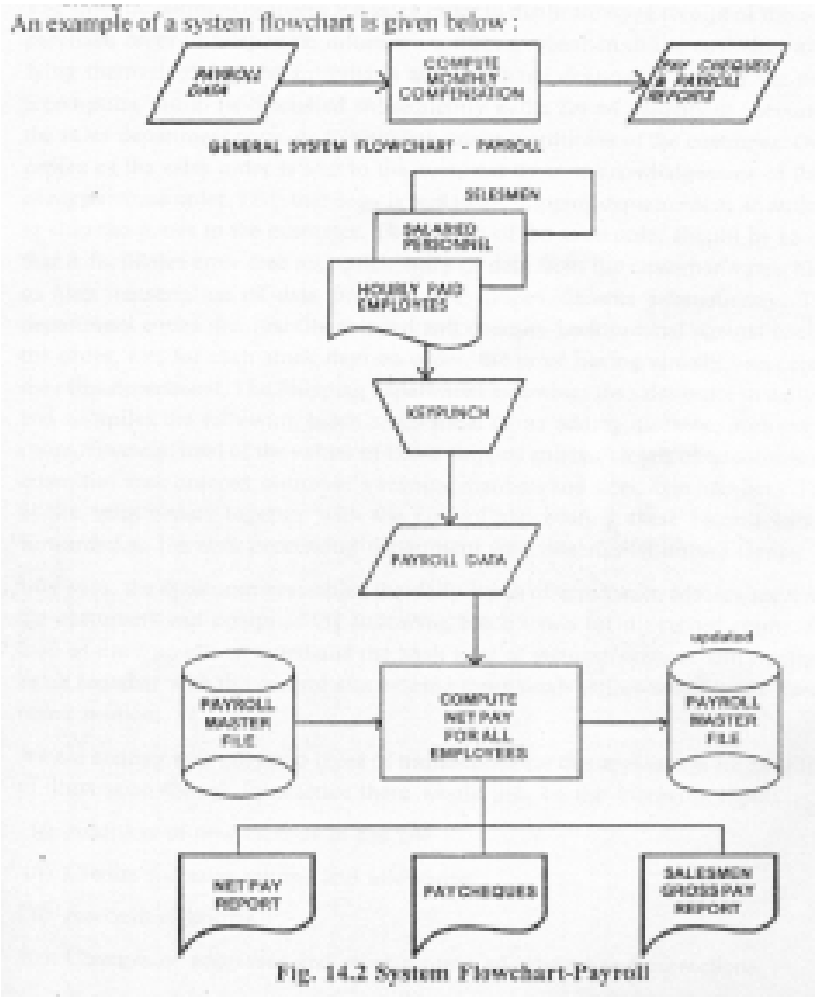
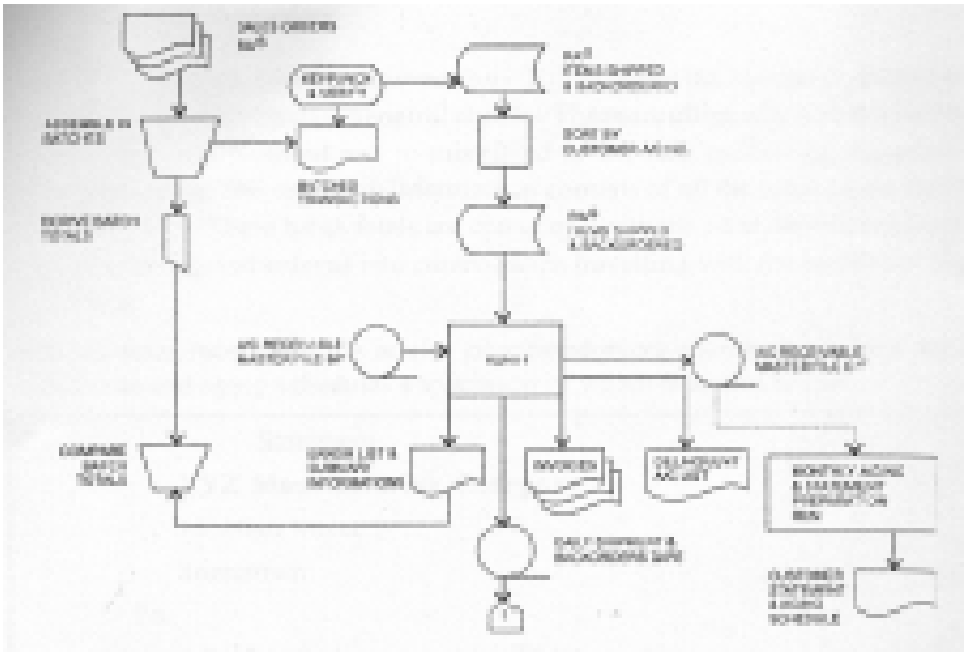


Fig. 14.2 System Flowchart-Payroll

3. Run Flowcharts :-

This is the detailed version of the system flowcharts. It contains the details of each compute operation.

Example : Sales order processing system :

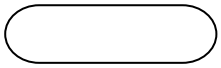


Program Flowcharts :

Program flowcharts are the most detailed and are concerned with the logical / arithmetic operations on data within CPU.

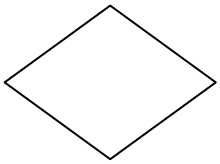
Here, the data flows between CPU and input / output.

Start / end



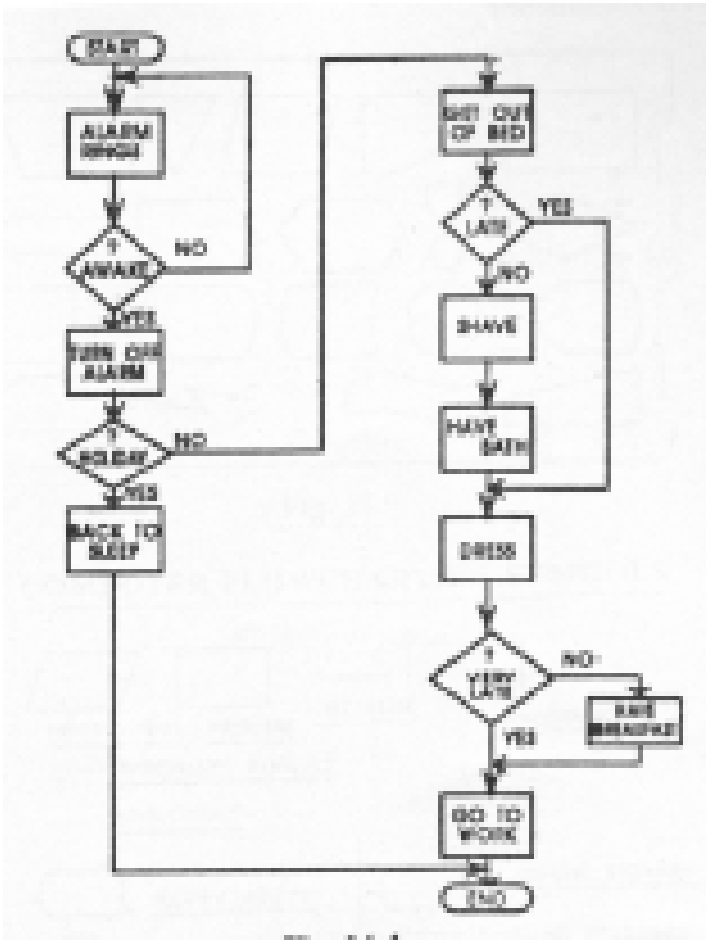
Box
(Process)

Diamond
(decision)

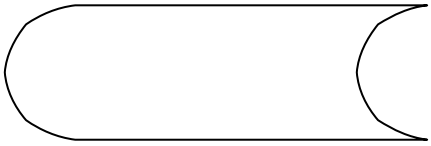


Input / Output

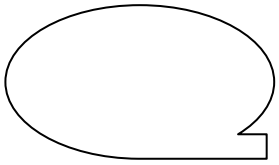
Document



Floppy diskette
Or online storage



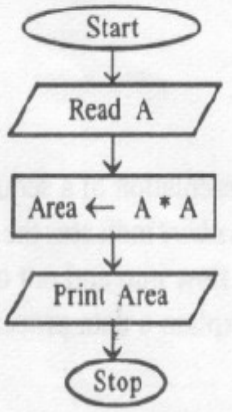
Magnetic Tape



Manual Input

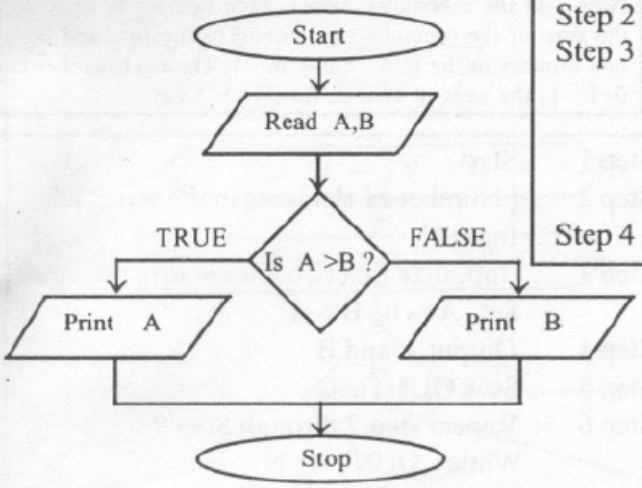
Display

Example 1.7 : *Design a flowchart and an algorithm to find the area of a square.*



Step 1 : Start
Step 2 : Read the value for a(side)
Step 3 : [Compute] Area ← a * a
Step 4 : Output Area
Step 5 : Stop

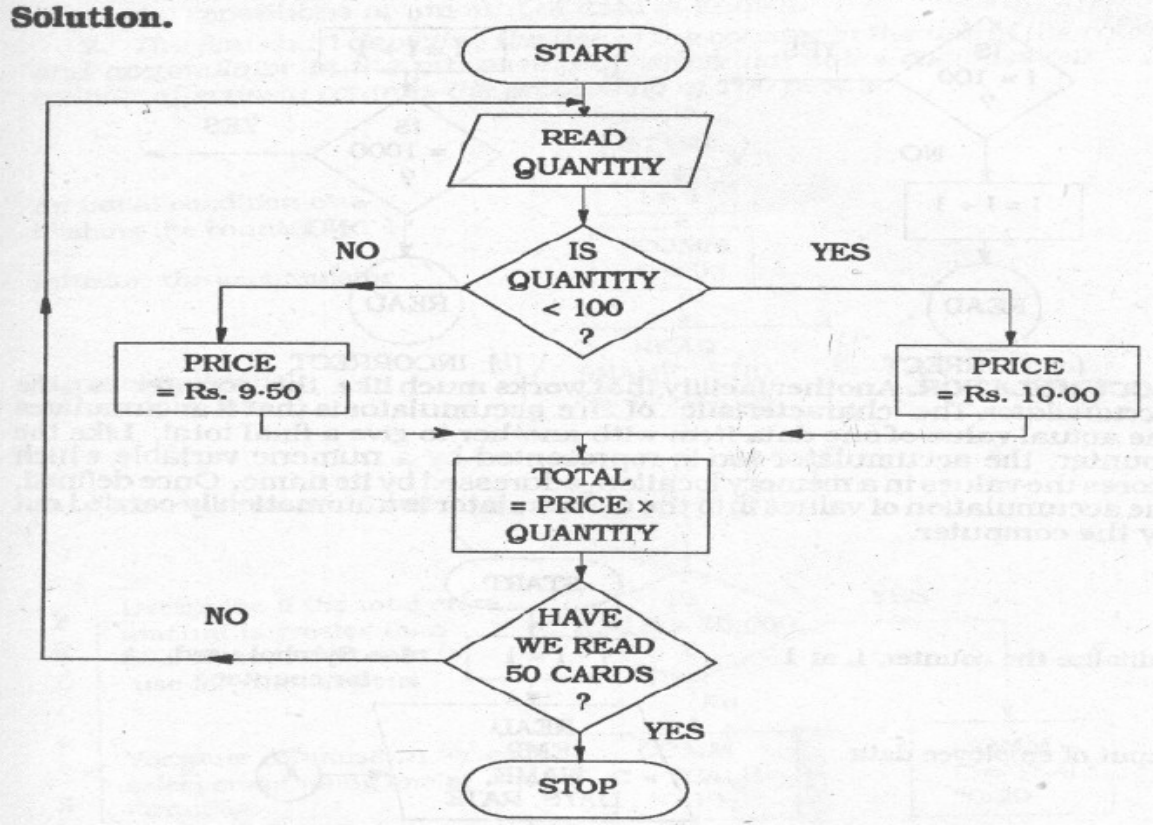
Example 1.8 : *Design a flowchart and an algorithm to find the largest of two numbers.*



Step 1 : Start
Step 2 : Read the values for A and B
Step 3 : If A > B then
Output A
Else
Output B
[End IF]
Step 4 : Stop

Illustration 2. *The following flowchart is for a simple program designe to read 50 cards. Each card has a value representing a quantity. If the quanti is less than 100, the price is set at Rs. 10. If the quantity is 100 or greater, th price is set at Rs. 9·50. For each card record, we print the quantity, the pric and the total. The program, terminates when 50 cards have been read.*

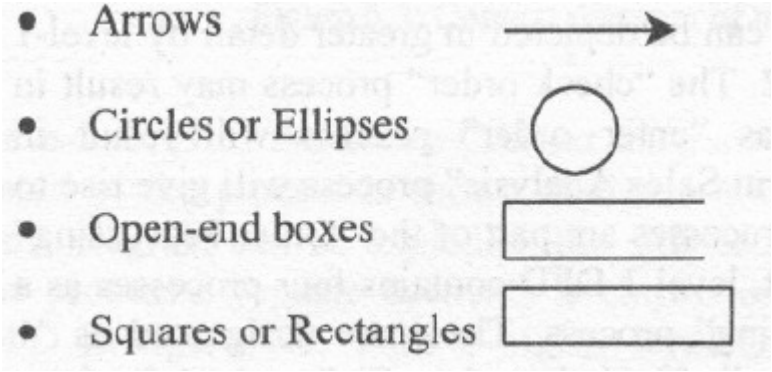
Solution.



Data Flow Diagrams :

Data Flow Diagram (DFD) is a graphical description of a system's data and the processes that transform these data from one 'form to another. Some graphical symbols are used to construct data flow diagram.

These symbols are given below.



A DFD may consist of several external entities, processes, and data flows and data stores. An arrow identifies data flow -data in motion. These data flows

originate from some source and after being transformed by processes are received by some destinations. The source or destination of a data flow is called external entity. It is denoted by a rectangle. A circle or ellipse stands for a process that converts data into information. An open-end box represents a data store - data at rest, or a temporary repository of data. A square / rectangle defines a source (originator) or destination of system data.

DFDs are simple to draw and easily depicts the basic components of a system. It can be drawn in increasing level of detail, staring with a summary high level view and proceeding to more detailed lower level views. Thus, it supports modular, structured and top-down approach to design of information system The highest level of data flow diagram (level-O DFD) that depicts the summary of a system or process is called Context Diagram.

Consider a system for processing orders received from customers. The system after processing a customer's order sends either an order acceptance or an order rejection to the customer. The system also generates a sales report and sends it to the management. Here the customer and management are the external entities. The summary level-O DFD or Context Diagram of the above system is shown in figure.

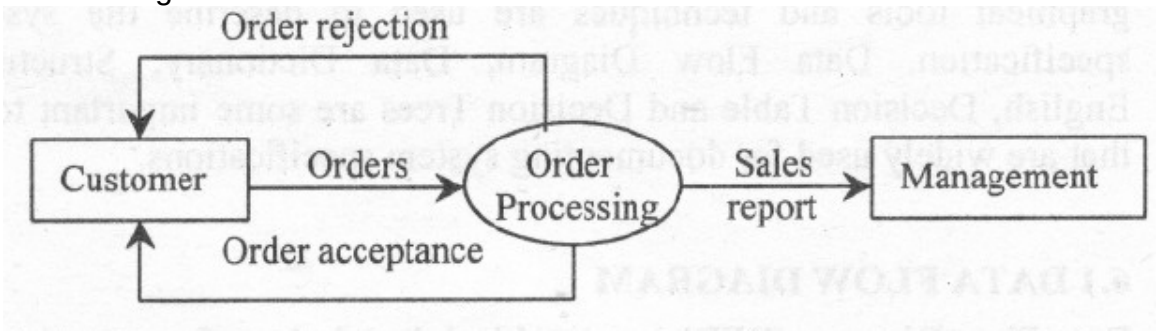


Figure 1: Context diagram of Order Processing System

The same Context diagram can be depicted in greater detail by level-1 DFD as shown in figure 2. The "check order" process may result in rejection of order, whereas "enter order" process will result in acceptance of order. "Perform Sales Analysis" process will give rise to the sales report. All these processes are part of the "Order Processing" process in figure 1. In fact, level-l DFD contains four processes as a part of the "Order Processing" process', These are designated as "check order", "2 enter order", "3 Update data file" and "4 Perform Sales Analysis" as shown in figure 2.

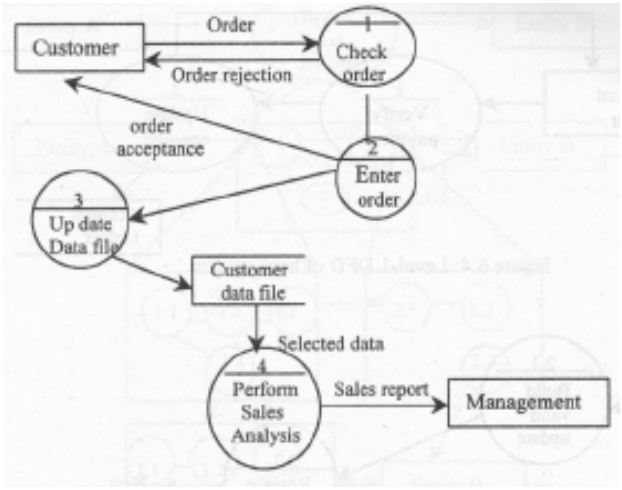


Figure .2: Level.1 DFD of Order Processing System

Example 2 :

Let us consider another example of a bank system. The account holder gives payment (deposits) and receives payment receipt. The context diagram is shown in figure 3.

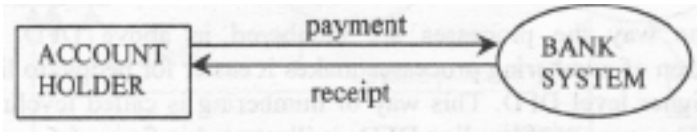


Figure 3: Context diagram of bank system

Level-1 DFD of the above Context diagram that depicts some greater detail of the process is shown in figure 4. Each of the above data flow diagram can be exploded into still detailed DFDs. For example the process-2 (update account) is shown in greater detail in level-2 DFD in figure 5. Thus a higher level DFD forms a parent-child relationship with its lower level DFDs.

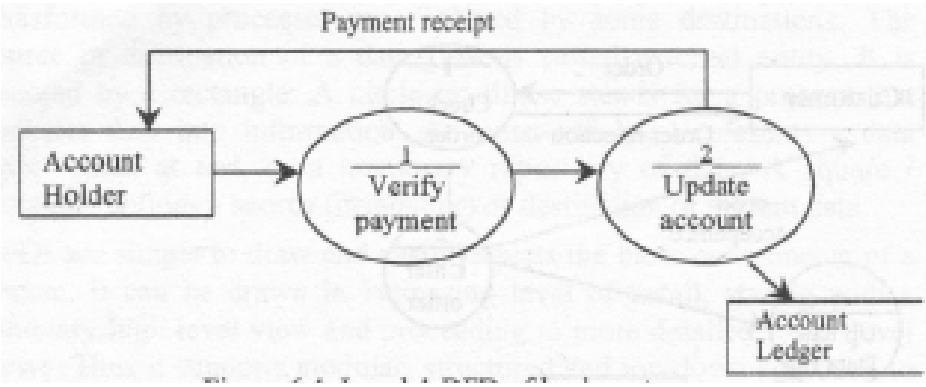


Figure 4: Level-1 DFD of bank system

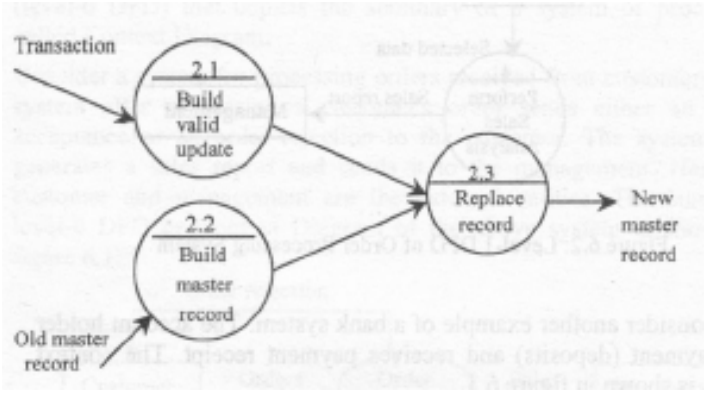


Figure 5: Level-2 DFD ofprocess-2 (update account) of bank system

Note the way the processes are numbered in above DFD. This convention of numbering processes makes it easier for people to link it to its higher level.DFD. This way of numbering is called leveling of DFDs. The process of leveling DFDs is illustrated in figure 6.

Physical and Logical DFD: DFD are of two types; i.e. Physical DFD and Logical DFD. The DFDs considered so far are examples of logical DFD. A logical DFD specifies various logical processes performed on - data. It does not specify who does the processing, where the processing is done or on which physical device data are stored. The above facts are specified by physical DFD. An example of physical DFD is shown in figure 7. It shows the process for withdrawal of money from bank by an account holder against withdrawal voucher. The DFD shows that the processing of withdrawal voucher is processed at five different desks.

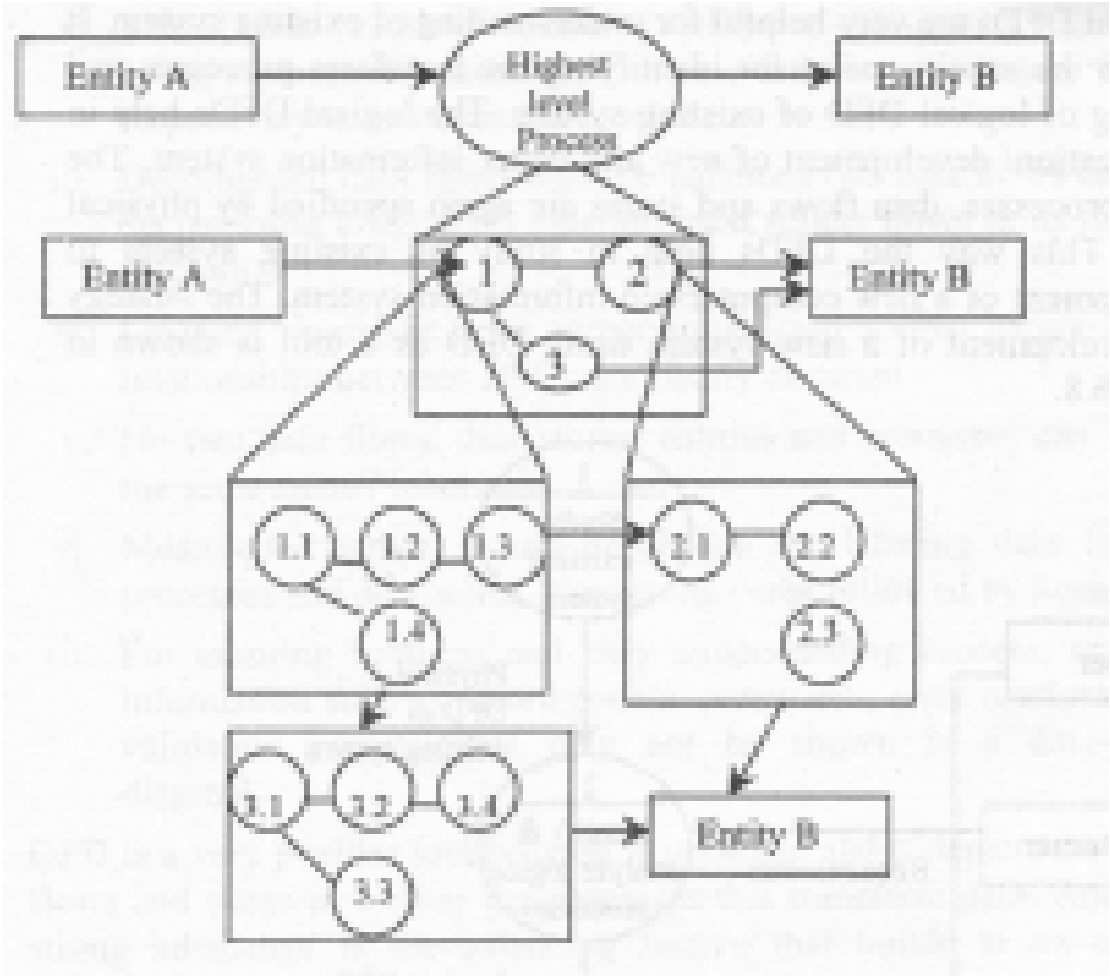


Fig 6 : The process of leveling DFDs is illustrated in figure 6.

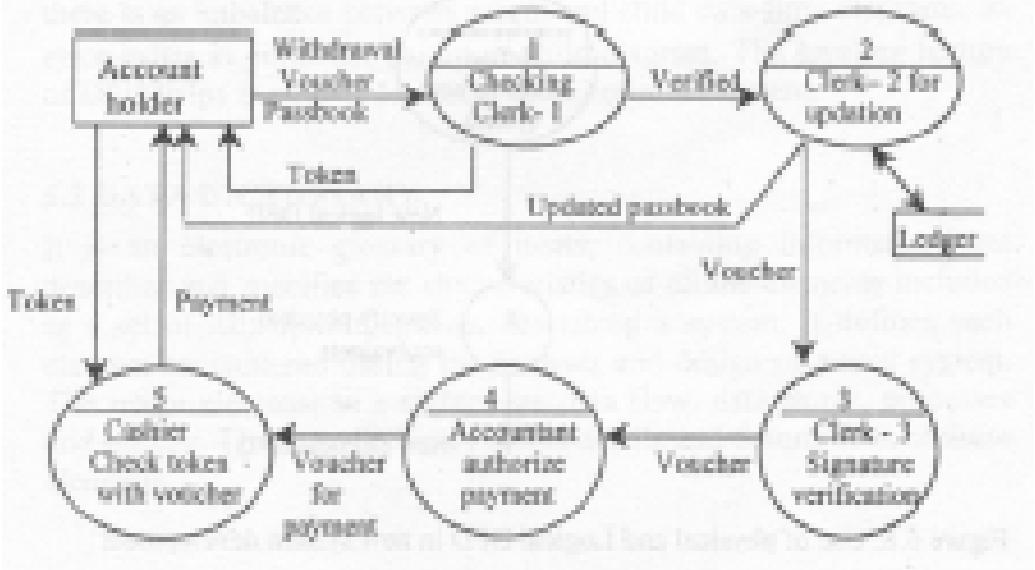
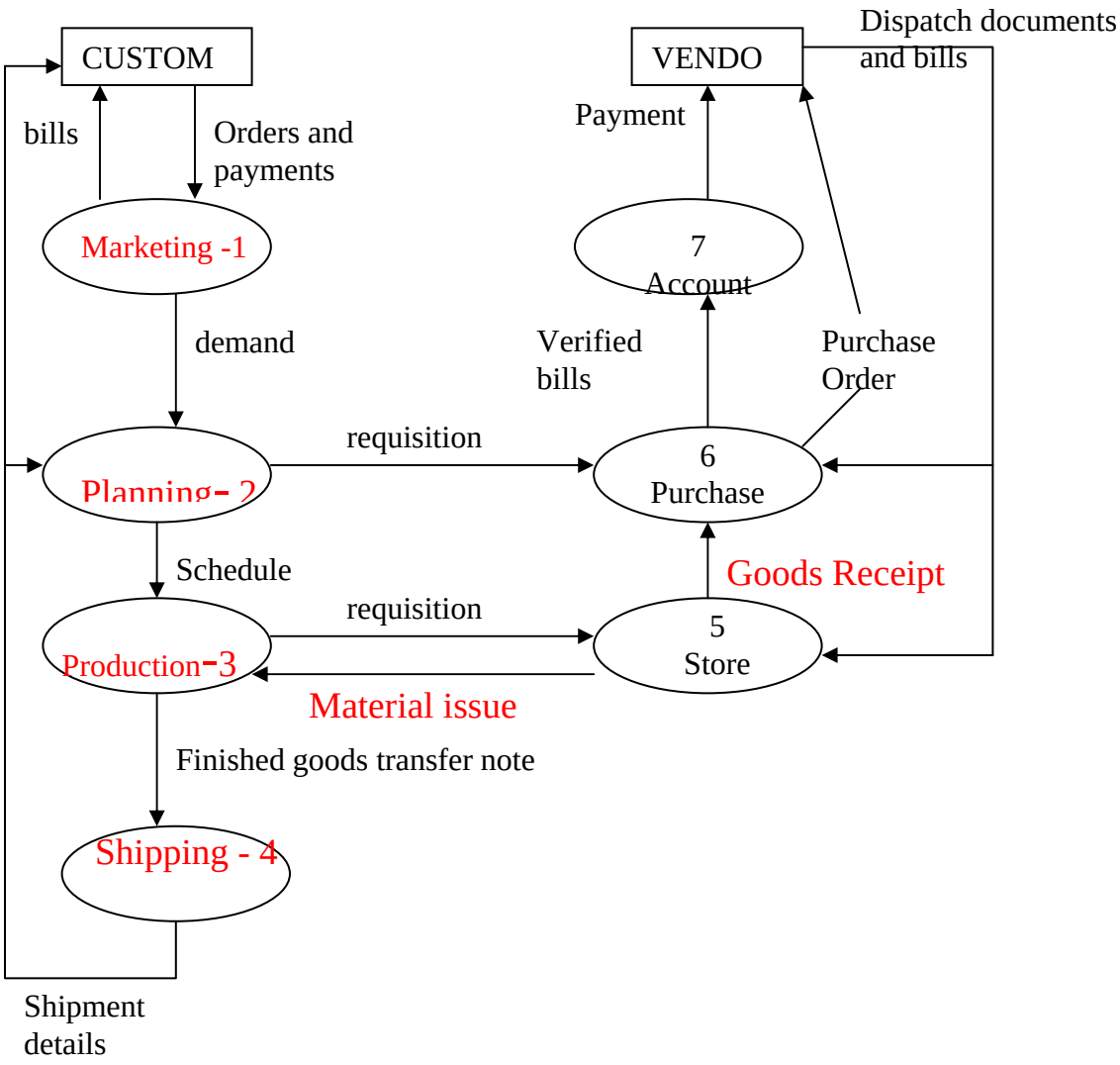
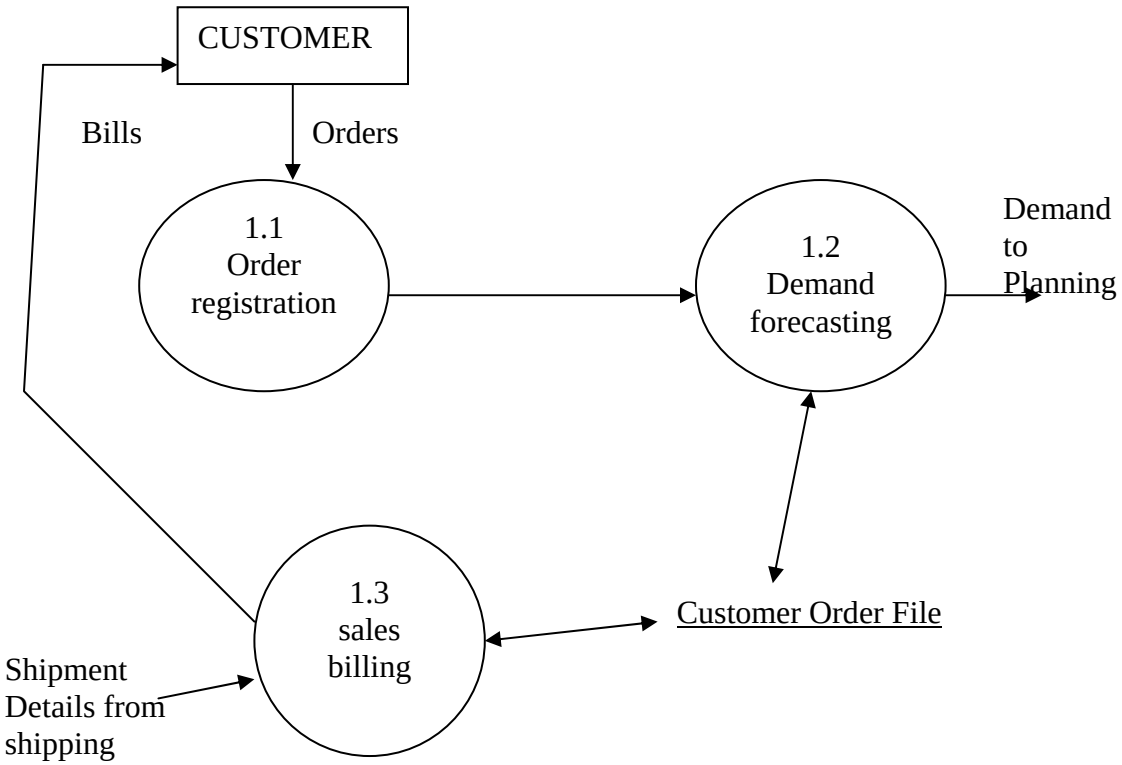


Fig 7 : An example of physical DFD

Example 3 :
Data Flow Diagram of Business Process : (Zero level)



Data Flow Diagram of Marketing Process : (First level)



CH - 9
System Analysis & Design

After identifying a particular approach for system development, system analysis and design phases start. System analysis is concerned with study of various operations to be performed by the system and their relationship within and outside the system. System design prescribes the technical specifications that will be applied in the chosen system. It also includes the construction of program and program testing.

SYSTEM ANALYSIS :

The basic objective of system analysis is to determine the feasibility of a system, and how it will meet the requirements of system users. Though in a typical system development life cycle, these activities are assigned to a system analyst, the current approach is to divide these activities among different teams having members with specialization in different fields. A system analyst is an information system expert having intensive knowledge of computer hardware and software. His major functions are defining requirements, gathering data, analyzing data, drawing up system specifications, designing system, and testing system. System analysis involves the following aspects of system development:

1. Feasibility study.
2. Requirement analysis.
3. Structured analysis.

FEASIBILITY STUDY

Feasibility study is the process of determining whether a system is appropriate in the context of organizational resources and constraints and meets the user requirements. The basic objectives of the feasible study are to identify whether the proposed system is feasible and will be more appropriate than the existing system. before the commitment of organizational resources to the system. At this stage, the system development team (often a team consisting of appropriate number of persons is constituted for system development rather than entrusting the job to a single system analyst) defines the problems or opportunities, establishes overall objectives of the system and defines the scope of the system. A feasibility study covers economic feasibility, technical feasibility, operational feasibility, and legal feasibility.

Economic Feasibility : Economic feasibility involves determination of whether the given system is economically viable. It is done through cost/benefit analysis of the system to identify whether the benefits are more than the costs. For a system to be economically viable, its benefits must be more than its costs.

Technical Feasibility : Technical feasibility analyses whether the proposed system is technically viable with the available hardware. Software, and technical resources. It centres around the existing technical facilities and the extent to which these can support the proposed addition. If additional technical facilities are required to implement the system, technical feasibility also takes into account whether the required technology is available in the market and is compatible with

the organization's existing technology. The technological risk involved in the technology to be acquired is also assessed.

Operational Feasibility : Operational feasibility, also known as behavioral feasibility, determines whether the proposed system will work effectively within the existing managerial and organizational framework. Often a new system faces resistance from people as they are inherently resistant to change while the new system requires change. It is a common phenomenon that computer installations have something to do with transfer, retraining, and job status of employees. Similarly, resistance may come from management too if the new system does not fit with the existing organizational policies relating to information systems. For example, if the new system requires distributed databases while the existing policy is to have a centralized database, the new system will face resistance from the management. Operational feasibility must take these factors into account while measuring the operational viability.

Legal Feasibility : Legal feasibility tries to ensure whether the new system meets the requirements of various information technology regulations, such as privacy laws, computer crime laws, software theft laws, malicious access to the data, international laws, etc. Government of India has formulated a comprehensive Act, known as Information Technology Act. 2000 that provides regulations for the use of information technology.

Steps in Feasibility Study

Many feasibility studies are disillusioning for both users and analysts. These studies often presuppose that when the feasibility document is being prepared, the analyst is in a position to 'evaluate solutions. Further, many studies tend to overlook the confusion inherent in a system development- the constraints and the assumed attitudes. With the result, such studies hardly serve the purpose of decision making. Therefore, in order to make feasibility study report meaningful for decision making a logical procedure must be followed which consists of the following steps.

1. Constitution of a Project Team : The objective behind constituting a project team is that future users of the system should be involved in its design and implementation. Their knowledge and experience in the operations area are essential to the success of the system. While a small project may not require a team but it is essential for larger projects or when the organization is switching from manual to computerized system.

The team may consist of system analysts and user staff. In some cases, even outside consultants and information system specialists may be included in the team. The team should have a project leader who may guide the other members as to how to proceed for the job.

2. Identification of Potential Candidate Systems : Keeping in mind the objectives for which a new system is required. Alternative candidate systems should be identified. All systems work on the principle of equifinality. This principle suggests that a system can reach the same final state from differing initial conditions and by a variety of paths. It implies that many information systems may be able to achieve pre-determined objectives though their

approaches may be different. Therefore, at this stage, a number of systems should be identified so that the project team has several alternatives to choose a system that best fits organizational requirements.

3. Identification of Characteristics of Candidate Systems : At this stage, the team identifies the various characteristics of candidate systems so that those systems that do not meet the initial selection criteria are eliminated as it is difficult and time consuming to have a detailed evaluation of large number of systems. These initial criteria may be in the form of volume of investment required, operational efficiency, organizational constraints etc. Only those systems that meet these initial criteria go to the next step.

4. Performance and Cost Evaluation : Detailed performance and cost evaluation is carried for those systems which pass successfully through the previous step. At this stage, performance of each system is evaluated against the performance criteria set before the start of the feasibility-study. Whatever the criteria may be set. there has to be as close a match as possible. Besides performance, each system should be evaluated in terms of costs too. The costs include all types of costs-cost of initial investment in additional hardware, software, and physical facilities, development and installation cost, cost of training, updating the software, documentation, and the recurring operating cost. In many systems, initial investment cost may be low but its operating cost may be high to offset the advantage of lower initial cost. This fact should be taken into account.

5. Weighing System Performance and Cost Data : Often performance and cost move in the same direction. that is.. if the cost is high. it is associated with high performance though it may not be true for all systems. Therefore, mere absolute figures of performance and costs are not sufficient to choose a system. This problem may be overcome by assigning certain weights to performance criteria and costs. For example, weights can be assigned to performance criteria like system accuracy, growth potential, response time, user friendly, etc. In the same way, weights can be assigned to different components of costs.

6. Selection of the Best System : Based on the weights assigned to different systems, the system may be selected that has the highest weight score. However, in actual practice, mere weight scores of different systems are *not* the sole criteria for selecting a system but other organizational factors like organizational policy to procure capital goods (hardware, software, etc. are capital goods), resource constraints, suppliers' reputation, etc. play important role in the selection of a system. Therefore, these factors should be taken into account. .

7. Preparation of Feasibility Report : When the feasibility study is complete the project team prepares a feasibility report on the basis of which management takes suitable action including the final selection of a system. After all, a project team can make only recommendations for a particular system and does not have authority to choose the system. Usually, a project report contains the following items:

A. Covering letter containing briefly the nature of the study, general findings, and recommendations.

B. Table of contents indicating location of various parts of the study.
C. Overview of the study indicating its objectives and reasons for undertaking it.
D. Detailed findings indicating the projected performance of the systems and costs involved.
E. Recommendations and conclusions suggesting the management the most beneficial and cost-effective system.
F. System design and implementation schedule indicating the time to be taken in completing various activities and the time by which the system becomes ready for operational use.
G. Appendix that may include documents, memos, and data compiled during the course of study.
Presentation of written feasibility report may be followed by oral presentation by key team members before management. During oral presentation, doubts about various aspects, if exist, can be removed. After the final decision about a system is made by management, subsequent activities proceed.

REQUIREMENT ANALYSIS
Requirement analysis is the most crucial stage of system analysis in which an analysis is done about who requires what information in what form and when. These three Ws are very important aspects because a system is meant for its users and not for designers and operators. Requirement analysis defines the scope of the system and the functions it is expected to perform. If the system is not designed according to information requirements, it will fail to achieve its objective in spite of choosing the best system.
What information is required by the end users of a system depends on the organization and its strategy to use information systems *for* generating competitive advantage. From this point of view, information requirements must be analyzed using strategic approach involving critical success factors, value chain, and competitive *forces* model. However, since managers might be using these approaches in their decision making, at this stage, the system development team might be more interested in analyzing how users do the job and what information they need for doing the job. For this purpose, the team may use a variety of tools to identify the requirements-procedures and forms used, on-site observation, interviews, questionnaires, and systems used in other similar organizations.

Procedures and Forms Used : Every organization uses certain procedures and forms in performing different functions. A procedure is a series of related tasks that make up the chronological sequence and the established way of performing the work .to be accomplished. If an organization has adopted the policy of formalization, various procedures are codified in a procedure manual. Information for completing a procedure can be found in the manual. However, before extracting the information from the manual, it is necessary for the project team to ensure that the manual is updated and reflects the present situation.
Like procedures, an organization uses different types of forms for conducting its operations. Printed forms are widely used for capturing and providing information.

The objective of getting information from forms is to understand how forms are used. The following questions in this context may be useful:
1. Who are users of the forms and how useful are these forms for them?
2. Do forms have all the necessary information? What items should be added, deleted or changed?
3. How many and what departments do receive the forms? What are the purposes of receiving the forms?
4. How does the information contained in a form help other users to make better decisions?

On-site Observation : Another method of gathering information for analysis is on-site observation. It is the process of recognizing and noting people, objects and occurrences to obtain information. The analyst's role is that of information seeker' and he is expected to be detached from the system being observed. The major objective of on-site observation is to get as close as possible to the system being studied. For this reason, it is important that the analyst is knowledgeable about the general makeup and activities of the system. The analyst should try to find out the answers of the following questions through on-site observation:
1. What kind of system is it and what does it do?
2. Who is responsible for running the system and who are other important persons involved in it?
3. What is the history of the system and how did it reach its present state?
4. What kind of system is it in comparison to other systems of the organisation?

Interviews : Information can be collected about the likely requirements through the personal interviews. Interview is a formal, in-depth conversation conducted to gather information about how the present systems work and what modifications are required in them. Interviews can be used for two main purposes-as an exploratory devise to identify relations or verify information and to capture information as it exists. In conducting an interview, the analyst should proceed in the following manner:
1. Setting stage for interview by explaining the purpose of interview and nature of information required.
2. Setting rapport with interviewees to seek as much information as possible.
3. Asking questions and initiating deliberations for seeking information.
4. Obtaining and recording information solicited through the interview.

Questionnaires : A questionnaire is a formalized written schedule containing different questions relevant to the object being studied. It obtains and records specified and relevant information with tolerable accuracy and completeness. A questionnaire can be directly administered by the analyst himself and gets the questionnaire filled himself on the basis of information provided by the respondent or can be administered indirectly by requesting the respondent to fill-up the questionnaire. Detailed questionnaires are quite useful for collecting quantitative information where the response size is quite small and the response is well structured.

Systems Used in Other Organisations : When the organisation for which a system is being developed, does not have specific and methodological systems.

information can be collected by studying the system of the similar nature. Information about such systems can be gathered from professional journals, consultants' reports, and other publications. However, while gathering information from these sources, it must be ensured that the information is relevant for the organization under study.

STRUCTURED ANALYSIS

In analyzing the present system and likely future requirements of the proposed system, the analyst collects a great deal of relatively unstructured data through procedure manuals, interviews, questionnaires and other sources. The traditional approach is to organize and convert the data through system flowcharts which support future development of the system and simplify communication with the users. However, a system flowchart represents a physical rather than a logical system. It makes difficult to distinguish between what happens and how it happens in the system. In order to overcome this problem, structured analysis is undertaken which is a set of techniques and graphical tools and allow the analyst to develop a new kind of system specifications that are easily understandable to the users. Structured analysis uses data flow diagram. Structured analysis has the following features:

1. Structured analysis is graphic that presents a picture of what is being specified and is a conceptually easy-to-understand presentation of the application.
2. The process used in structured analysis is partitioned so that a clear picture of progression from general to specific in the system flow emerges.
3. Structured analysis is logical rather than physical. It specifies in a precise, concise, and highly readable manner the working of the system.
4. In structured analysis, certain tasks that are normally carried out late in the system development are undertaken at the analysis phase. For example, user procedures are documented during analysis rather than in design or implementation phase.

SYSTEM DESIGN :

System design is the most crucial stage of system development process as the design determines the success or failure of the system. System design involves:
1. Reviewing the system's informational and functional requirements and
2. Developing a model of the new system, including logical and physical specifications Of outputs, inputs, processing, storage, and procedures. Before we proceed to the designing of outputs, inputs, storage, processing. and procedures, it is worthwhile to go through the concept of and activities involved in logical and physical design. Figure 1 presents logical and physical design of a system.

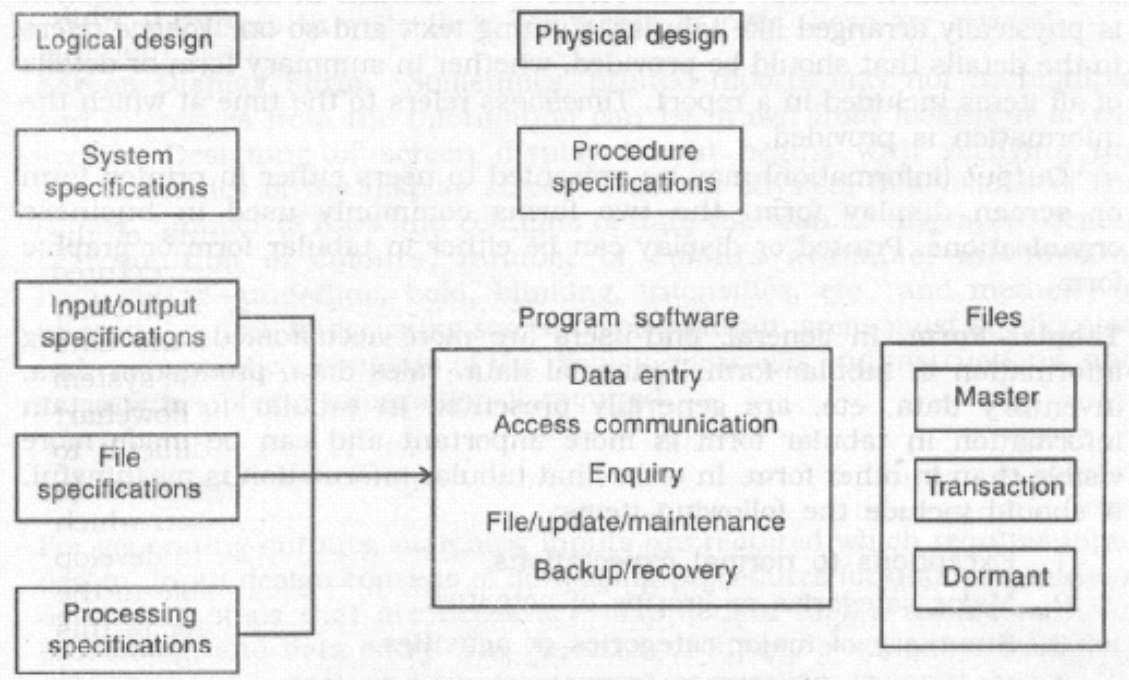


FIGURE. 12.1: Logical and physical design

Logical Design. Logical design, also known as conceptual design, lays out the components of the system and their relationship to each other as they appear to users. It shows what the system will do as opposed to how it is actually implemented physically; It contains input/output specifications, file specifications, and processing specifications. Input/output specifications describe the forms in which input data will be required and the forms in which outputs will be presented to users. File specifications describe the way in which various files will be organized. Processing specifications describe the mode of data processing. .

Physical Design. Physical design, also known as detailed design, translates the abstract logical design into specific technical design for the new system. It includes details of output design, input design, data storage design, processing design and procedure design. Physical design follows logical design as this stage converts the specifications developed at the logical level into specific technical design.

Output Design

Computer output refers to any information generated by a system whether printed or displayed. In fact, the main objective of a system is to generate information in a form which users can use. At the system analysis stage, the system development team identifies the outputs the proposed system should produce in order to satisfy the information requirements of the users. In designing outputs, the factors that should be considered are content, form, format, volume and timeliness. *Content* refers to the actual pieces of information that should be provided to users. *Form* refers to the way in which the information is provided like

text, graphics, visual, audio, or a combination of these. Format refers to the manner in which information is physically arranged like tabular, running text, and so on. *Volume* refers to the details that should be provided, whether in summary form or details of all items included in a report. *Timeliness* refers to the time at which the information is provided. Output (information) may be presented to users either in printed form or screen display form, the two forms commonly used in business organizations. Printed or display can be either in tabular form or graphic form.

Tabular Form: In general, end-users are more accustomed in receiving information in tabular form. Financial data, sales data, production data, inventory data, etc. are generally presented in tabular form. Certain information in tabular form is more important and can be made more visible than in other form. In order that tabular information is meaningful, it should include the following items :
1. Exceptions to normal expectations.
2. Major categories or groups of activities.
3. Summary of major categories or activities.
4. Unique identification information.
In the output design, tabular output should ensure the above items.

Graphic Form : In graphic form. information is presented in the form of charts. Diagrams, bars, etc. which not only provide visual appeal but also ease the process of drawing inference from the information. For example, how much growth a business organization has achieved during the successive periods can be presented by bars where comparison can be made easily. Similarly, various components of cost of production can be shown by pie chart for meaningful inference.
Printed Form : Tabular and graphic presentation of information may be either in printed form or screen display form. Both require certain specific layout. A layout is the arrangement of items on the output medium. In preparing the layout of a printed report or document, certain guidelines should be followed:
1. Reports and documents should be designed to read left to right and from top to bottom.
2. The most important items of the report should be highly visible to locate.
3. Report/document should contain title. date of preparation, page number and column headings.
4. Each data item should have a heading which should be short but descriptive. Data items that are related to each other should be grouped together in the report.
5. Control breaks should be used in the report to increase readability.
Control break reports are those in which repeating columns can be grouped together and exceptions can be highlighted.
6. Sufficient margin should be left on all sides of the report to enable the users to write their comments in case these are needed.
Screen Display Form : Sometimes. printed reports may not be required and inferences from the information can be drawn from looking it at the screen.

Designing of screen display layout begins with verifying the characteristics of the display screen. such as physical dimensions of the screen, number of rows and columns of data that can be displayed, degree, of resolution of colours, number of colours available, methods of highlighting-underline, bold, blinking, intensities, etc., and methods of intensity control. In designing screen display output, areas must be allocated to headings/titles, contents of the display, messages and instructions and explanation of the information if required.

Input Design

For generating outputs, matching inputs are required which requires input design. Input design consists of developing procedures for data preparation, developing steps that are necessary to put data into a usable form for processing. and data entry. The objective of input design is to make data entry as easy, logical, and free from errors as possible. In input design, the focus is on computer operators and not on end-users. In entering data, operators need to know the following:

1. The allocated space for each field in the computer memory.
2. Field sequence which must match that in the data source.
3. The format in which the data fields are entered, for example, filling out the date field requires edited format-mm/dd/yy or dd/mm/yy.

In input design, many of the issues that are involved in output design are also involved here, such as content, form, volume, timeliness, etc. For capturing input data. different devices can be used, such as keyboard, online entry without using keyboard, and source data automation-scanners, voice input devices and sensors. The input design should take these devices into consideration. When keyed input system, which is most common, is used, it requires form design, coding, and data entry.

Form Design : Forms are printed papers that are filled by those persons who supply the information. Since forms are used as data source, these must be designed properly. In designing forms, following guidelines should be followed:

1. Contents of the form should be in the same sequence in which the data are entered in the computer.
2. Forms should be divided in logical sections. such as headings, identification and access, instructions, body, comments, verification, and signature with date.
3. Forms should be created to serve one or more purposes in recording, processing, storing, and retrieving information for various businesses.
4. Forms should be designed in such a way that these ensure correct and speedy completion.

Coding : Coding is the process of assigning codes to lengthy descriptions. A code is a brief number, title, or symbol that denotes a particular description. Coding is required because a computer has limited memory and if detailed descriptions are used for inputs, they will occupy memory unnecessarily. For example, instead of using business-to-business as input, its code B2B is used as input, or business-to-consumer is coded as B2C, and so on. Although coding methods may exist in manual system also, it is usually necessary to modify these

to suit computer capabilities since human beings can work with bad and unorganized coding but not the computer.

Designing Data Entry : Designing of an efficient data entry method is a pre-requisite for the system being successful. To the extent data entry can be made automatic, there would be speed and accuracy. While keyed data input is more common, other source data automation devices, such as magnetic ink character recognition (MICR) device, optical character recognition (OCR) device, pen-based input device, etc. can be used for data input. Apart from using various devices to improve the quality of data entry, input validation can also be used for this purpose. The system designer may assume that data entry errors will occur.

Storage Design

In every information system, data storage is required for concurrent use as well as for future use. There can be two approaches for designing data storage system. *First,* data can be stored in individual files with one file for each application. *Second,* a database can be developed which can be shared by different users as the need arises. Further, database can be either centralized or distributed. While a file system may be more effective because separate files are designed for specific programs, this method tends to create data redundancy. Therefore, this method is more suitable for smaller organizations having limited number of applications. In larger organizations, where the number of end-users is quite large and computer networking system is followed, database method is more appropriate. This method allows different users to use data in different forms.

Processing Design

Processing design focuses on the design of software resources, that is, the programs needed by the proposed information system. It involves developing detailed specifications for the program modules. Processing design produces detailed program specifications to meet user interface. Processing design must also produce specifications that meet the control and performance requirements developed in the analysis stage. Software to be used for data processing may be either developed in-house or can be procured from the market depending on the information technology capability of individual organizations.

Procedure Design

Procedure design specifies how the computer will function from data entry stage to output stage. The procedure indicates the logic of data processing and flow of the system control step by step. The steps in the procedure are shown in the computer system flow chart. The broad steps in the procedure are as follows:

1. Data entry-as per the input design specifications.
2. Data validation-as per the data validation specifications controlling data errors and absence of required data.
3. Transaction validation-preventing the entry of wrong transactions.

4. Edit and update-completing records before data processing through data editing and updating.
5. Data processing-sorting. merging. collating. and computing data.
6. Output processing-indicating whether output is to be printed, displayed, or stored.

Documentation

After completion of system analysis and design, documentation is required. Documentation describes how an information system works from both a technical and end-user standpoint. It is a written record of different phases of a system development and establishes design and performance criteria *for* these phases. Lack of proper documentation often leads to system failure. Therefore, documentation should be done carefully. Since, documentation provides detailed procedures of how a system works, such procedure should be prescribed for all types of personnel who come in contact with the system. These personnel are end-users, secondary users, computer operating personnel, and trainers.

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CHAPTER 10

Information Systems in Functional Areas

Every information system requires certain objectives; inputs, outputs, process and database. All these parameters have to be identified for the design of each information system. Therefore, the block diagram of a typical information system will be as follows:

1. OBJECTIVES
2. INPUTS
3. PROCESSES
4. OUTPUTS
5. DATABASES

1. PRODUCTION CONTROL SYSTEM

Production is based on three M's such as:

Man power
Equipment (Machine)
Material

These things are basic requirements for any production till it has been completed.

Objective :
The objectives of the production control system are as follows :
i. To ensure that sufficient stock is available.
ii. To expand orders into material requirement, determine production process required and work out a production schedule.

Inputs :
The necessary inputs to the system are as follows:
i. Data on customer orders
ii. Production availability
iii. Production stock availability
The various input documents are as follows :
i. Current stock list
ii. Stock on order
iii.Demand forecast
iv. Re-order list

Process :
The production control system will look like figure 1.

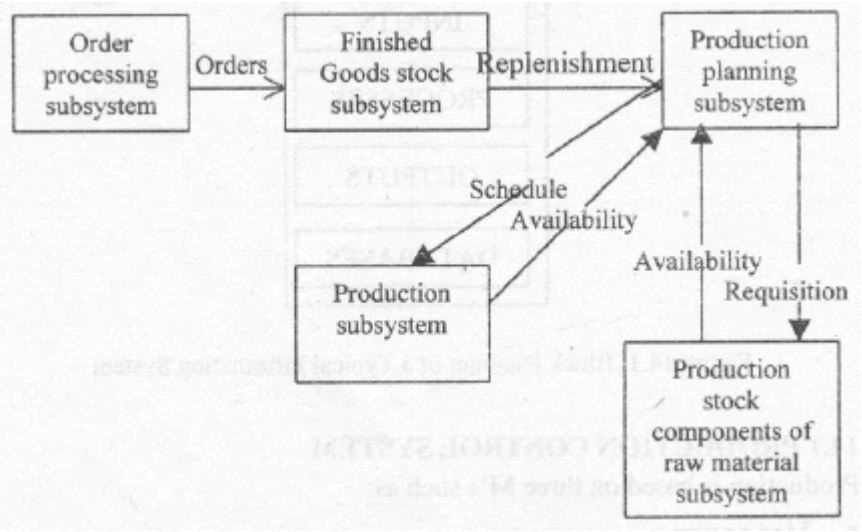


Figure 1 : Production Control System

The Order processing subsystem sends orders to the finished goods stock subsystem, which in turn intimates the Production planning subsystem if the stock level is low. If the Production planning subsystem asks for raw materials to Production stock subsystem and sends a production schedule to Production subsystem.
The information system needs to know a lot about the following :
i. Forecast demand
ii. Methods of production
iii. Resources required
iv. Timing of processes

Databases:
The detail record layouts can be given as follows:

FILE NAME	FILE TYPE	PROCESSING MODE	FIELD NAME	RECORD KEY
Stock file	Master file	Batch	Stock item code Item description Quantity in stock Supplier Details Price Re-order level Re-order quantity.	Stock item code
Order file	Transaction file	Batch	Order no. Agent no. Stock item code Qt. Ordered Total price	Stock Item Code
Job file	Master file	Batch	Stock item code Item description Material cost Labor cost Overhead cost Total cost	Stock item code

The two databases are required for the production control systems, which are shown as follows:
i. Stock file (Master file) : This gives the inventory available.
ii. Order file (Transaction file) : This gives the detail about customer's orders.
iii. Job files (Master file): This gives the detail about the production done.

Outputs:
The various outputs are as follows :
i. Material requisitions to stock subsystem
ii. Production schedule to production subsystem
The detail output reports are as follows ;
i. Material requisition report
ii. Production schedule report
iii. Production cost report

2. INVENTORY CONTROL SYSTEM
The unfinished, semi finished and finished products are called "stock". The usable things are called inventory. The term inventory refers to the stockpile of product a firm is offering for sale and components that make up the product. In other words, inventory is composed of assets that will be sold in future in the normal course of business operation. Inventory is expensive. It is also essential. The important thing is that in hand. It shouldn't be much more or much low. Therefore it is needed to control the stock. Inventory control is often the data processing application that provides the greatest potential benefit of a company.

Objectives :
The objectives are as follows :
i. To provide high quality service to customers by utilizing a fast, accurate and efficient method of filling customer order and avoiding stock-out.
ii. To keep the amount of money invested in inventory required covering inventory changing cost as low as possible.
iii. To provide management with information needed to assist or achieve the two proceeding objectives.

Inputs:
The necessary inputs for the inventory control system are as following
i. Accepted order data
ii. Transaction data
iii. Data describing stock received by the receiving dept.
iv. Miscellaneous Transaction data

Process:

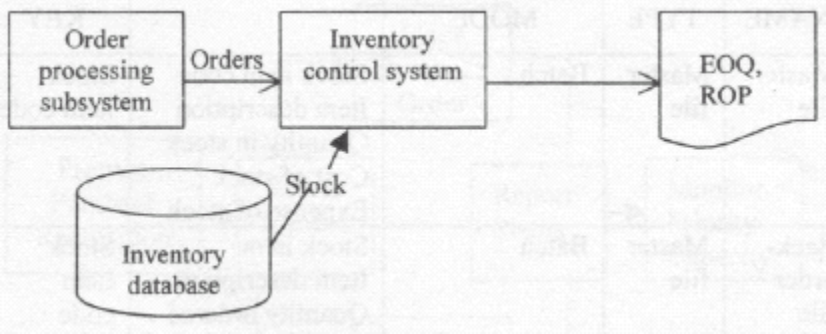


Figure3: Inventory Control System

A firm should place neither too large nor too small orders considering the benefits derived from an inventory and the carrying cost of it. An optimum level of the orders to be placed should be determined. The optimum level is popularly known as Economic Order Quantity. EOQ is defined as that level of inventory order that minimizes the total cost associated with inventory management.
Reorder point (ROP) is stated in terms of the level of inventory at which an order should be placed with the suppliers for replenishing the current stock of inventory.
Clearly the information system needs to know a lot about the following :
i. demand forecast
ii. expenses on availability

Outputs:
The general outputs of inventory control systems are as follows:
i. Economic Order Quantity (EOQ)
ii. Recorded.point (ROP)

Databases:

The two databases required for the inventory control systems are as follows:
i. Master file: This gives relatively permanent data regarding the various transactions with the customers.
ii. Back-order file: This gives the necessary information regarding the unfilled customer's order.
The detail record layouts of the files are as follows:

FILE NAME	FILE TYPE	PROCESSING MODE	FIELD NAME	RECORD KEY
Master file	Master file	Batch	Stock item code Item description Quantity in stock Cost of stock Expense of stock	Stock item code
Back-order file	Master file	Batch	Stock item Item description Quantity ordered Cost of quantity	Stock Item code

3. PURCHASE INFORMATION SYSTEM

Purchasing department is one of the vital points of the industry because it controls the purchase made in the organization. A mass production organization which needs a continuous flow of material require a dynamic purchase department, which acts as a mediator between the industry and the supplier. Purchasing means supply of materials, machinery and servicing needed for production and maintenance of the industry.

Objectives:

The main objectives of purchase information system are:
i. To purchase the right material
ii. To purchase material in right quantity.
iii.To obtain material of right quality
iv. To process reliably
v. To purchase material at economic cost.
vi. To receive material at right time.

Inputs:

The inputs are:
i. Material requisition report
ii. Previous cost of materials

Process:

Based on the material requisition report, the Purchase department gives orders to the suppliers. The suppliers are selected based on the lowest quotation and quality of materials. Therefore, the information system needs to know a lot about the following:
i. Material cost
ii. Material quality

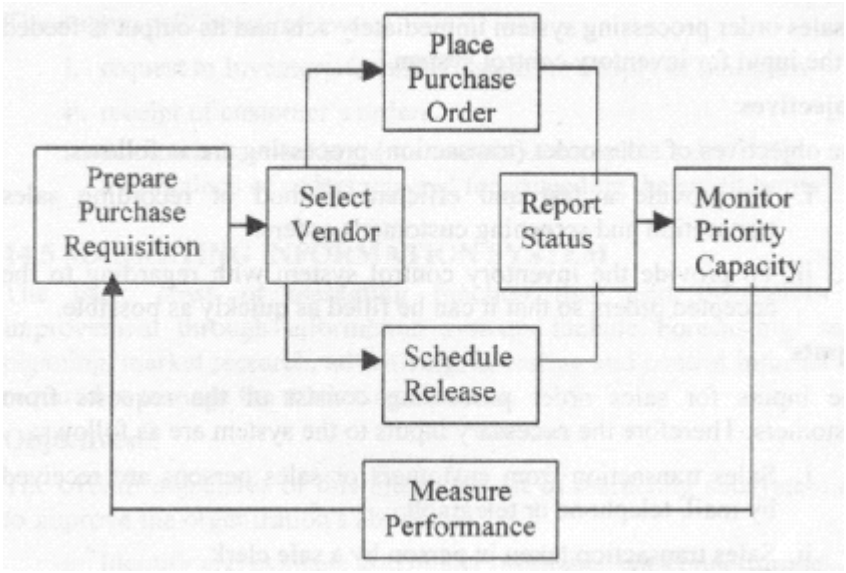


Figure 4: Purchase Information System

A purchase requisition is prepared and vendors are selected accordingly. Purchase order preparation and release of schedule follow this. A status report is prepared and based on capacity monitoring again a purchase requisition is prepared.

Outputs:

The outputs will be as follows:

i. Purchase ledger update

ii. Supplier listing

Database:

The only database is the stock containing the detail transaction with the suppliers.

FILE NAME	FILE TYPE	PROCESSING MODE	FIELD NAME	RECORD KEY
Stock file	Master file	Batch	Stock item code Item description Suppliers no Supplier names & address Price Reorder level Reorder quantity	Stock item code

4. SALES ORDER PROCESSING INFORMATION SYSTEM

A sales order processing system immediately acts and its output is feeded as the input for inventory control system.

Objectives:

The objectives of sales order (transaction) processing are as follows :

i. To provide a fast and efficient method of recording sales transaction and screening customer's orders.
ii. To provide the inventory control system with regarding to the accepted orders so that it can be filled as quickly as possible.

Inputs:

The inputs for sales order processing consist of the requests from customers. Therefore the necessary inputs to the system are as follows :
i. Sales transaction from customers or sales persons are received by mail, telephone or telegraph
ii. Sales transaction taken in person by a sale clerk
The various input documents are as follows:
i. sales receipt or sales order forms manually or computerized
ii. optical character recognition (OCR)

Process:

The sales order processing first check the input data for accuracy. Then it intimates the inventory control system about the orders that can be executed.

Database:

The sales order (transaction) processing system utilizes the database customer's master file.

FILE NAME	FILE TYPE	PROCESSING MODE	FIELD NAME	RECORD KEY
Customers file	Master file	Batch (Daily)	Order no. Customers no Customer's address & details Stock item code Quantity Ordered Total price	Order no

Outputs:

The outputs will be as follows:
i. request to Inventory Control System for supply of materials
ii. receipt of customer's orders.
iii. acknowledgement to customers about complete sales transactions or orders rejected for exceeding the credit limits.

5. MARKETING INFORMATION SYSTEM :

The basic areas of marketing function that lend themselves to improvement through information systems include Forecasting, sales planning, market research, advertising, operating and control information required to manage the marketing function.

Objectives:

The overall objectives of this integrated set of marketing subsystem are to improve the organization's ability to:
i. Identify and evaluate potentially profitable sales opportunities.

ii. React rapidly to changes in market conditions
iii. Establish profit-maximizing product prices
iv. Control marketing costs
v. Deploy sales personnel most effectively
vi. Assist in allocating expenditures for advertising and other forms of promotion.

Inputs :

The various inputs are
i. Customer invoices
ii. Annual reports (customers, suppliers etc)
iii. Competitor share value
iv. Competitor product price
v. Dealer sales transaction
vi. Sales forecasts
vii. Sales expenses
viii. Marketing budgets
ix. Cost reports
x. Inventory reports
xi. Warehouse reports
xii. Manufacturing cost
xiii. Accounts Receivable
xiv. Accounts payable
xv. Payroll(marketing)

Process :

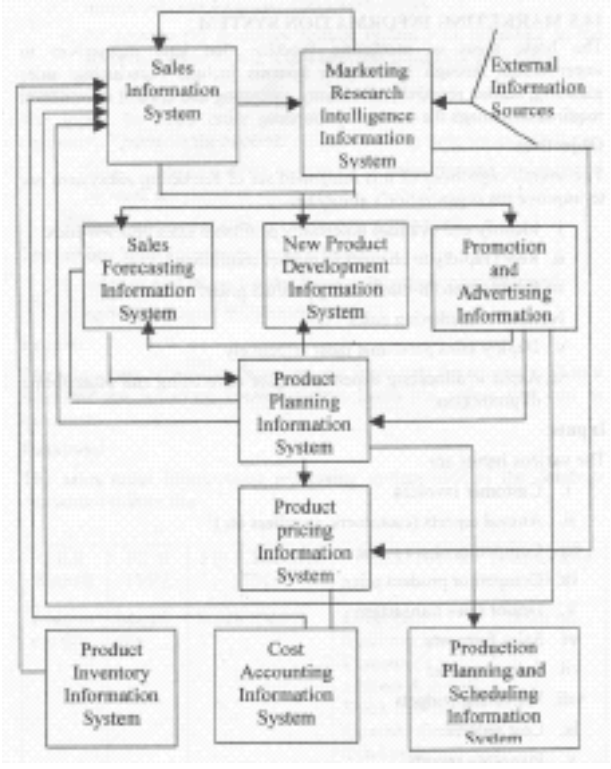


Figure 5: Information Flows within the Marketing System

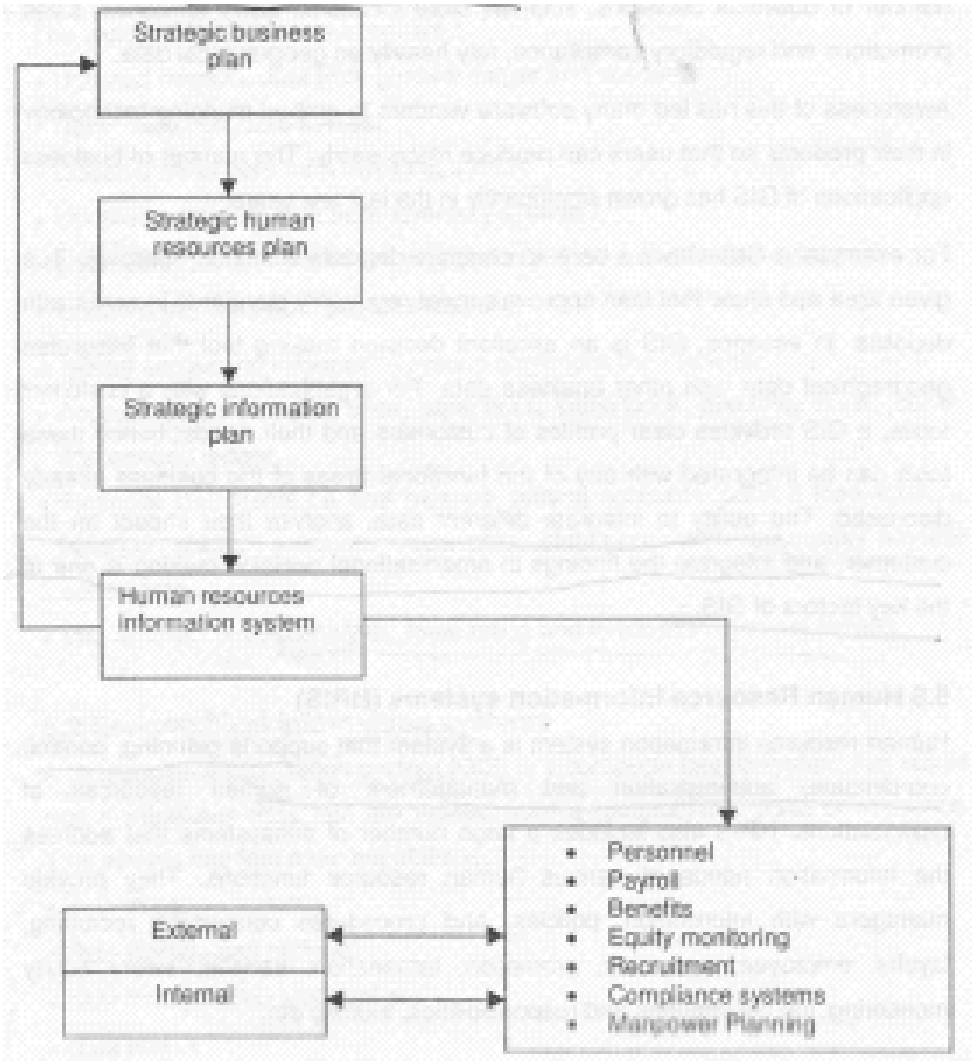
The major sources of information for these activities are :
i. Sales invoices and other transactions information
ii. Salespersons' customer call reports
iii. Salespersons' debriefing by marketing managers
iv. Sales history files
v. Customer account files
vi. The cost accounting system
vii. The profit planning (budgeting) system
viii. Market research and intelligence-gathering activities.
ix. Sales forecasts
x. Production schedules
xi. Inventory status reports.

Outputs:
The various outputs are :
i. Sales recap: An overall performance summary to date, compared with previous periods, budgets or other standards. Major areas of performance analysis might include total sales by product, sales expense, new accounts, and variety of profitability analysts, market share.
ii. Record summaries: Sales by model, by sales plan, by industry, by customer type.
iii. Transaction analysis: Transactions defined in terms of dollar volume, no of sales etc.
iv. Exception inquiries: Any inquiry.

6. Human Resource information systems (HRIS) :
Human resource information system is a system that supports planning, control,

coordination, administration and management of Human resources of organizations. HRIS also includes a large number of subsystems that address the information needs of various human resource functions. They provide managers with information, policies, and procedures concerning recruiting, layoffs, employee evaluation, promotion, termination, transfer, salary equity monitoring, job descriptions and responsibilities, training etc.

Since HRIS also facilitate vital information on matters such as payroll, central and state taxes, health benefits, child care, grievance procedures, and other personal information that affects the employees personal and professional lives, it is imperative that these systems be highly responsive to employee needs. The HBIS is derived from the strategic business plan, the strategic human resources plan, and the strategic information plan as shown below.



Some subsystems within the HRIS are personnel data, payroll, benefits, administration, equity monitoring, processing job applications, monitoring

positions, training and development, safety, employee compensation, union negotiations and collective bargaining. The core of an HRIS is a database that contains detailed personal and professional information about each employee in the organization. Personal data include name, age, gender, address, and social security number; professional data include educational level, job title, job description, department code, years of employment. Number of promotions, performance evaluations and so on. All other human resource subsystems derive their information from this core database.

An important subsystem of the HRIS is the compliance system, which closely tracks and monitors the organizations record of compliance with government, laws and regulations, such as affirmative action, equal employment opportunities and others. In the last two decades, the amount of regulatory paperwork has increased manifold and organizations are actively looking for ways to cut down the time and money they spend on these activities. One way to achieve this objective is through compliance subsystems.

Another vital HRIS subsystem manages records and generates information regarding recruitment, transfer, promotion, layoff and termination of employees. Often, when any of the above situations occur, a large amount of information is generated and the organization needs a system that processes it. As the number of lawsuits for improper hiring, promotion and firing policies increases, accurate and timely record keeping becomes even more important.

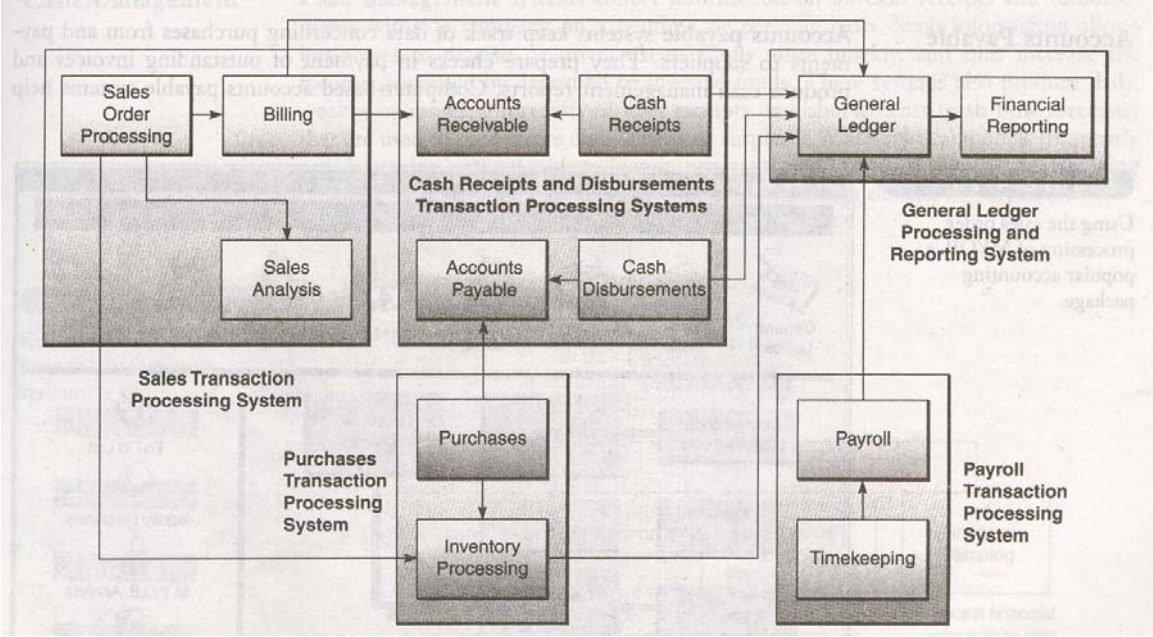
Other subsystems of the HRIS include systems that develop and maintain job and job descriptions for all jobs in the firm, compensation and benefits information systems, and manpower planning systems. A performance appraisal system that provides employees with real-time' information or corporate performance measurements, thus making continuous performance improvement a way of corporate life rather than an annual chore, is another important subsystem in an HRIS. Pre testing, compensation policies, ensuring that employees meet certification requirements, identifying problem areas in employee turnover, and providing training and employee empowerment programs are some other functions of an HRIS.

7. Write a note on Accounting information systems ?

Accounting information systems-are used for the financial activities that take place in any organization. These include the operation of sales order processing systems, payroll, budgeting and reporting of the financial condition of the organization. Other functions include the management of capital investment and general cashflow management.

. *Operational accounting systems* focus on daily recording of business transactions, that is, the flow of funds through an organization. All businesses require this basic information. In larger businesses these systems will be linked to other operational functions, such as sales order processing and inventory.

. *Management accounting systems* enable planning and control of business finance. These are sometimes referred to as financial information systems and will be linked to executive information systems.
Application areas for accounting information systems Most companies use an integrated accounting system that covers a number of application areas, as shown in Fig 6.25. ,The essential modules are accounts receivable, accounts payable and the general ledger. Many companies will look to extend these to related areas such as sales order processing and payroll.



. *Sales order processing.* The SOP system is particularly important, as it records sales transactions and supplies documents to other areas such as stock control and manufacturing. There might also be links to payroll to calculate such elements as bonus payments to sales people on receipt of a customer order. The accounts receivable system contains customer information such as sales made, payments made and account balances for overdue payments. These can be used to halt the extension of further credit until the balances have been cleared. The system may also be searched to identify lists of customers who have purchased certain items, which is then used as the basis for a mailing list for promotional purposes. The accounts payable system contains information regarding the firm's creditors (as opposed to customers for the accounts receivable). The system provides information on which a schedule of supplier payments can be made and thus ensures that payments can be made as late as possible (to optimize cashflow) without losing discounts offered from suppliers for prompt payment.
. *Inventory.* The inventory system maintains stock levels by recording when stock is used for sales orders. A reorder point (ROP) system will generate an order for stock once the level of a stock item falls below a number of units. Other time-based systems will replenish stocks after a predetermined time interval.

. *Payroll.* The payroll system processes payments to employees, "including deductions for such items as National Insurance and income tax. Many organizations will have electronic links to banks for direct deposit to employee accounts rather than issuing pay cheques.

. *Budgeting systems.* Budgets are an important control tool for management. A predetermined budgeted amount is periodically compared to the actual expenditure and any difference noted as a variance. This comparison of allocations (budgeted amounts) against actual (amounts spent or received) can be reported to management. The identification of a variance will normally instigate a discussion and may lead to corrective action being taken to eliminate any adverse variance.

Budgets for areas or departments can be aggregated or brought together to form a functional or organizational budget statement for higher-level decision making.

+ *Cashflow reporting.* A major cause of business failure is inadequate cash reserves to keep the organization functioning. Cashflow reporting is necessary to keep track of the organization's cash reserves. Cash is needed for working capital (day-to-day expenses) and for the purchase of long-term assets such as plant or machinery. A cashflow report will contain a running total of the cash balance from information on cash inflows and outflows for each reporting period. An adverse cash position may necessitate the deferring of a planned acquisition. The report can be used as a planning tool by incorporating different cost and revenue scenarios and studying the results.

+ *Capital budgeting system.* The financial system should contain tools which allow for the evaluation of capital spending plans. Major investments are compared to the financial return that the organization could have gained from placing the cash in a bank account and accruing interest. The investment evaluation may also inform the decision to buy or lease equipment. Financial measures often used to assess an investment include net present value (NPV), internal rate of return (IRR)and payback period.

+ *Financial analysis system.* Financial analysts use a variety of performance measures to gauge the financial position of an organization. These include such measures as the current ratio, inventory turnover and earnings per share (Dyson, 1997). An information system can be used to generate these values automatically using figures stored in a database of such items as current assets and current liabilities.

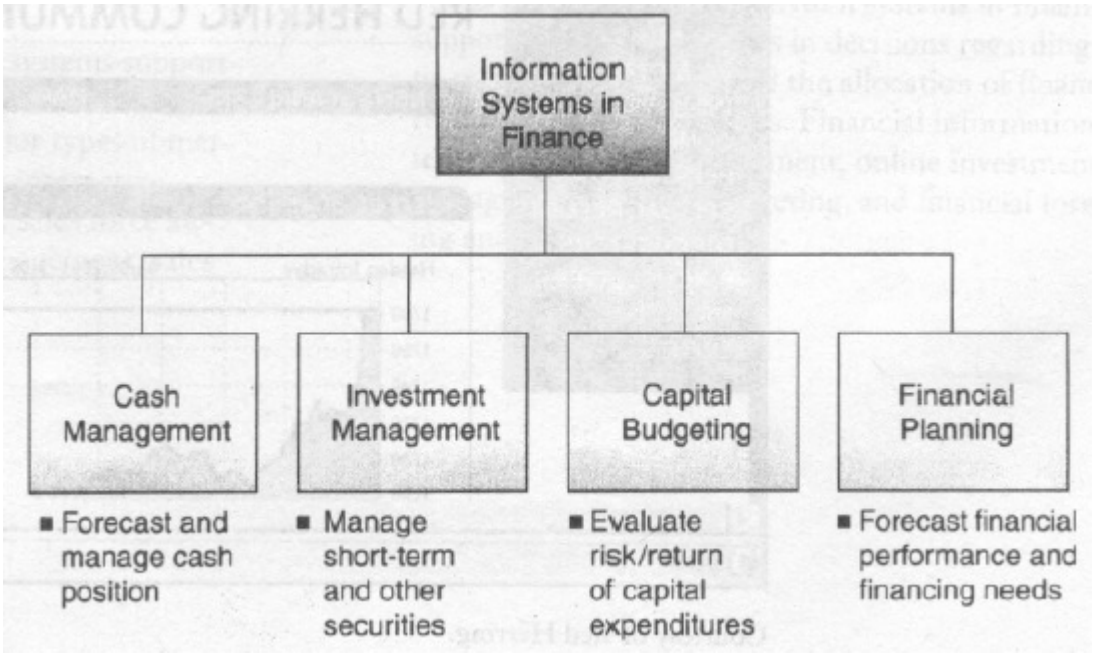
+ *Forecasting systems.* By projecting budget statements into the future, an organization is able to forecast the potential financial state of the organization. These forecasts will need to incorporate economic and market forecasts in order that sales and cost data can be estimated.

9. Write a note on Financial Information System ?

Computer-based financial management systems support financial managers in decisions concerning (1) the financing of a business and (2) the allocation and control of financial resources within a business. Major financial management

system categories include cash and investment management, capital budgeting, financial forecasting, and financial planning.

Cash management systems : These collect information on all cash receipts and disbursements within a company on a realtime or periodic oasis. Such information allows businesses to deposit or invest excess funds more quickly, and thus increase the income generated by deposited or invested funds. These systems also produce daily, weekly, or monthly forecasts of cash receipts or disbursements (cash flow forecasts) that are used to spot future cash deficits or surpluses. Mathematical models frequently can determine optimal cash collection programs and determine alternative financing or investment strategies for dealing with forecasted cash deficits or surpluses.



Investment Management : Many businesses invest their excess cash in short-term low risk marketable securities or in higher-return/higher-risk alternatives, so that investment income may be earned until the funds are required. The portfolio of such securities can be manage with the help of portfolio management software packages. Investment information and securities trading are available from hundreds of online sources on the Internet and other networks. Online investment management services help a financial manager make buying, selling, or holding decisions for each type of security so that an optimum mix of securities is developed that minimizes risk and maximizes investment income for the business.

Capital budgeting : This process involves evaluating the profitability and financial impact of proposed capital expenditures. Long term expenditure proposals for plants and equipment can be analyzed using a variety of techniques. This application makes heavy use of spreadsheet models that

incorporate present value analysis of expected cash flows and probability analysis of risk to determine the optimum mix of capital projects for a business.

Financial Planning : Financial analysts typically use electronic spreadsheets to evaluate the present and projected financial performance of a business. They also help determine the financing needs of a business and analyze alternative methods of financing. Financial analysts use financial forecasts concerning the economic situation, business operations, types of financing available, interest rates, and stock and bond prices to develop an optimal financing plan for the business. Electronic spreadsheet packages, DSS software, and Web-based groupware can be used to build and manipulate financial models. Answers to what-if and goal-seeking questions can be explored as financial analysts and managers evaluate their financing and investment alternatives.

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CH – 11

SYSTEM IMPLEMENTATION & MAINTENANCE

System implementation has different meanings, ranging from the conversion of a basic application to a complete replacement of the existing system. Therefore the activities involved in system implementation vary. There are basically three types of implementation:
1. Implementation of a computer system to replace a manual system which requires acquisition of computer hardware and software, file conversion, creating accurate files, and user training.
2. Implementation of a new computer system to replace an existing one like from mainframe to a network of microcomputers or independent computing to client/server computing.
3. Implementation of a modified application to replace an existing one using the same computer.
A broad view of system implementation involves hardware acquisition, software acquisition, Installation, Conversion, user training, and post-implementation evaluation. It also involves managing resistance to change if the organization.

1. HARDWARE ACQUISITION :

The type of hardware that is required for implementing a system is specified in system analysis and design documentation. After the specifications are made available, the particular type of computer may be chosen for acquisition. There are mainly three types of computers-mainframe, minicomputer, and microcomputer-that are used by business organizations. Though each of these computers has its own pros and cons, there is increasing emphasis on the use of microcomputers because of their low prices and increasing processing capabilities. Therefore, many organizations prefer to acquire microcomputers or a network of microcomputers instead of acquiring mainframes or minicomputers. In acquiring a computer, an organization has to evaluate its performance as well as its vendors' performance and to decide the methods of acquisition.

Hardware Evaluation :

For acquiring a computer hardware. two aspects are evaluated-hardware capability and vendor capability. For evaluating hardware, information may be collected from different sources-vendors' catalogues, other publications, and current users of the same hardware. After collecting the information from different sources, the evaluation is generally made by a committee consisting of technical experts and users. The committee evaluates hardware in the light of certain pre-determined criteria. For using these criteria in evaluation, three approaches can be adopted-ad hoc approach, scoring approach and cost-value approach.

Ad hoc approach : Ad hoc approach is the least methodological and uses personal opinions, including biases to a particular hardware of evaluation committee members. Members may be inclined to a particular hardware based

on their observations of functioning of the same hardware elsewhere or hearsay. However, this evaluation approach is not very scientific.

Scoring Approach : In scoring approach, the characteristics of each hardware are listed and each characteristic is given a score in relation to maximum rating points. The alternative which has the maximum points may be selected as shown in Table 1.

Based on the scoring approach, hardware *A* may be selected as it has the maximum score. An alternative to the above scoring method is to assign points based on the characteristics of each element of hardware alternatives. These characteristics may be termed as excellent. very high, high, average, and below average and points may be assigned ranging from 5 to 1 with 5 for excellent and 1 for below average. Total of these points for different hardware alternatives will be taken as base for selecting an alternative.

Table 1: Scoring approach for hardware evaluation

Elements	*Maximum Points*	*Hardware alternatives* A	B	C
CPU capability:	**80**	**63**	**60**	**52**
Arithmetic	5	3	4	2
Main memory capacity	15	12	8	10
Secondary storage capacity	20	16	18	17
Input/output capacity	5	4	3	2
Communication capability	20	17	15	12
Multiprogramming capability	10	7	8	6
Environmental requirements	5	4	4	3
Maintenance ease	12	10	9	11
Operation ease	8	7	7	6
Total score	100	80	76	69

Cost-value Approach :. In the scoring approach. only characteristics of different hardware alternatives have been taken into consideration and not their prices while prices may be an important consideration in selecting a hardware. Price impact can be calculated by cost-value approach in which monetary value is assigned to different characteristics of hardware alternatives. The total of these values assigned to different hardware alternatives is compared to their prices and the alternative which gives the highest value in comparison to its price is selected.

Vendor Capability : Apart from the hardware evaluation, there must be evaluation of vendors too who are likely to supply the hardware. In evaluating vendors, various criteria, such as delivery time, performance records, quality of service, maintenance charges, user training, and number of hardware installed should be taken into consideration. For evaluating these characteristics, either ad

hoc approach or scoring approach may be used, as discussed above. If scoring approach is used, that vendor should be selected which has the highest score.

Hardware Acquisition Method :

When the decision to acquire a particular hardware has been made, another issue arises about the method to be adopted for acquiring this. Since the acquisition of hardware has financial implications, an organization may adopt any of three methods:

1. Rental directly from the manufacturer.
2. Leasing through a third party.
3. Outright purchase.

Rental Option : Rental option is a form of lease by the manufacturer. Rental may be payable monthly or any other period decided by the manufacturer and the user. Many computer users prefer renting a hardware because of the following reasons:

1. There is financial leverage for the user. With no investment required in procuring the hardware, the user is able to utilize the fund elsewhere profitably. This also eases the liquidity problem of the user.
2. Rental makes it easier to change to other hardware systems, thereby protecting itself from the risk of technological obsolescence.
3. Insurance, maintenance, and other expenses are included in the rental charge.
4. Rental charge is tax deductible though the user loses the benefit of tax saving in the form of depreciation deduction.

Rental option has one basic disadvantage in that rental charges are quite high because of the uncertainty of rental revenues to the manufacturer.

Lease Option : Instead of taking a hardware system directly from the manufacturer, it can be taken on lease from a third party. In this case, the lessor, usually a leasing company. remains the owner of the hardware and charges lease rental from the user. Leasing period may be for a year with a provision of renewal on year-to-year basis or may be for longer period.

Both options have their own pros and cons. While a short-term lease may involve higher rental but frees the user to run the technological risk, reverse is the case with longer-term lease. There are several advantages in lease options:

1. No fund is required for acquiring hardware system and the technological risk is borne by the lessor.
2. Lease charges are generally lower as compared to rental charges for the same period and are also tax deductible.

However, the lease option has its own limitations. In the absence of an up gradation clause, the user may not be able to exchange the leased system for another system. Further, if interest rates have declining trend, the user has to bear fixed rental charges as committed earlier. If the lease contract is terminated, it may involve heavy financial penalty.

Purchase option. An user can purchase a hardware system outright. Purchasing means assuming all the risks of ownership including taxes, insurance,

and technological obsolescence. Purchase option has certain advantages over rental and lease options:
1. There is a flexibility of modification of the hardware system at will.
2. Tax benefits are available in the form of depreciation.
3. Residual value can be realized if the user disposes off the hardware system.
However, purchase option has high initial investment outlay and runs the risk of technological obsolescence.
Each option of acquiring a hardware system has unique characteristics. These options can be evaluated both qualitatively as well as quantitatively. Qualitative method evaluates the options by taking their features and the user's ability to bear the financial burden in different alternatives and the risk of technological obsolescence.

2. SOFTWARE ACQUISITION
System analysis and design specifies the types of software that would be required to produce desired outputs to satisfy user needs. There are basically two types of software-system software and application software. System software runs the computer hardware and application software makes the computer useful for producing outputs.
Separate set of issues is involved in selecting system software and application software.

Selection *of* System Software
A system software manages the resources of the computer, such as central processor, communication links, and input/output devices. Some of the system software can be used on any type of computer while some can be used on only specified type of computer. Some of the commonly used system software include DOS, MS Windows, MS Windows NT, OS/2, and UNIX. In evaluating the suitability of a system software, following factors should be taken into consideration:
1. The type of computer required *for* using a given system software.
2. The type of applications that can run on a system software.
3. Ease of learning and using a system software.
4. Extent to which multiple users on networks can use the system software.
5. Extent of multitasking capabilities of the system software.
6. Reliability of the system software.
7. Technical support and assistance required to install the system software.
8. Cost of installation of the system software.
If an organization wants a system software *for* its mainstream business applications, it needs a software that is compatible with the software required by these applications. The system software should be easy to install and operate. Mission-critical applications require special system software. For such applications, software that can support multitasking and memory management is required. The software should be able to run multiple applications quickly without having the system crash because different applications contend *for* the same memory space. Mission-critical applications typically have large volume of

transactions to process and require system software that can handle large complex software programs and massive files.

Selection of Application Software :

While system software has to be acquired from developers or their vendors because a system software cannot be developed in-house as development cost is prohibitive, in case of application software, an organization has the option either to develop it in-house or to acquire it from the market. For this purpose, the organization has to assess its technological capability to find out whether it is in a position to develop application software tailored to its requirements at a given cost. Since the organization's main job is not to produce software, it finds that it is not in a position to develop application software at competitive cost. Therefore, it is better to acquire standardized application software known as application software package or simply as software package, from the market. A software package is a set of prewritten, pre-coded application software programs that is commercially available for sale or lease. There are a number of software packages that are available for different applications.

Advantages of Software Packages

There are certain advantages of software packages as compared to inhouse development. .The major advantages are as follows :

1. Rapid implementation-Software packages are readily available for implementation while in-house software development may take much time may be many months.
2. Low risk-Since software packages are readily available, the organization is free from the risk involved in software development process. In-house development of software has uncertainty both in terms of time and cost.
3. Quality-Since software packages are developed by specialists, they are generally of higher quality. Such specialists may not be available internally because employment of such specialists has recurring cost implications.
4. Low cost-Since software package developers produce the packages in bulk quantity, their cost of development per unit of a package tends to be low.

Disadvantages of Software Packages

There are some disadvantages of software packages which are as follows :

1. Lack of customization-Software packages are produced in bulk quantity in standard format. This standard format may not suit all organizations, as each organization has its unique requirements.

Therefore, an organization has to modify a package according to its requirements. This involves additional cost.

2. Commercial software packages have not yet achieved the level of sophistication and technical quality needed to produce multipurpose packages that can do every thing well that users want in a specific application.
3. There is a significant fringe element in the software market that does not subscribe to ethical marketing practices. Therefore, a buyer has to be very careful while buying software packages.

Software packages can be used in the following conditions effectively :
1. When functions for which packages are being acquired are common to many organizations, such as payroll for which different organizations can use the same package.
2. When the packages are required for desktop microcomputer applications as numerous easy-to-use packages have been developed for desktop microcomputers.
3. When information system resources are not well equipped for inhouse software development: this is applicable more in the case of smaller organizations.

Evaluation of Software Packages
Before buying a software package, it is essential that it is evaluated against the criteria set by the user organization. These criteria may be set on the following aspects of software packages:
1. Functions included-the package must include the functional requirements of the application; functions that can be supported by modifying codes, degree of modification required, and meeting present and future requirements.
2. User friendliness-ease of operation from non-technical stand point, training required to understand and operate the package, and ease of user control.
3. Hardware and software required-type of hardware required type of operating system (system software) required, capacity of CPO required, and computer time required to run the package.
4. Database features-nature of database/file structure required.
5. Installation effort-changes in the existing procedures required.
6. Maintenance-nature of maintenance required in terms of up gradation and enhancement.
7. Documentation-nature of documentation and its understandability.
8. Cost-basic price. taxes. maintenance charges etc.
Using the above criteria. a software package may be evaluated by using ad hoc approach, scoring approach, or cost-value approach as used in the case of hardware evaluation.

Process of Acquiring Hardware/Software
When an organization is implementing its computerized information system for the first time, it is required to acquire hardware and software simultaneously. In a case where an organization has already a computerized system, it may just require to buy additional software. However, the process of acquisition remains same. For acquiring hardware/software, an organization may adopt the following steps:
1. Determination of Hardware/Software Required :
Based on system analysis and design and organizational analysis of the type of hardware/software it wishes to install. hardware/software requirement is determined.
2. Request for Proposal. Request for proposal (RPF) is prepared and is sent to various computer vendors for sending their proposal to supply the required

hardware/software. RPF specifies the type of hardware/software that the organization wants to buy or get on lease.

3. Proposal Evaluation. If there are many proposals. evaluation may be made in two stages-primary and final. In primary evaluation, all those proposals that do not meet initial selection criteria, either on technical or cost basis are rejected. The remaining proposals go to the final evaluation stage. At the final evaluation stage, evaluation exercise is conducted in more detail. Such an evaluation exercise evaluates both hardware/software and its vendors. The evaluation is generally made by a committee constituted for this purpose and it evaluates hardware/software and vendors against the criteria prescribed in respect of these.

4. Finalization of hardware/software and vendor. On the basis of the detailed analysis of various proposals, the committee finalizes the hardware/software to be acquired and the vendor from which to acquire. After the finalization process is over, the committee prepares an evaluation report showing the details of proposals and the reason for selecting a particular system as well as vendor. The report is presented to formal approving authority as the committee normally works in advisory capacity.

5. Final Approval and Acquisition. On the basis of the report submitted by the committee and its recommendation, the person authorized to make final decision may finalize the recommendation. If the authorized person wants to have more information about the recommendation, he can solicit it from the committee. After the final approval, the order is placed to the concerned vendor showing the details of the items required, their delivery schedule. mode of transportation, mode of payment, etc. After receiving the hardware and software, the next step of system implementation that is installation proceeds.

3. INSTALLATION

During the process of acquiring hardware/software, installation work may proceed so that by the time equipment arrives, the platform is ready for its installation. An installation checklist should be prepared during this period based on operating advice of the vendor and the system development team. With installation checklist, an installation schedule should also be prepared so that it is completed well in time. Installation involves site preparation, equipment installation, and equipment checkout.

System Maintenance

After a system is implemented and is in operation, it requires maintenance on regular basis. When a system is in operation, modifications are made so that the system continues to provide the needed support. These modifications are called system maintenance. Generally, system maintenance is performance for three reasons:

1. To correct errors-uncovering bugs in the programs or weaknesses in the design that were not detected ,during testing, and correcting these weaknesses.
2. To keep system current-over the time, changes occur in the system's environment that require modifications in the system design and software.

3. To improve the system--continuous improvement in the system is required to meet user requirements.

System maintenance may be undertaken either by in-house maintenance team of the maintenance work can be assigned to vendors or other system maintenance agencies. In those organizations, where number of computers installed is large enough, in-house maintenance team may be given the responsibility of system maintenance. In smaller organizations, the job may be assigned to outside agency on contract basis. System maintenance involves hardware maintenance and software maintenance.

4. HARDWARE MAINTENANCE

Hardware maintenance includes computer hardware and its peripherals as well as network maintenance. Hardware maintenance can take place in three forms-preventive maintenance, breakdown maintenance, and replacement maintenance.

Preventive Maintenance. Preventive maintenance is regarded as *'stitch in time that saves nine'.* Preventive maintenance of hardware is a precautionary measure. There should be a schedule for weekly or monthly maintenance of each machine. Though sometimes, it appears that preventive maintenance is an addition a cost, it saves lot by avoiding loss due to production loss. It also helps increasing the useful life of hardware.

Breakdown Maintenance. Breakdown maintenance is undertaken when a machine breaks down and stops working because of damage of any part. When the machine fails because of damaged part, the part can be got repaired or a new part is installed. In part repairing, the organization should make a decision regarding the number of times, a particular part may be repaired.

Replacement Maintenance. Replacement maintenance involves replacing the major devices of hardware like keyboard, monitor, printer, or other devices that are at ending stage of their useful life. Generally, various devices of hardware do not complete their life cycle simultaneously. Therefore, the organization should formulate a policy indicating the time by which a particular device has to be replaced.

5. SOFTWARE MAINTENANCE

Software maintenance is more critical as compared to hardware maintenance because there are many issues involved in software maintenance. Software maintenance covers a wide range of activities, including correction of coding and design errors, updating documentation and test data, and providing user support. Many activities classified as software maintenance are actually enhancements: While maintenance means restoring something to its original condition, enhancement means adding. modifying, or redeveloping the codes to support changes in the specifications. Although software does not wear out like the hardware, it ages and eventually fails to perform because of cumulative maintenance. Over the time, the integrity of the program, test data, and documentation degenerates as a result of modifications. Eventually, it takes more effort to maintain the application than to rewrite it.

Software maintenance may be classified as corrective, adaptive, or perfective. *Corrective maintenance* means repairing processing or performance failures or making changes because of previously uncorrected problems and assumptions. *Adaptive maintenance* means changing the program function. *Perfective maintenance* means enhancing the performance or modifying the program to respond to the users' additional or changing needs. For software maintenance, software reengineering concept has been developed.

6. SUCCESS AND FAILURE OF MIS :

Most organizations use MIS more successfully than other organizations. Through hardware, software and technology available are the latest and the best, its use is more for the collection and storage of data and its elementary processing. There are some factors, which make MIS, a success while there are some factors, which make it a failure.

Factors contributing to success of MIS : If MIS is to be a success, then it should have all the features listed below

- MIS is integrated into the management function. It sets clear objectives to ensure that MIS focuses on the major issues of the business. Also adequate development resources are provided and human & organizational barriers to progress are removed.
- An appropriate information processing technology required to meet the data processing and analysis needs of the users of MIS is selected.
- MIS is oriented, defined and designed in terms of the users requirements and its operational viability is ensured.
- MIS is kept under continuous surveillance, so that its open system is modified according to the changing information needs.
- MIS focuses on results and goals, and highlights the factors and reasons for non achievements.
- MIS is not allowed to end up into an information generation mill avoiding the noise in the information and the communication system
- MIS recognizes that a manager is a human being and therefore, the systems must consider all the human behavioral aspects in the process of management.
- MIS recognizes that the different information needs for different objectives must be met with. The globalization of information in isolation from the different objectives leads to too much information and its non use.
- MIS is easy to operate and therefore, the design of MIS has such good features which make up a user friendly design.
- MIS recognizes that the information needs become obsolete and new needs emerge. The MIS design, therefore, has a potential capability to quickly meet newer and newer needs of information.
- MIS concentrates on developing the information support to manage critical success factors. It concentrates on the mission critical applications serving the needs of the top management.

Factors contributing to failures : Many times, MIS is a failure. The common factors which are responsible for this are as follows :

- MIS is conceived as a data processing and not as an information system.
- MIS does not provide that information which is needed by managers but it tends to provide the information generally the function calls for. MIS then becomes an impersonal function.
- Underestimating the complexity in the business systems and not recognizing it in the MIS design leads to problems in the successful implementation.
- Adequate attention is not given to the quality control aspects of the inputs, the process and the outputs leading to insufficient checks and controls in MIS.
- MIS is developed without streamlining the transaction processing systems in the organisations.
- Lack of training and appreciation that the users of the information and the generators of the data are different, and they have to play an important role in the MIS.
- MIS does not meet certain critical and key factors of its users, such as a response to the query on the database, an inability to get the processing done in a particular manner, lack of user friendly system and the dependence on the system personnel.
- A belief that the computerized MIS can solve all the management problems of planning and control of the business.
- Lack of administrative discipline in following the standardized systems and procedures, wrong coding and deviating from the system specifications result in incomplete and incorrect information.
- MIS does not give perfect information to all the users in the organization. Any attempt towards such a goal will be unsuccessful because every user has a human ingenuity, bias and certain assumptions not known to the designer. MIS cannot make up these by providing perfect information.

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CHAPTER 12

Emerging Concepts & Issues in MIS

1. Knowledge Based Systems
   Artificial Intelligence + Expert System + Robotics + Neural Networks
2. Data warehousing
3. OLAP
4. Data Mining
5. Enterprise Wide Information System (ERP)
6. Latest Trends in IS :
   (a) Object Oriented Systems
   (b) Total Quality Management Systems
   (c) Manufacturing Execution Systems
   (d) Business Process Re-engineering
   (e) Geo-graphical Information systems

Emerging Concepts & Issues in MIS

A. Knowledge Based Systems
B. Enterprise Wide Information System (Enterprise Resource Planning)

A. Knowledge Based Systems :
Knowledge based system contains Artificial intelligence, Expert systems, neural network, robotics etc.

1.1 Artificial Intelligence (AI)
Artificial intelligence can be defined as a field of study that designs and develops machines capable of performing tasks that would require intelligence if performed by a human being.
A more formal definition of artificial intelligence is that, it is a branch of computer science concerned with designing intelligent computer systems, ie; systems that exhibit the characteristics associated with intelligence in human behavior - understanding, language, learning, reasoning etc.

1. Components of AI :
Broadly speaking, AI consists of
(a) Expert systems
(b) Robotics
(c) Natural Language
(d) Learning
(e) Computer Vision
(f) Perceptive Systems

(g) Artificial Intelligence hardware
(h) Neural Networks

(a) Expert Systems: It is a computer program that attempts to represent the knowledge of human experts in the form of heuristics.
(b) Robotics : They consist of computer controlled devices that help in AI applications.
(c) Natural Language : This enables users to communicate with the computer in different languages and also enables the computer to check grammar and spellings.
(d) Learning : This encompasses all the activity that enables the computer or other device to acquire knowledge in addition to what has been entered into the memory by its manufacturers and programmers.
(e) Computer vision: This is to endow computers with the ability to recognize and identify objects and the context to which they belong. This also entails an ability to recognize shapes, features etc. automatically and in turn automate movement through robots.
(f) Perceptive Systems: These use visual images and auditory signals to instruct computers or other devices such as robots.
(g) Artificial intelligence hardware: This includes physical devices that help in artificial intelligence applications. Examples are hardware that is dedicated to knowledge based systems, neural computers used to speed up calculations –etc.

(h) **Neural networks:** They are highly simplified models of the human nervous system that exhibit abilities such as learning, generalization and abstractction. These abilities enable the models to learn human like behavior.

1.2 Expert system (ES)
An expert system is a computer application that guides the performance of ill structured tasks, which usually require experience and expertise. Using an expert system, a non expert can achieve performance, which is comparable to an experts performance in that particular domain.
An expert system is vary similar to a decision support system, ie.; both are intended to provide a high level of problem solving support to their users. But they differ in two major ways:
First, a DSS consists of routines that reflect as to how the manager believes a problem should be solved, as well as the manager's style and capabilities. An expert system on the other hand, offers the opportunity to make decisions that exceed the manager's capabilities.
The second but most important difference between DSS & ES is that, the expert system (ES) to explain its line of reasoning in reaching a particular solution. Very often, the explanation of how a solution was reached is more valuable than the solution itself.
1.2.1 Components of ES
Expert system consists of 4 major parts
(a) user interface

(b) knowledge base
(c) inference engine
(d) development engine

Applications of ES

The business applications of expert systems are many. Some of them are as follows:

Manufacturing

. Maintaining facilities
. Analyzing quality and providing corrective measures
. Determining whether a process is running correctly or not
. Scheduling job shop tasks
. Selecting transportation routes
. Assisting with product design and facility layouts

Marketing

. Establishing sales quotas
. Responding to customer inquiries
. Assisting with marketing timing decisions
. Determining discount policies

Accounting and Finance

. Providing tax advice and assistance
. Helping with credit authorization decisions
. Selecting forecasting models
. Providing investment advice

Personnel

. Assessing applicant qualifications
. Giving employees assistance in filling out forms

General Business

. Assisting with project proposals
. Recommending acquisition strategies
. Educating trainees
. Evaluating performance

B. Enterprise Resource Planning (Enterprise Wide Information System) **:**

Originally, ERP packages are targeted at the manufacturing industry and consisted mainly function for planning and managing core businesses such as sales management, production management, accounting and financial affairs, etc.

However, in recent years, adaptation not only to the manufacturing industry, but also to diverse types of Industry has become possible and the expansion of implementation and use has been progressing on a global level.

ERP software has been designed to model and automate many of the basic process of a company, from finance to the shop floor with the goal of integrating information across the company and eliminating complex, expensive links between computer system that were never meant to talk to each other.

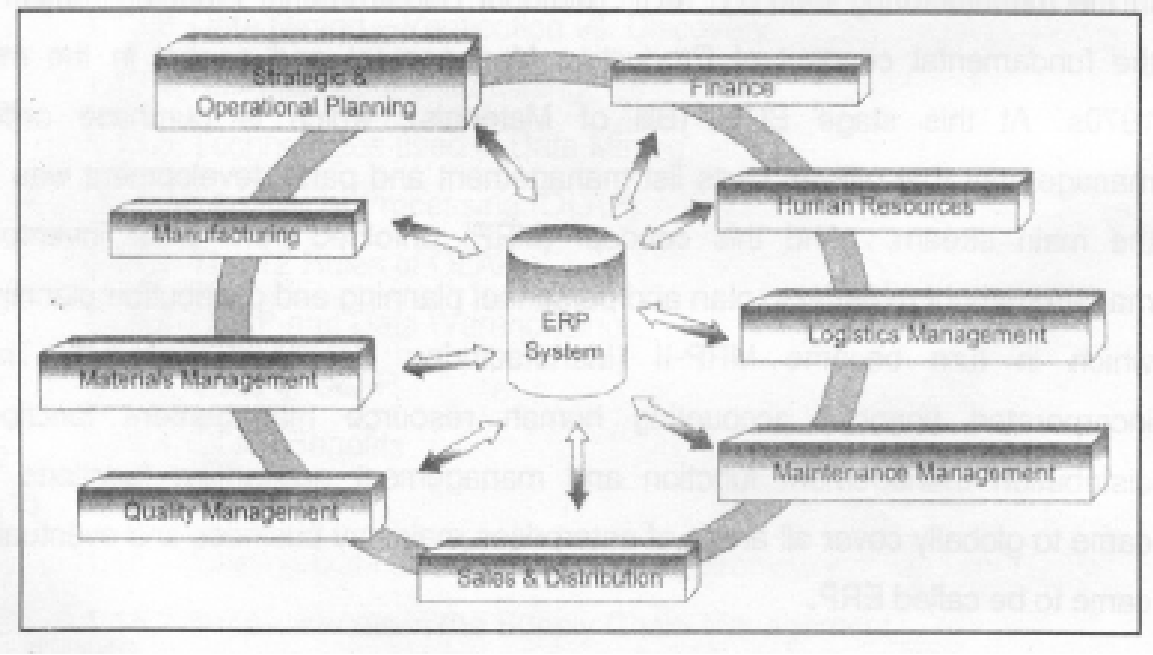

Figure 1 : Information Integration through ERP Systems

ERP System's set to generic processes produce the dramatic improvements that they are capable of only when use to connects parts of an organization an integrate its various processes seamlessly.

When a warehouse in Noida enters a customer order, for example, the data flows automatically to others in the company who need to see it - to the finance department and the company head quarters in Mumbai and manufacturing plant in Chennai.

Advantages of ERP :

Installing an ERP system has many advantages - both direct and indirect. The direct advantages include improved efficiency, information integration for better decision making, faster response time to customer queries, etc. The indirect benefits include better corporate image, improved customer goodwill, customer satisfaction, and so on.

The following are some of the direct benefits of an ERP system:

. Business integration
. Flexibility
. Better analysis and planning capabilities
. Use of latest technology

ERP and Related Technologies :

ERP is an abbreviation for Enterprise Resource Planning and means, the techniques and concepts for the integrated management of businesses as a whole, from the viewpoint of the effective use of management resources, to improve the efficiency of an enterprise.

ERP systems serve an important function by integrating separate business functions - materials management, product planning, sales, distribution, finance and accounting and others - into a single application. However, ERP systems have three significant limitations:

1. Managers cannot generate custom reports or queries without help from a programmer and this inhibits them from obtaining information quickly, which is essential for maintaining a competitive advantage.

2. ERP systems provide current status only, such as open orders. Managers often need to look past the current status to find trends and patterns that aid better decision making.

3. The data in the ERP application is not integrated with other enterprise or division systems and does not include external intelligence.

There are many technologies that help to overcome these limitations. These technologies, when used in conjunction with the ERP package, will help in overcoming the limitations of a standalone ERP system and thus, help the employees to make better decisions. Some of these technologies are BPR, Data Warehousing, Data Mining, Online Analytical Processing (OLAP), Supply Chain Management and so on.

With the competition in the ERP market getting hotter and hotter, and ERP vendors searching for ways to penetrate new market segments and expand the existing ones, tomorrows ERP systems will have most of these technologies integrated into them. In this chapter, we will see how each of these technologies are related to ERP systems.

1. Business Process Reengineering (BPR) :
BPR has been around for quite some time and a lot has been written about it in both, the practitioner trade press and the academic research journals. However, the controversy still remains about whether there is any accurate description of BPR or BPR is just a fad - an appealing label to tag on to whatever your company is doing, to suggest that your latest and greatest work is 'in vogue'. But if reengineering is to continue in the long run, then it must do more than advertise its considerable successes to date. It must become more proactive and inclusive with regard to human, organizational and motivational change issues.

Dr. Michael Hammer defines BPR as “... the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance such as cost, quality, service and speed." One of the main tools for making this change is the Information Technology (IT), any BPR effort that fails to understand the importance of IT, and

goes through the pre-BPR analysis and planning phases without considering the various IT options available and the effect of the proposed IT solutions on the employees and the organization, is bound to crash during takeoff.

We have seen that the ERP systems help in integrating the various business Processes of the organization with the help of modern developments in IT. With a good ERP package, the organization will have the capability of achieving dramatic improvements in critical areas such as cost, quality, speed and so on. So many BPR initiatives end up in the ERP implementation.

2. Data Warehousing :

If operational data is kept in the databases of the ERP system, it can create a lot of problems. As time passes, the amount of data will increase and this will affect the performance of the ERP system. So it is better to archive the operational data once its use is over. When I say 'the use is over', it does not mean that the archived data is useless. On the contrary, it is one of the most valuable resources of the organization. However, once the operational use of the data is over, it should be removed from the operational databases. For example, one the financial year is over, the daily transactional data can be archived. Figure 2 shows what happens if the data is not archived.

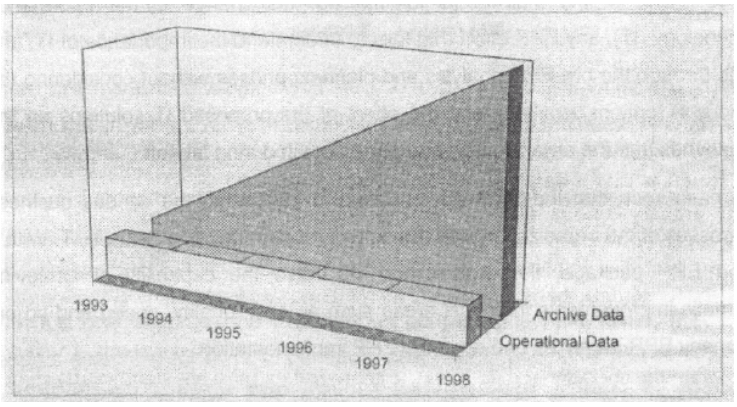

Figure 2 : Operational Data vs. Archive Data

It is evident from the Figure 2 that even though the operational data volume is nearly the same each year, since the data is not archived, the total amount of data that is stored in the operational database will go on increasing. Figure 2 shows the effect of keeping this huge amount of data in the operational database.

It is clear from the graph (Figure 3) that as the volume of the data in the database increases, the performance of the database and the related applications decreases.

It is evident that we should separate the operational data from the non-operational data. Here the term archive data is not used because if the non-operational data is archived, there is little or no use for it. But this data is a very

valuable resource and is too precious to be kept in some archive. It is in this situation that a data warehouse comes in handy.

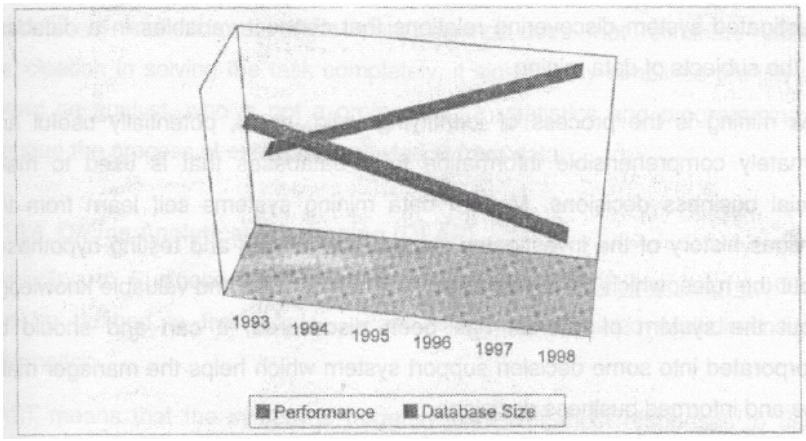

Figure 3. Data Volume Vs. Performance

Separating it from the data in operational systems can access the primary concept of data warehousing is that the data stored for business analysis most effectively. The most important reason for separating data for business analysis, from the operational data, has always been the potential performance since analysis processes much more complex and sophisticated. In addition to producing standard reports, today's data warehousing systems support very sophisticated online analysis, including multi-dimensional analysis.

3. Data Mining :

We are living in the information age. The importance of collecting data that reflects one business or of activities that achieve competitive advantage, are widely recognized now. Powerful systems for collecting data and managing it in large databases are available in most organizations. However, the major bottleneck of converting this data into effective information is the difficulty faced in extracting knowledge about the system from the collected data. Modeling the investigated system discovering relations that connect variables in a database are the subjects of data mining.

Data mining is the process of identifying valid, novel, potentially useful and ultimately comprehensible information from databases that is used to make crucial business decisions. Modern data mining systems self learn from the previous history of the investigated system, formulating and testing hypotheses about the rules, which the system obeys. When concise and valuable knowledge about the system of interest has been discovered, it can and should be incorporated into some decision support system which helps the manager make wise and informed business decisions.

The main reason for needing automated computer systems for intelligent data analysis is the enormous volume of existing and newly appearing data that require processing. The amount of data accumulated each day by various'

businesses, scientific and governmental organizations around the world is daunting. Research organizations, academic institutions and commercial organizations create and store huge amounts of data each day. It becomes impossible for human analysts to cope with such overwhelming amounts of data. The other problems that surface when human analysts process data are:

- ☛ The inadequacy of the human brain when searching for complex factorial dependencies in the data
- ☛ The lack of objectiveness in analyzing the data

A human expert is always a hostage of the previous experience of investigating other systems. Sometimes this helps, sometimes this hurts, but it is almost impossible to get rid of this fact.

One additional benefit of using automated data mining systems is that this process has a much lower cost than hiring an army of highly trained (and paid) professional statisticians. While data mining does not eliminate human participation in solving the task completely, it significantly simplifies the job and allows an analyst, who is not a professional in statistics and programming, to manage the process of extracting knowledge from data.

4. Online Analytical Processing (OLAP) :

According to Business Intelligence Ltd., (httP://www.OlAPReport.com), OLlAP can be defined in five words - Fast Analysis of Shared Multidimensional Information. FAST means that the system is targeted to deliver most responses to users within about five seconds, with the simplest analysis taking no more than one second and very few taking more than 20 seconds. ANALYSIS means that the system can cope with any business logic and statistical analysis that is relevant for the application and the user, and keep it easy enough the target user.

SHARED means that the system implements all the security requirements for confidentiality (possibly down to cell level) and, if multiple write access is needed, concurrent update locking at an appropriate level. MULTIDIMENSIONAL means that the system must provide a multidimensional conceptual view of the data, including full support for hierarchies and multiple hierarchies. INFORMATION is refined data that is accurate, timely and relevant to the user.

Simply put, OLAP describes a class of technologies that are designed for live adhoc data access and analysis. While transaction processing (OLTP) generally relies solely on relational databases, OLAP has become synonymous with multidimensional views of business data. These multidimensional views are supported by multidimensional database technology and provide the technical basis for calculations and analysis required by Business Intelligence applications.

OLAP technology is being used in an increasingly wide range of applications. The most common are sales and marketing analysis; financial reporting and consolidation; and budgeting and planning. Increasingly however, OLAP is being used for applications such as product profitability and pricing analysis; activity

based costing; manpower planning; and quality analysis; or for that matter any management system that requires a flexible, top down view of an organization.

5. Supply Chain Management :

A supply chain is a network of facilities and distribution options that performs the function of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers. Supply chains exist in both service and manufacturing organizations, although the complexity of the chain may vary greatly from industry to industry and firm to firm.

Traditionally, marketing, distribution, planning, manufacturing, and the purchasing organizations along the supply chain operated independently. These organizations have their own objectives, which are often conflicting. Marketing's objective of high customer service and maximum sales revenue conflict with manufacturing and distribution goals. Many manufacturing operations are designed to maximize throughput and lower costs with little consideration for the impact on inventory levels and distribution' capabilities. Purchasing contracts are often negotiated with very little information beyond historical buying patterns. The result of these factors is that there is not a single, integrated plan for the organization - there are as many plans as businesses. Clearly, there is a need for a mechanism through which these different functions can be integrated together. Supply chain management is a strategy through which such integration can be achieved.

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14. Write a note on Input and Output Devices ?

Input Devices :

Data and instructions must enter the computer system before any processing can be performed and the results of processing must be supplied to users. This requires input-output devices. They are also known as peripheral devices or *peripherals* because they surround the CPO. Input devices are used to enter data into primary storage. A variety of input devices are available and for a particular application. one type of device may be more desirable than another. Various input devices are classified into four categories:

1. Keyboard :

2. Pointing devices :

(a) Mouse
(b) Trackball
(c) Joystick
(d) Touch screen
(e) Degitiz1ng tablet

3. Source data automation :

(a) Scanner
(b) Bar code reader
(c) Optical character reader

(d) Optical mark reader
(e) Magnetic ink character recognition
(f) Voice input device
(g) Sensor

KEYBOARD :

Keyboard is an input device consisting of a set of typewriter-like keys that enable the computer operator to enter data into a computer. Computer keyboards are similar to electric typewriter keyboards but contain additional keys. The keys on computer keyboards are often classified as follows:

1. Alphanumeric keys-letters and numbers.
2. Punctuation keys-comma. colon. semicolon. period. etc.
3. Special keys-function keys. control keys. arrow keys. caps lock key. etc.

The standard layout of letters. Numbers, and punctuation is known a QWERTY because the first six keys on top row of letters is spelled QWERTY. In fact, the QWERTY keyboard was designed in the 1800s for mechanical typewriters and was designed to slow typist down to avoid jamming the keys. However, it is in practice in the same way today. Another keyboard designed which has letters positioned for speed typing is the Dvorak keyboard. The developers claim that their keyboards are easier to learn as compared to QWERTY keyboard. However, Dvoark keyboard is not widely accepted because most people have already learned the QWERTY keyboard. QWERTY keyboard is relevant for English language only and in languages other than English different patterns are followed.

There is no standard computer keyboard although many manufacturers imitate the keyboards of PCs. There are three different PC keyboards - original PC keyboard with 84 keys; the AT keyboard also with 84 keys; and the enhanced keyboard with 101 keys. The three keyboards differ some what in placement of function keys, shift keys, control keys and return keys. Some new keyboards have 107 keys with new keys designed to simplify working with Windows operating systems. The speed and accuracy of data entry through computer keyboard depend on the efficiency of computer operator. Prolonged keyboard use can cause wrist problems to the computer operators. To overcome this problems ergonomic keyboards have been developed. An ergonomic keyboard is fully suited to human posture while operating the keyboard. One special type of keyboard is membrane-switch keyboard in which the keyboard is covered by the protective film. Membrane-switch keyboards are reliable durable and resistant to such hazards as liquids or grease. These keyboards are ideal in manufacturing situations that require lesser use of keyboard.

POINTING DEVICES :

Many computer operators use pointing devices in place of keyboards whenever possible. Pointing devices minimize the amount of typing errors and relieve the operator from developing wrist problem. The main pointing devices are mouse, trackball, joystick, touch screen and digitizing tablet.

Mouse :

Mouse is a palm-size device with a ball built into the bottom. It is called mouse because it functions as a natural mouse. that is. it moves here and there very

fast. A mouse is usually connected to a computer by a cable and may have one to four buttons. but usually two. Out of these two buttons, mostly left side button is used. As the computer operator moves the mouse, the pointer on the display screen moves in the same direction.
Mouse is one of the great breakthrough in computer ergonomics because it frees the user to a large extent from using the keyboard. In particular, the mouse is important for graphical user interfaces because the user can simply point to options and objects and click a mouse button. Such applications are often called point-and-click programs. The mouse is also useful for graphics programs that allow users to draw pictures by using the mouse like a pen pencil or paint brush. There are three basic types of mouse-mechanical, optomechanical and optical.

Mechanical Mouse : Mechanical mouse has a rubber or metal ball on its bottom that can roll in all directions. Mechanical sensors within the mouse detect the direction the ball is rolling and move the screen pointer accordingly.
Optomechanical Mouse : Optomechanical mouse functions in the same way as a mechanical mouse does but it uses optical sensors to detect motion of the ball. instead of mechanical sensors.
Optical Mouse : Optical mouse uses a laser to detect the mouse's movement. Optical mouse has no mechanical moving parts but the user must move the mouse along a special mat with a grid so that the optical mechanism has a frame of reference. An optical mouse responds more quickly and precisely as compared to mechanical or optomechanical mouse but it is more expensive.
A mouse is connected to a microcomputer in one of the following three ways:
1. Serial mouse is connected directly to an Rs-232C serial port or a PS/2 port. This is the simplest type of connection.
2. Bus mouse is connected to the bus through an interface card. This is somewhat more complicated because the user needs to configure and install the expansion board.
3. Cordless mouse is not physically connected to the computer at all. Instead, it relies on infrared or radio waves to communicate with the computer. The choice between the first two connections depends on whether the user has a free serial port. If he has, it is usually simpler to connect a serial mouse. Cordless mouse is more expensive than serial or bus mouse but it eliminates the cord which can sometimes get in the way.
The use of mouse requires a mouse-pad over which the user can move the mouse. A mouse-pad provides more friction than smooth surfaces such as glass or wood. A mouse-pad makes it easier to move a mouse accurately. For an optical mouse, a special mouse-pad that has grids drawn on it is required.
Trackball :
Trackball is another pointing device which functions essentially like a mouse. To move the pointer. the user rotates the ball with his thumb, fingers, or the palm. Like mouse, a trackball has one to three buttons. In some computer systems, trackball has been replaced with a red plastic button called a trackpoint which is located in the middle of the keyboard.

The main advantage of a trackball over a mouse is that it requires less space as it is stationary. Further, the trackball can be placed on any type of surface. For these reasons, trackballs are becoming popular pointing devices. In fact, some people of the computer industry believe that the mouse will soon be replaced by devices that do not require much space to use.

Joystick :

Joystick has a gearshift-like lever that is used to move the pointer on the computer screen. A joystick is similar to a mouse, except that with the mouse the cursor stops moving as soon as the user stops moving the mouse. In the joystick the pointer continues moving in the direction the joystick is pointing. To stop the pointer the user must return the joystick to its upright position.

Joystick device is often used for playing games on computers. In business, joysticks are used to control robots. Flight simulators and other training simulators also use joysticks.

Touch Screen :

Touch screen is a type of display screen that has a tough-sensitive transparent panel covering the screen. If enables the user to select an option by pressing a specific part of the screen. Instead of using a pointing device like mouse, trackball or pen, the user can use his finger to point directly to objects on the screen. Touch screen system is commonly used in grocery stores, fast-food restaurants, information kiosks, etc.

Although touch screen system provides a natural interface for computer devices, it is unsatisfactory for most of the applications because the finger is such a relatively large object that it is not possible to point accurately to small areas of the screen.

Digitizing Tablet :

Digitizing tablet also known as digitizer graphics tablet or touch tablet, is an input device that enables the user to enter drawings and sketches into the computer. A digitizing tablet consists of an electronic tablet and a cursor or pen. A cursor, also called puck, is similar to a mouse, except that it has a window with cross hairs for pinpoint placement. It can have as many as 16 buttons. A pen, also called stylus, looks like a simple ballpoint pen but uses an electric head instead of ink. Electronic tablet contains electronics' that enables it to detect movement of the cursor or pen and translate the movement into digital signal that is sent to the computer.

A digitizing tablet has different points and each point represents a point on the display screen in a fixed manner. This differs from a mouse in which a movement is relative to the current cursor position. The static nature of the digitizing tablet makes it particularly effective for tracing drawings.

SOURCE DATA AUTOMATION

Source data automation is a technology that captures data in computer readable form at the time and place the data are created. The main advantage of source data automation is that the errors that occur when people use keyboards to enter

data are almost eliminated. Further, it makes data entry operation fast. Source data automation devices can be divided into three broad categories;
1. Scanner.
2. Voice input device.
3. Sensor.

Scanner :

A scanner is basically an input device that is capable of recognizing characters. marks. and pictures. Thus, it can be used for direct data entry into the computer. A scanner reads the printed surface and translates it into machine codes. Scanners can be broadly classified into two broad categories-optical scanners and magnetic ink character recognition scanners. Optical scanners are of three types-bar code reader, optical character reader, and optical mark reader.

Bar Code Reader : Data coded in the form of light and dark lines are known as bar codes. Bar codes are used particularly by the retail trade for labelling goods and for stock control. They are also used for numbering books. A bar code reader is a device used for reading bar codes. It is a scanner linked to a computer which uses laser beams for reading bar codes. The laser beams are stroked across the pattern of bits which are recorded as input data.

Optical Character Reader : An optical character reader (OCR) reads alphabetic and numeric characters printed on paper. These characters may be either typewritten or handwritten. However, in the case of handwritten characters, special care has to be taken to ensure that the characters are of standard size, lines making up the characters are connected, and no stylish loops are made. An OCR examines each character as if it were made of a collection of minute spots (pixels). Once the whole character has been scanned, it is compared with the characters the machine has been programmed to recognize. Whichever pattern it matches or nearly matches, is considered to be the character read. OCRs are used mostly by publishing and printing industry. These can also be used for office automation if the volume of work justifies their use.

Optical Mark Reader : An optical mark reader (OMR) recognizes specified types of marks made by pencil/pen. For recognizing marks, an OMR focuses light on the page being scanned and detects the reflected light pattern from the marks. The presence of a mark is indicated by drop in light. This method is applied where marks are made by any instrument other than a graphite pencil. For recognizing marks made by a pencil. Residing process is used in which marks are determined by conductivity of graphite. OMRs are used for evaluating answer sheets having answers marked by pens/pencils.

For recognizing pictures and other graphics. flatbed scanners are used which function on the principle of reflectance of light.

Magnetic Ink Character Recognition : Magnetic ink character recognition (MICR) devices have been developed primarily for banking sector for processing cheques/drafts. MICR devices can be used to process only those cheques on which numeric codes are printed by using magnetic ink which contains

magnetize able particles of iron oxide. The most commonly used character set by MICR devices is known as E13B that consists of the numerals 0 to 9. Coded data in the form of these fonts are transferred from cheques to the computer by a MICR reader and sorter. When a cheque enters the reading unit, it passes through a magnetic field which causes the particles in the ink to become magnetized. Read heads then interpret these characters by examining their shapes. The sorter is used to sort the cheques into different pockets according to their identification numbers.
To process the amount of cheques either keyed input is used or the amount can be encoded by a bank employee in the lower right corner of a cheque before it goes for processing.

Voice Input Device :
Voice input device makes it possible to communicate with a computer orally. This is known as voice recognition system which consists of a microphone that converts human voice into electrical signals. A signal pattern is transmitted to the computer where it is matched against presorted patterns to identify the input. The set of pre-stored patterns is known as the vocabulary of the system. To build this vocabulary, the system has to. be programmed to recognize words and phrases that are present in the vocabulary. Voice recognition systems though in their infancy stage have wide application where people want to communicate orally with the computers.

Sensor :
A sensor is a device that collects data directly from the environment for input into a computer system. For example. sensors are used to measure the intensity of earthquakes. Similarly. sensors are used to measure environmental pollution caused by smokes, dirts. etc. In business, sensors are not used for input meant for information systems. However, many vehicle manufacturers deploy sensors along with computers and screens in their vehicles that display the surrounding area, driver's routes, and vehicle's location. For example, many models of cars manufactured by General, Motors have sensors, computers, and screens.

Output Devices :
Output is anything that comes out from a computer as a result of input processing. Most computer output can be divided into two categories-soft copy and hard copy. Soft copy is in the form of visuals and voices which can be only seen or heard and cannot be stored. Soft copy is in some physical form which can be used again and again. for example, printed paper. A soft copy can be converted into a hard copy with the help of output devices. An output device is any machine that is capable of representing information from a computer. Output devices include the following:
1. Monitor.
2. Printer,
3. Plotter.
4. Audio output device.
5. Computer output microfilm.

Monitor :

Monitor is the term used for the display screen. However, the term monitor usually refers to the entire box, whereas the display screen means just the screen. There are different types of monitors and they can be classified on the basis of colour capabilities and size.

Colour Capabilities : On the basis of colour capabilities, monitors can be classified into monochrome and colour. A monochrome monitor displays two colours, one for the background and one for the foreground. The colours may be black and white, green and black, or amber and black. The most usual colour combination is black and white. That is why monochrome II monitors are called black and white monitors. A colour monitor can display anywhere from 16 to 1 m1llion different colours. Colour monitors are sometimes called RGB (red. green. and blue) monitors because they accept three separate signals-red, green and blue. The colour monitor differs from the colour television as the latter uses composite video signals, In which all the colours are mixed together. An RGB monitor consists of three electron guns-one each for red, green, and blue-at one end of the screen.

The three electron guns fire electron at the screen which contains a phosphorous coating. When the electron beams excite the phosphors, they glow. Depending on which beam excites them, they glow red, green or blue. Ideally, the three beams should converge for each point on the screen so that each pixel (picture element) is a combination of the three colours.

Monitor Size: Monitors come in different sizes. Monitor size, like television size. is measured from one corner of the screen to its opposite corner, and the measurement is expressed in inches. Monitors of 14 inches and larger than these are cathode-ray tube (CRT) monitors. CRT monitors are most widely used for video display devices. The smaller monitors that are used on laptop and notebook computers are known as flat-panel displays.

Common types of flat-panel displays include liquid crystal display (LCD), electro-luminescent (EL) display, and gas plasma display.

In order to connect a monitor to a computer, graphics adapter board, I also known as a video card. is used. Each type of monitor requires a ; different type of board. The graphic board plugs into an expansion slot I inside the computer, and the monitor plugs into the board. For running graphics-intensive programs properly and quickly, most graphics boards come with some memory capability. known as video memory.

PRINTER :

A printer is an output device in the computer system that produces hard copy of output on paper (mostly), transparency, and other media. Printer is the only means of written-printed communication between the user and the computer as this translates the computer's Internal character representation Into alphanumeric Information familiar to the user. Though some printers can print graphics and pictures but their quality is low.

Therefore, for such purpose, plotters are used. Printers are categorized by whether anything mechanical actually touches the paper; whether they do or do not produce a solid character; and whether they produce a character, a line, or a

page at a time. On the basis whether anything mechanical touches the paper or not, printers are divided into two categories-impact printer and nonimpact printer. These Impact and nonimpact printers can print a character, a line or a page at a time depending on their technology.

Impact Printer :

When a part of printer presses the paper to form the character, the printer Is considered as Impact printer. Impact printers can produce copies along with the original printing. Impact printers are fairly loudy, although covers are available to muffle the noise. Impact printers can print a character or a line at a time. There are four types of impact printers-dot-matrix printer, letter-quality printer, chain printer and drum printer.

Dot-Matrix Printer : A dot-matrix printer prints one character at a time and each character as a pattern of dots. Dot-matrix printers do not have a fixed character form. Therefore. they can print any shape of character that a programmer can describe. This enables the dot-matrix printers to print text as well as graphics. such as charts and graphs. The print head comprises a matrix of tiny needles. typically 7 rows with 9 needles each. which hammer out characters in the form of pattern of tiny dots. The shape of each character is obtained from information held electronically in the printer.

The print quality of dot-matrix printers is inferior than letter-quality printers but dot-matrix printers are generally faster with speed ranging from 40 to 250 characters per second. These printers are comparatively cheaper. Therefore, if print quality is not a prime consideration. dot-matrix printers are more suitable.

Letter-Quality Printer : A letter-quality printer prints a character at a time. It uses a print wheel font, known as a daisy wheel. A daisy wheel consists of several petals and different characters are embossed on different petals. A motor spins the wheel at a rapid rate. When the desired character spins to the desired position. a print hammer strikes it to produce the character. The output of a letter-quality printer resembles a typed output and the quality of printing is superior to a dot-matrix printer. The speed of a letter-quality printer is slower as compared to a dot-matrix printer and ranges from 10 to 50 characters per second.

Chain printer : A chain printer uses a rapidly moving chain known as print chain. Each link of the chain is a character font. For each possible print position. there is a print hammer located behind the paper. As the print chain rotates. the properly timed print hammer strikes the paper, along with the ribbon against the proper character on the chain. Speed of chain printer ranges from 400 to 2500 characters per minute.

Drum Printer : A drum printer is basically a line printer which prints a line at a time. A drum printer consists of a solid, cylindrical drum that has raised character in bands on its surface. There are as many bands as there are printing positions. Each band contains all the possible character. For each possible print position. there is a print hammer located behind the paper. The drum rotates at a rapid speed and the hammer strikes the paper along with the inked ribbon against the proper character on the drum as it passes. One revolution of the drum is required to print each line. Typical speed of drum printers ranges from 300 to 2000 lines per minute.

Nonimpact Printer :

A nonimpact printer does not presses or strikes the paper but ink used for printing is spread by some other means. A nonimpact printer can produce only original and cannot produce a carbon copy. Because of their quality of print and speed of printing. nonimpact printers are increasingly becoming more popular. There are two types of nonimpact printers-ink jet printer and laser printer.

Inkjet Printer : An inkjet printer is a character printer in which electronically charged ink is spread through a jet nozzle and passed to an electronic field which deflects the ink to form a character. Inkjet printer produces high quality output because the characters are formed by dozens of tiny dots.

Inkjet printers can produce mult1-colo~r print. The document printed by an inkjet may contain multiple character styles and variety of type sizes. However, the speed of inkjet printers is considerably slower.

Laser Printer : A laser printer prints one page at a time. It works in the same manner as a photocopy machine works. In laser printers. a laser beam creates electrical charges that attract toner to form an image and transfer it to paper. The print quality of a laser printer is of high level and its printing speed is also high. The speed of laser printers ranges from about 4 to 20 pages of text per minute. A typical rate of 6 pages per minute is equivalent to about 400 characters per second. However, a laser printer is the costliest printing device. Therefore, laser printers are suitable only for those applications where high quality printing in high volume is required.

PLOTTER :

A plotter is an output device that produces hard copies of graphs and designs based on commands from the computer. A plotter differs from a printer in that it draws line using a pen. As a result, it can produce continuous lines, whereas a printer can only simulate lines by printing a closely spaced series of dots. Plotters are basically of two types-drum plotter and flatbed plotter.

Drum Plotter : In the case of a drum plotter, the paper on which the design has to be made is placed over a drum that rotates back and forth to produce vertical motion. The mechanism also consists of one or more pen holders mounted horizontally across the drum. The pen(s) clamped in the holder(s) can use to produce horizontal motion. The drum and the pen move simultaneously to produce the design and the graph. In order to produce multi-coloured designs. pens having inks of different colours can be mounted in different holders.

Flatbed Plotter : A flatbed plotter plots on paper that is spread and fixed over a rectangular flatbed table. In flatbed plotter system. the paper does not move and the pen holding mechanism is designed to provide all the motions. In the case of flatbed plotter. pens for different colours can be mounted which are used for multi-coloured plotting. The plot size is restricted by the area of the bed. Some beds may be as small as A4. size while some beds may be very large and can be upto 20x50 feet. These large beds are used in the design of cars, ships, aircrafts, buildings, highways, etc.

Plotters are normally very slow in motion because of excessive mechanical movement required during plotting. Therefore, there is a mismatch between the speed of CPU and the speed of a plotter. In order to overcome this mismatch

problem, in most cases, output is first transferred by the CPU to a tape and the plotter is activated to plot the design from the information contained in the tape. However, in the case of a computer system dedicated to design work. the CPU may send output directly to a plotter.

AUDIO OUTPUT DEVICE

Audio output device, also known as audio response device, is an output medium that produces verbal output from the computer system. In an audio output system, all the sounds are needed to process the possible enquiries on pre-recorded storage medium. Each sound is given a code.

When enquiries are received, the computer follows a set of rules to create a reply message in a coded form. This coded message is then transmitted to an audio output device which assembles the sound in the proper sequence and transmits the audio message back to the station requesting the information.

Audio output devices have a number of applications ranging from toys that entertain *young* children to businesses that are using audio output devices, such as banking, Insurance, Telephone, Railways, airports, etc.

COMPUTER OUTPUT MICROFILM

Computer output microfilm (COM) technology is used to record computer output information as microscopic film images. In COM. the information is recorded either on a sheet or roll of microfilm. A sheet of film measuring 4. x 6 inches is called a microfiche. (Fiche is a French word meaning card and is pronounced as 'fish'.) An ordinary microfiche is capable of holding 270 frames (pages of information) while an ultrafiche can store about 1.000 frames in the same space. Microfilm comes in the form of a roll.

Rolls of 16 or 35 mm film packaged in cartridges are also used for COM recording. COM recording devices store characters that are about 4.8 times smaller than those produced by conventional printers.

A COM recording device consists of a microfilm recorder that receives information either stored on magnetic tape/disk or directly from the CPU. After receiving the information, the reader projects the characters of output information on a CRT screen. A high speed camera. in-built into the system takes the picture of the displayed information. In some systems, the recorder processes the film from the camera and in other systems, a separate automated film developer is used. When the film is required in many copies. a film duplicator is used. For reading the contents of the microfilm or microfiche. a special device known as microfilm reader is used. The microfilm operates on a back projection principle displaying a frame at a time on a translucent screen, typically about A4 size. Some COM systems also use a reader-printer combination to produce a hard copy of what is displayed on the screen.

A COM system is ideal for use in applications where there is a large amount of Information to be retained such as manuals. Industrial catalogues and archives. Where companies need to retain records of such things as bills and invoices for a number of years. also find COM system useful. Generally, banking and Insurance companies, government agencies, public utilities and many other types of organizations are regular users of COM.

Chapter 13

MS DOS Operating System

1. Introduction :

Disk Operating (DOS) System is most important software for IBM personal computers (PC) or compatibles. Like any other operating system, DOS controls all activities on a computer. It decides where in memory to load any programs, transfers files from hard disk to memory, accepts data from keyboard, displays information on the screen, handles printing and so on.

There are two main types are DOS operating systems available for use : MS-DOS and PC-DOS. Both are developed by Microsoft corporation.

PC-DOS was developed specifically for IBM PC. Microsoft still owns PC-DOS and earns large amount of royalty fees from IBM. MS-DOS is very similar to PC-DOS but Microsoft sells it to IBM clone manufacturers or directly to customers. Both MS-DOS and PC-DOS are very similar.

When we switch on the computer, the computer will try to find DOS. It checks disk drive A first (you may notice the light glow of drive A) although the DOS installed in disk drive C (hard disk). After the disk drive C is accessed and searched. If DOS is found, it is loaded automatically in to the memory (RAM). This process is called ***booting up***. Now you will see the DOS command prompt as follows :

C> _

Alternately your computer may booted up to Microsofts Windows operating system if it has been set up in your system. In such case you can boot up MS-DOS from Start menu and then from Programs. Now also you will see the DOS command prompt as follows :

C> _

The DOS command prompt is a prompt for you to type a DOS command. It is also sometimes called the System prompt. The letter C is the current disk drive. It can be A or B, if you log on to one of these floppy disk drives. Drive C is usually the hard disk and is default drive. The greater-than symbol (>) just tells you that this is where you should type your DOS commands. The small flashing dash (_) after it is called a cursor. This is where the first character you type will appear. The cursor will also move to the right automatically, ready to receive the next character, and so on. This invisible line where DOS commands are typed is referred to as the ***Command Line***.

2. DOS Basic Commands :

All DOS commands have a structure or a format. Each command is made up of up to three parts. Command, Parameters, Options or switches. For example, consider following DOS command :

C> dir a : / w

Here, “dir” is the command part, “a :” is the parameter, and “/w” is the option or switch part.
The parameter “a :” indicates that you want to see the files in the disk in A drive. The /w switch will display the directory in wide format, occupying up to five columns.

I. Commands for Displaying Directory :-

The DIR command can be issued in number of formats given bellow :

DIR	DIR A:
DIR /P	DIR A: /P
DIR /w	DIR A: /w

To read a pure text file (also called ASCII file) of name say aithal, type :

C> type aithal.txt

II. Changing disk drives :-

To access another disk drive, type the letter designated to represent the drive followed by a colon. For example, to access the A floppy disk drive, type :

C> a:

Ensure that you have inserted a floppy disk into your drive A before accessing it.

To access the C drive (hard drive), type :

A> c:

III Making the Directory :-

For creating a new directory type the command as

C:\> MD BOOK
This will create new subdirectory by the name BOOK.

IV. Changing the Directory :-

In DOS operating system, the main directory (say c) is called the root (represented by a backslash "\" symbol) and all other directories are sub-directories. A sub-directory from the root can also have other sub-directories and so on. (This is exactly like folders, sub-folders in windows operating system.)

For example,

C> cd \ accounts

This changes the directory to accounts which exists directly under root.

C> cd \ accounts \ feedata

This changes the directory to feedata which exists under accounts. Note that the whole path needs to be specified.

The following command changes the directory to the root :

C> cd \

The CD command is a short version of CHDIR command, standing for Change Directory.

DOS hierarchy is :

Drive -> Directory -> Sub Directory -> File name

For example,

C:\letters\personal\raju.txt

V. Changing Computer Date and Time :

You can change or set correct date and time on your PC or just check it ! by typing :

C> date

Then the system will display the current date as follows :

Current date is Tue 21 – 02 – 2003

Enter new date (dd-mm-yyyy) : _

To reset the date to 4th March 2003, type :

04 – 02 – 2003

If the date is correct and you don't want to change it, just press the Enter key.

To check the current time type :

C> time

The computer may display :

Current time is 10 : 37 : 29.56a
Enter new time :_

To set the new time to 3.45 p.m. say, type :

15 : 45

Since, the computer has 24-hour clock, you have to do so. You need not change the second and hundredth of the second.

DOS versions :

If you don't know which version of DOS you have installed on your computer, just type :

C> ver

Now DOS will tell you whether it's version is 2.0, 2.1, 3.1, 3.2, 4.0, 5.0, 6.0, 6.2 etc.

Clearing the Screen :

To clear the screen quikly (!) type :

C> cls

Now whole screen will clear.

Help on a DOS command :

For DOS version 5 and above, you can use the HELP command followed by DOS command to obtain information on how to use specific command (including the parameters and options you can use). For example :

C> help dir or dir / ?

Help on its own will display all commands alphabetically.

The Prompt Command :

When you are moving around different directories at the command prompt, it is difficult to know which directory / subdirectory you are using at a time. To solve this, the PROMPT command can be used to change the DOS command prompt and give you this information. For this type :

C> prompt pg

This changes the command prompt to display current directory too. For example, when you are at the root directory, the command prompt will look like :

C : \ >

The \ again indicating that it is the root directory. If you change to aithal directoary, the command prompt changes to :

C : \ aithal >

Changing the directory again to PERSONAL will show :

C : \aithal \ PERSONAL >

IV. Internal and External Commands :

There are two types of DOS commands that you can issue at the DOS command prompt : internal and external. Internal commands include :

COPY, DEL, DIR, TYPE, COPY, MD, CD, DATE, TIME, CLS etc.

These commands can be issued from any disk drive or directory because they are in the computer's memory (RAM).

External commands, however, are not in the memory to start with. They resides as separate files on hard disk; one for each command. When you issue an external command, the relevant file has to be located and loaded into memory from disk – just like when you want to run a program. Examples for external commands include :

BACKUP, CHKDSK, FORMAT, UNDELETE, DIDKCOPY, MOVE etc.

VI Basic File Commands :

DOS manages Files are basic units of information. All your work is stored in a number of files. These files include word processor documents, spreadsheet forecasts and graphic illustrations.

1. Naming MS –DOS Files :

A DOS file name is divided into two parts :

* The file name, which identifies the specific contents of a file.
* An optional extension, which identifies the type of the contents.

For example : srinivas.txt
Book.EXE

Following rules are used to govern the file name :

(1) The file name can not exceed 8 characters in length (1-8 characters).
(2) The extension portion can not be more than 3 characters (0-3 characters).
(3) You have to use a period to divide the file name from extension.
(4) You can not include a blank space in either the file name or extension portion.
(5) A file name and name extension can contain alphabet, as well as numbers and they can start with alphabet or number.
(6) You can not use certain characters like "/ \ [ ] ! < > + : = ; ? "
(7) A file name can not contain more than one period symbol.
(8) A file can not have same name as another file in the same directory.
(9) A file name can not be from following reserved words. These words have special use for the DOS. These are AUX, COM, CON, LPT, PRN.

File name extension for different software are as follows :

1. BAK - Back-up file, when a file is saved after some change, old file is renamed with .BAK extension
2. BAS - Basic language programs.
3. BAT - DOS Batch files.
4. BIN - Binary files. Files that contains instructions to computer.
5. CDR - Coreldraw files
6. CHK - File created by DOS CHKDSK command.
7. COM - Command file, a file contain instructions for DOS execution.
8. DAT - Data file.
9. DBF - Data file created by DBase program.
10. DBT - Data file created by DBase program.
11. DLL - Dynamic Link Library, files that contain instruction for computer, used by Windows program.
12. DOC - Document files, contain text.
13. EXE - Executable file, instructions executed by DOS.

14. FNT - Font file.
15. GIF - Graphic Image File.
16. HLP - Help file.
17. LBL - Label file, created by dBase program.
18. NDX - Index file for data, created by dBase program.
19. OVL - Overlay file. Files that contain instruction for computer.
20. PIF - Program Information file, used by Windows.
21. PRG - Program files contains dBase program.
22. SYS - System files, used by DOS, contain instruction for computer.
23. TIF - Tagged Image Information File, image files.
24. TTF - True Type Font file, font file used by Windows
25. TMP - Temporary file used by many programs.
26. WK1 - Spreadsheet file, used by Lotus 1-2-3 program.
27. ZIP - File compressed using the PKZIP program.
28. $$$ - Temporary file created by many programs.

2. To see a Directory :

Type **DIR *. *** on command line. This will list all the file contained in that directory.

If you type **DIR * .EXE** on command line, all the files with extension EXE will be listed.

If you type **DIR A *.*** on command line, all the files beginning with A will be listed.

3. Copying just one File :

Using the COPY command you can easily copy a file. For this you want to know the name of the file and where you want to copy it to. For example, to copy a file named srinivas.txt from your hard disk C to a floppy disk A, type :

C> copy srinivas.txt a:

This assumes that you are issuing the COPY command from the appropriate directory in your C disk. If you are not in that directory, prefix the filename with the correct path :

C> copy c : \ aithal \ teaching \ srinivas.txt a:

The path can also be specified on the other side (the destination side) of the command. For example,

C> copy c : \aithal \ teaching \ srinivas.txt b : \ mis

4. Formatting a Disk :

Type FORMAT Disk Name. For example,

C:\> FARMAT A:

This will format the floppy inserted in Drive A.

5. Assigning Label to a Disk :

To label a disk after formatting and storing some files following command can be used :

C:\> label a: ACCOUNTS_2000

6. System Disk Formatting :

While formatting a disk, it is possible to copy the main DOS system files to it too. For this :

C:\> format a: /s

The system program will be copied in formatted floppy disk.

If you want to copy entire system DOS program to a already formatted floppy, use following command :

C:\> sys a:

The above command is same as /S option on the FORMAT command.

7. Duplicating a Disk :

To duplicate a disk from drive A (source) to a disk inserted in drive B (target), type :

C :\> diskcopy a : b :

If you only have one disk drive and you want to duplicate a disk, type :
C;\> diskcopy a : a :

First insert source disk and then the target disk.

8. Comparing Disks :

If you want to compare the content of two disks after DISKCOPY operation, use DISKCOMP command.

C> diskcomp a: b:

For DOS version 5 and above, instead of DISKCOMP, after DISKCOPY, type following single command.

C> diskcopy a: b: /v

9. Working with Hard Disk :

For formatting hard disk type on command line

C> format C:

To make hard disk ready after purchasing a new computer, use FDISK command.

C:\> FDISK ↵

This will start FDISK program and display the FDISK main menu on the screen. You can choose various options from menu.

FDISK command is mainly used to partition a hard disk drive, to divide a hard disk drive into number of logical drives. However, even if you do not want to divide the hard disk into number of smaller partitions, you must use the FDISK program and specify the complete hard disk drive as a single partition.

For checking disk (status of files and directories) type

C> chkdsk

To compress the disk to increase the disk space (only in versions 6 and above) you can use Double space command.

C> dblspace

You can use the DBLSPACE command with following switches :

DBLSPACE/COMPRESS	Compress a hard disk drive or floppy disk.

DBLSPACE/CREATE	Create a new compressed drive in the free space on an existing drive.
DBLSPACE/ DEFRAGMENT	Defragment a compressed drive.
DBLSPACE/ DELETE	Delete a compressed drive.
DBLSPACE/ FORMAT	Format a compressed drive.
DBLSPACE/INFO	Display information about compressed drive.
DBLSPACE/ LIST	Display a list of drives on ypur computer.
DBLSPACE/ MOUNT	Mount a compressed Volume File (CVF)
DBLSPACE/ RATIO	Change the estimated compression ratio of a compressed drive.
DBLSPACE/ SIZE	Change the size of a compressed drive
DBLSPACE/ UNCOMPRESS	Uncompress a compressed drive.
DBLSPACE/ UNMOUNT	Unmount a compressed drive.

For scanning the hard disk, to analyze and repair problems,

C> scandisk C:

10. Moving files :

To move a file from one directory to another :

C> move myfile.doc \ windows

Here, Myfile.doc will move from the current directory to the windows directory.

If file with same name exist in that directory, it will be over-written.

11. Renaming Files :

To rename the file without making a copy of it, use REN command :

C> ren aithal.txt aithal.new

First filename typed after REN will be renamed as second filename.

You can use wildcards to rename several files

C> ren *.txt *.old

All files in the current directory ending with .txt will be renamed with a new file extension, .old.

12. Deleting Files :

To delete files use either DEL or ERASE commands.

C> del srinivs.txt

To delete all the files in that disk use wildcard

C> del *.*

13. Undeleting Files :

To undelete the deleted file, use UNDELETE command.

C> undelete srinivas.txt

By typing undelete /list, one can list the list of all files that can be recovered.

C> undelete / list

C> undelete /all This will recover all deleted files.

14. Printing Files :

To print a text file from DOS, type :

C> print srinivas.txt

Another easy way to print text files is to use the COPY command :

C> copy srinivas.txt prn

This will copy the srinivas.txt file to your printer, designated by prn.

15. Virus Scanning :

MSAV (Microsoft Anti Virus) command is used to scan files on your storage device for known viruses. The following command scans the disk in the A: drive for known viruses.

C : \> MSAV A : ↵

The following command scan the disk in drive A and remove any virus found.
C:\ > MSAV A :/C ↵

VSAFE is a memory – resident program which continuously monitors your computer for virus like activity and displays warning when it finds any.

This is an external command.

C : \ > VSAFE ↵

The above command will install the VSAFE in the computer's memory.

If you want to remove the VSAFE from memory use following command.

C:\> VSAFE / U ↵

16. GRAPHICS - Printing Graphics

GRAPHICS command loads a memory resident program GRAPHICS.EXE into the memory. This program allows DOS to Print the graphics displayed on screen to a variety of printers. This is an external command.

The following command will load the program GRAPHICS.EXE into computers memory. Then you can use Print Screen (PrtSc Key) to print screen images to a printers.

4. Installing DOS :

When you purchase DOS, it comes to you in a number of floppy disks. To install or to copy the DOS into your machine you need to copy the DOS from the floppy disk to the hard disk drive.

This process of copying DOS from the floppy disk into your machine's hard disk is called "Installing the DOS".

Once the DOS is installed on the hard disk drive, you will not require the DOS floppies. Every time the computer is switched on, the computer will start the DOS from the hard disk drive.

To install the DOS Do following steps :

1. Turn off your computer, if it is on.
2. Insert the setup disk number 1, received with the DOS package, into drive A.
3. Switch on the computer.
4. Wait for sometime for the computer to load the DOS from the setup disk into the computers memory. At the end of this process you will see A:> prompt on the screen.
5. Once the DOS prompt comes on the screen, type SETUP and press Enter key as shown below :
   A : \ > SETUP ↵
6. This will executes the DOS installer program SETUP. Now follow the instructions appearing on the screen, given by the SETUP program.
7. To check that the install is done properly, remove the floppy disk from the A : drive, and switch off the computer. Now switch on the computer without the DOS disk in A : drive.
8. If the install process was successful then the DOS should be started from the hard disk without any trouble and you should get the DOS prompt C: \> on the screen.

5. Batch Processing :

Batch Files :

A batch file is basically a text file with .BAT extension, that contains one or more DOS commands, each command on a different lines.

When this file is executed at DOS prompt, the commands in the file are taken by DOS, one at a time and executed.

For example, if you have WordStar program in the WS directory then to use the WordStar, each time you need to type the following three DOS commands

C : \ > **CD \ WS** ↵

(this will take you to WordStar Directory)

C : \WS **WS** ↵

(This command will start the WordStar program)

After using the WordStar, to go back to root directory type

C : \ WS> **CD ** ↵

Instead of typing these three commands each time, you can use batch file W.BAT (you can use any primary name).

To make the batch file for the above, you can use the following DOS command

C : \ > **COPY CON W.BAT** ↵

Now type following DOS commands one after another.

CD \ WS ↵
WS ↵
CD \ ↵

After typing the above three lines, in the fourth line, press Ctrl + Z keys and press the Enter key, this will take back to the DOS prompt.

^ Z ↵

C : \>

Now you will have a batch file W.BAT on your directory.

To execute /run this batch file type **W** at the DOS prompt and press **Enter**.

C : \ **W** ↵

Now you can see that all three commands that you have typed in the W.BAT batch file, execute one after another.

CALL – Calling one batch file from another batch file :

CALL command is used in a batch file to call one batch program from another without causing the first batch program to stop.
For example, to run the START.BAT program from W.BAT program, include the following command in the W.BAT batch program.

CALL START . BAT

GOTO – Directing batch program flow to a line identified by a label :

The GOTO command directs MS-DOS within a batch program to a line identified by a label. When MS-DOS finds the label, it processes the commands beginning on the next line.

This command is used in only in batch programs.

GOTO label

The label cannot include separator such as spaces, semicolons or equal signs.

GOTO uses only the first eight characters of label.

The label value specified on the GOTO command line must match a label in the batch program.

MS DOS recognizes a batch-program line beginning with a colon (:) as a label and does not process it as a command.

The following batch program formats floppy in drive A:. If the operation is successful, the GOTO command directs MS-DOS to a label named NOERROR, otherwise an error message is displayed.

```
ECHO OFF
FORMAT  A:/Q/U
IF NOT ERRORLEVEL 1 GOTO NOERROR
ECHO AN ERROR OCCURRED DURING FORMATTING.
GOTO END
:NOERROR
ECHO SUCCESSFULLY FORMATTED DISK.
:END
```

REM – Including comments in a batch file or in CONFIG.SYS file :

The REM command can be used to add some remarks in the batch file and CONFIG.SYS files.

When using the remark in a batch file, use the following syntax :

REM [string]

The parameter [string] specifies the comment you want to add to batch file.

ECHO – Display / Hide text in batch program :

ECHO command displays or hides the text in batch programs when the program is running. It also indicates whether the command –echoing feature is on or off.

When you run a batch program, MS DOS typically displays (echoes) the batch program's commands on the screen. You can turn this feature on or off by using the following syntax of the ECHO command.

ECHO [ON/OFF]

ON / OFF specifies whether to turn the command – echoing feature on or off.

To use the ECHO to display a message, use the following syntax :

ECHO [MESSAGE]

Message specifies the text you want MS – DOS to display on the screen.

To display the current ECHO setting, use the ECHO without a parameter.

****

Comparisons between MS DOS, MS WINDOWS and UNIX Operating Systems :

No	Feature	MS DOS	MS WINDOWS	UNIX
1	Multi-tasking	Not Available	Available	Available with better feature
2	Multi-programming	Not Available	Available	Available with better feature
3	File concept	Not applicable (EXE Files)	Not applicable (EXE Files)	Any type of files
4	Core Concept	Not available	Not available	Available
5	Graphical User Interface	Not available	Available	Available
6	Object linking & Embedding	Not available	available	available
7	Networking & Internet	Not available	Available	Available
8	Virus affection	Possible	Possible	Not Possible
9	Security	Low	Low	High

CHAPTER 14

MICROSOFT WORD

1. MS word Basics
2. Paragraph Formatting
3. Tables
4. Inserting Objects
5. Page Design
6. Mail Merge
7. Views & Zooming
8. Printing & protecting
9. Style & Templates

1. MS-WORD BASICS :

MS Word is a word processor developed by Microsoft Corporation. Using this you can create, edit and print the documents according to your requirement. You can also use features like auto correct, spelling and grammar checking, text formatting, mail merge, graphics, table etc.
The minimum system requirement to run MS Word are 80486 or higher microprocessor, Hard disk with minimum 100 MB, minimum 16 MB RAM, VGA monitor, Keyboard and Mouse.
To start MS Word 95/97/2000, select Start → Microsoft Word. Word opens an empty document after displaying the Logo.

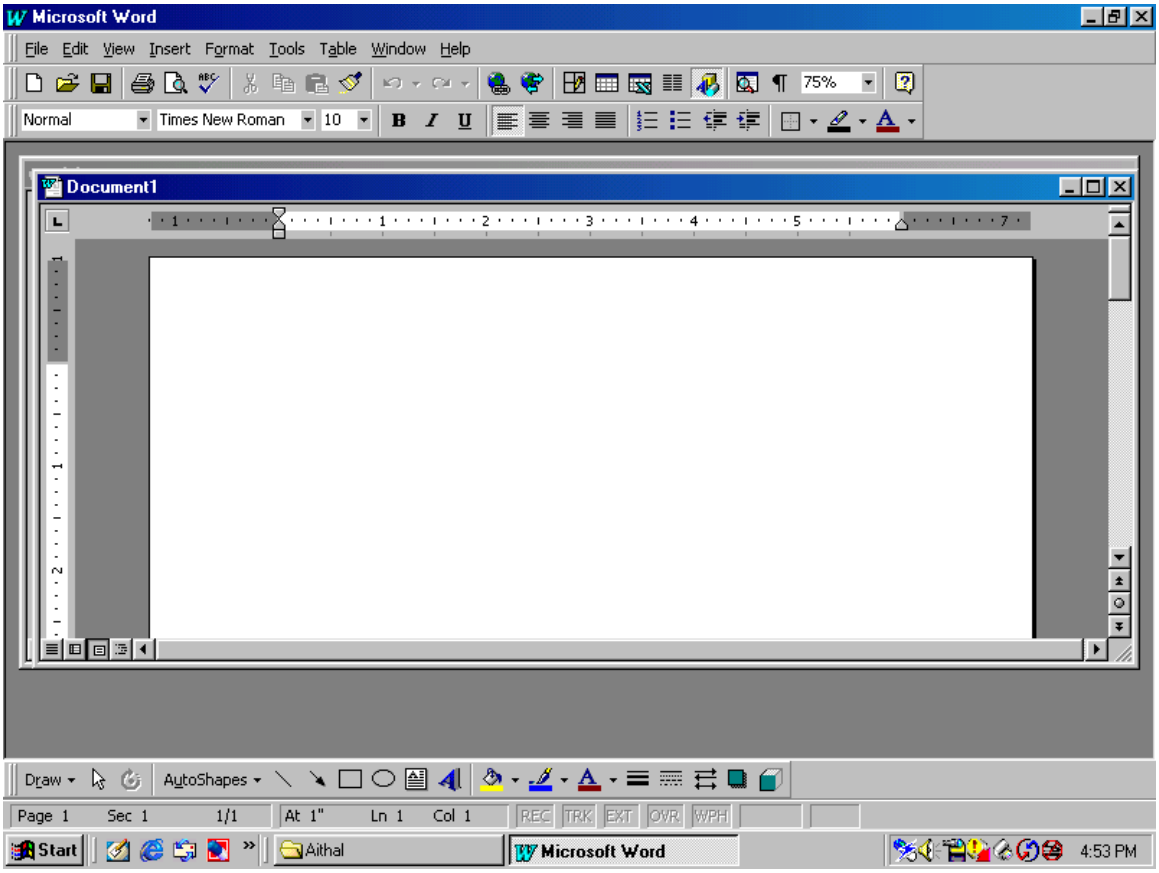
1.1 PARTS OF MS Word Screen :

Identify the following parts in MS Word Screen.
Control box, Title bar, Minimize, Maximize, Restore and Close buttons, Menu bar, Standard Toolbar, Formatting Tool bar, Ruler lines (Horizontal and vertical), View bar (4-Normal view, Online layout view, Page layout view, and outline view), Drawing toolbar, Status bar and Task bar.

1.2 **Creating a Document** :

When you load the MS Word, a blank window will display automatically. Type the text in this document window. Note the following tips.

- Type the text at inserting point. While typing, when the right margin is encountered, the insertion point will automatically return to the next line with out entering Enter key.
- To change the paragraph, press Enter key.
- To start a new line without considering it as a new paragraph, press Shift+Enter.
- In case of mistakes, to delete backwards, press Backspace. To delete character at the cursor (insertion point), press Delete key.
- To edit a word, the cursor must be moved to that word by clicking the left mouse button on that place.



- By using Arrows keys, Page up, Page down keys, Home, End, and Ctrl + these keys, you can move the cursor to different places in the document.
  Ex: Type a 3 paragraph text and study various cursor movements.

1.3 File operations :

Study the following File Operations.

1. Saving the File> Using File → Save and Save As or Save icon
2. Creating a new File > Using File → New or icon
3. opening a File> Using File → Open or icon
4. Closing a File > Using File → Close or icon

1.4 Editing the Text :

Editing a process of changing the appearance of the text by deleting, duplicating or moving a part of it. For this, you must first select a portion of text, which needs the change.

Ex: use following methods to select a portion of the text.

1. Click and drag 2. Click and Shift Click 3. Double Click on the word.
4. Click on line from outside 5. Ctrl+ Click 6. Double click on a line
7. Ctrl + Click to block entire document 8. Alt + click and drag to block Column wise

1.5 Simple formatting the text :

Study various formatting features, like – font, font size, fold, italics, underline, text color, text background and text border by blocking a portion of text and clicking on appropriate icon on formatting toolbar.

Study how to remove them.

Study the advanced formatting features like - different types of underlines, Subscript, Superscript, Spacing between characters, and Animation by using Format.
→ Font →Font dialog box.

1.6 Changing the Case of the Text :

You can change the case of the text to Upper case, Lower case or Toggle case by selecting Format and then Change Case.

1.7 Moving the Text :

Following steps can be used to move the piece of text from one place to another place or from one file to another file.

- Block the text to be moved.
- Select Edit → Cut.
- Click on new place where the blocked text should appear.
- Select Edit → Paste.

1.8 Copying the Text :

The steps required are

- Block the text to be copied.
- Select Edit → Cut.
- Click on the new place where the blocked text should copied.
- Select Edit → Paste.

1.9 Undo, Redo and Repeat :

For this, either go through Edit or click the corresponding icons.

1.10 Existing the Word :

To exist from MS Word, do one of the following.

- Click on Close button.
- Select File → Exit.

2. Paragraph Formatting

In MS Word, a paragraph may be a text, graphics or other items that is followed by a paragraph mark. Paragraph mark is not displayed unless the Show/hide icon in standard toolbar is selected. This paragraph mark is inserted every time after Enter key is pressed.

To make any changes in the paragraph, first select the paragraph, then use Format → paragraph option. To gives a Paragraph option. This gives a Paragraph dialog box. From this you can align paragraphs, create line spacing, indent the paragraph, and specify line and page breaks.

2.1 Paragraph Alignment:

Study Left alignment, Center, Right alignment and Justified from Formatting toolbar as well as Format → Paragraph option.

2.2 line Spacing :

Study various types of line spacing from Format → paragraph option.

2.3 Spacing between Paragraphs:

Set different spacing before and after a paragraph using Format → Paragraph option.

2.4 Paragraph Indents :

In a letter You may wish to start the first line of every paragraph after some space.
These extra spaces are called indents.

Study the 4 types of indents → left, Right, First line, and Hanging (Which leaves a gap at the left side of paragraph except for first line). For this use Format → Paragraph option.

2.5 Drop Cap :

Drop cap is used to drop the first character of a paragraph to spread over more than one line (i.e., larger in size.) Drop cap can be specified using following steps.

- Select Format → Drop cap… option
- Select the position – Dropped or In Margin.
- Select the font of the word to be dropped.
- Specified the number of lines to be dropped.
- Specify the distance to be maintained between dropped text and the remaining text.

2.6 Borders and Shading :

Borders can be specified for paragraphs and pages. Also to emphasize the paragraph, the text can be shaded.

1. Paragraph Borders :

Various borders can be applied to a single paragraph or a group of paragraphs. Different styles of borders, like - thin, thick line, double or doted lines are available with different colors. Shadow can be also selected for right side or left side of a paragraph. To apply borders to a paragraph perform following steps.

- Click on the paragraph.
- Select Format → Borders and Shading.
- In borders tab, from settings select Box, Shadow 3-D or Custom.
- Select the line style of border.
- Select the line color of border
- Select the width of the line and click on OK.

Ex: Check how to remove paragraphs borders.

2. Page Borders :

You can also apply border to the full page. The steps required are

- Click on any page in the document.
- Select Format → Borders and Shading.
- Select the second tab Page Border.
- Select the type of the boarded from the settings or select an Art from drop down list.
- Under apply to : drop down list, whether page boarder is to be applied to the whole document etc., and click on OK.

Ex: Check how to remove the page boarder.

3. Paragraph Shading :

The paragraph shading can be done on one or any selected number of paragraphs using different colors. The steps required are

- Block one or more paragraphs.
- Select Format → Borders and Shading.
- From the shading tab, choose the desired color for filling, select the file style if required and click on OK.

Ex: Check how to remove paragraph shading.

2.7 Bullets and Numbering :

You can create Bulleted and Numbered list at the beginning of each paragraph using Bullets and Numbering icons or select Format → Bullets and Numbering. Also you can change the style of bullets from Bulleted tab.

Ex: Study more about it. Study also Outline numbering using Decrease Indent and Increase indent icons.

2.8 Tab Stops :

Tabs are used to type the text in columns. MS Word has tab stops set to every 0.5 inch by default. You can see these tab stops as gray thick marks that appear at the bottom of the

ruler. There are 5 types of Tabs as left, right, center, decimal and bar (thin vertical bar appears to separate the columns). The typed text can be aligned on the basis of these tabs. To set the tab stops perform the following steps.

- Select Format → Tabs to open the Tabs dialog box.
- Type the tan stop position number in inches.
- Select the type of leader if required.
- Click on Set.
- Repeat the above steps to set other tab positions.
- To remove the tab position, click on the tab stop number and click on Clear.
- To remove entire tab stops that are set, click on Clear All.
- Click on PK to come put.

Ex: Set different Tab stops using Ruler.

2.9 Checking Spelling & Grammar :

You can check the spelling of the words used in the document and also possible grammar and style errors.

In window 95 and above, the spelling errors are underlined with red color and grammar mistakes are underlined with green color.

Ex: Study these things in detail either using short cut menu (ABC) or selecting them in Tools menu. To correct the grammar, right click on such words.

2.10 Auto Text :

Frequently used words can be stored as Auto Text entries and can be inserted using few short cut keys. For example, Thanking you, Yours sincerely etc.

To store an Auto Text entry, type the text, and block it, then select Insert → Auto Text → New. A dialog box named Create Auto Text → New. A dialog box named Create Auto Text will appear. Type a short cut name to the Auto Text entry and click on OK. For example, You can give short cut name foe yours faithfully as YF.

To insert Auto text into the document, select Insert →Auto Text → Auto Text, click on the required shortcut name and click on Insert. You can also insert Auto text just by typing short cut name and pressing Function Key F3.

To delete the Auto Text entry, select Insert→Auto Text → Auto Text, click on the Auto Text short cut name to be deleted and click on Delete. To come out from dialog box, click on Close.

2.11 Auto Correct :

This is a facility used to correct the spelling of frequently typing word like Pandeshwar. This facility can be also used to get entire text just after typing its short cut without pressing any key further (unlike Auto Text). For example, by typing SRINIVAS you will get Srinivas College of P.G. Management Studies.

To create an Auto Correct entry, select Tool → Auto Correct. A dialog box will be displayed. Type the spelling of the word that we generally type e.g., SRINIVAS in Replace box. In With box, type the correct spelling of the word and click on Add on click on OK. Now onwards, if SRINIVAS is typed,. it will automatically convert to Srinivas College of P.G. Management Studies.

To delete the Auto Correct entry, select Tool → Auto Correct, click on the name of Auto Correct to be deleted and click on delete.

2.12 Word Count :

In MS Word, you can count the number o f pages, words, characters, paragraphs, and lines in the document. For this, select Tool → word Count, A dialog box will be displayed with the results.

2.13 Text Background :

Any pattern or picture can be displayed behind the text by selecting Format → Background. From the dialog box, select any color or select Fill effects… to select a design from gradient, texture, pattern or picture. If picture tab is selected from fill effects, click on Select picture button and select the name of the file that contains the picture (generally BMP file).

To remove the background, select Format → Background and click on No Fill.

Note: The background is visible in only Online layout view.

2.14 Breaks:

MS Word provides 3 types of breaks. They are, Page Break, Column Break, and Section Break. To insert any one, select Insert → Break. A dialog box appears.

Ex: study these things in detail.

2.15 Columns:

Columns are used to type the text in different columns. Text can be typed into the columns after defining the columns or the existing text can be converted into columns.

1. Typing the text by defining the columns:

perform following steps.

- Click on place where the text has to be in columns.
- Select insert → Break → Continuous, click on OK.
- Select Format → Columns. The columns dialog box will be displayed.
- Specify the number of columns required (two, three etc.)
- Specify whether a separator line is required in between the columns. If required, select the check box line Between.
- By default, the width of each column will be equal. If you want to have columns with different widths, change the width and spacing between the columns after deselecting Equal Column Width and click on OK.
- Type the text in the first column. When you have finished typing in first column and want to go to the next column, select Insert → Break → Column Break. Type the text in other columns.
- At the end of last column, select Insert →Break→Continuous.
- To end the columns and start typing the text as regular paragraphs, select Format → Columns and from Presets, select the number of columns as one.

Ex: Study how to create 3 equal columns and two unequal columns?

2. Converting existing text to columns text :

For this two methods available.

(a) To convert the existing text into columns text using Section breaks, include the continuous breaks at the beginning and at the end of the text. By clicking inside the text you can define the number of columns and its width etc.

(b) To convert the existing text into columns using the Block, block the text and define the columns by specifying the number of columns, width etc. This is preferred method of converting the text to columns because the number of lines in all columns will be equally distributed by including section breaks automatically.

3. Converting columns text to regular paragraph :

For this block the text written in columns and define the columns with number of columns 1.

3. Tables

In MS Word, table is any information arranged in rows and columns. Each intersection of row and column is considered as a cell. Any data especially numbers, is more presentable and easier to type in the tabular form.

1. Creating a Table :

To draw a table, you can use Draw a Table feature. For this, click on the Tables and Borders icon, or select, Table → Draw Table. With the help of a pencil tool, draw the table with any number of rows and columns.

To draw a table, you can also use, Insert table feature. For this, use following steps.

- Click on the portion of the text where the table must be created.
- Select Table → Insert Table.
- Enter the number of columns (between 1 to 63) and rows (between 1 to 32767) and click on OK.
- You can also insert a table by clicking Insert Table icon from the standard toolbar.
- This produces a grid containing 5 columns and 4 rows. Click on the box containing the table to specify number of rows and columns. For example, if you need a table having 4 columns and 3 rows, Click on the box of 3rd line 4th column. A blank table will be inserted in to the document.

2. Moving around the Table :

To move to any cell click inside that cell. You can use following keyboards for further movement.

TAB → To the next cell: Shift + Tab → To the previous cell.

→ Forward one character ← Backward one character

↑ To the previous row ↓ To the next row

Alt + Home → to the first cell in the row; Alt+End → To the last cell in the row.

Alt + PgUp → To first cell in the column; Alt + PgDn → To last line in column.

3. Typing in the Table :

Move to the appropriate cell and type next or number. You can go to next cell by pressing TAB key. Pressing Tab at the end of the row will move the insertion point to the next row and pressing Tab at the end of the table, will add a new row at the bottom of the table.

4. Selecting the Table :

1. To select entire table, click on any cell inside the table and select Table → Select Table.
2. To select a row, click inside any cell in that row and select Table → Select Row.
3. A row can also be selected by clicking in the selection area (space before first column in the left side) of the row to be selected. To select many rows, click and drag in the selection area of the rows.

4. To select a column, click on any cell in the column and select Table → Select Column. To select many columns, click and drag in the selection area (space above first row in the table) of the column.
5. To select a cell, click on the selection area of the cell (left side of the cell before to the cell content.

5. Inserting and Deleting a row or column :

To insert a row at the end of the table, click inside the last cell of the table and press tab key. A blank row will be inserted. To insert a row at the middle of a table, click inside any cell in the row, where a new row has to be inserted and select Table → Insert Rows. A blank row will be inserted.

To delete a row in the table, click on any cell in that row and select Table → Select row to select the entire row, then select Table → Delete Rows.

Ex: Study how to insert and delete a column?

6. Setting the row height and column width:

To align the table, i.e., to bring it to center or to the right side, select Center or Right from Alignment in Row of Cell Height and Width in Table menu.

7. Applying the borders:

Borders can be applied to any part of the table or entire table. For this select the cells (select the table for full border), and select Format → Borders and Shading. Select Grid (for inside boarders only) or Box (for outer boarder only) or All (for outer and gridline boarders), select the color and width , click on OK.

8. Sorting a table:

To sort the contents of a table, perform following steps.

1. Click on any cell inside the table, Select Table → Sort.
2. In the table, if there are column headings that should not be sorted, then select the option button My list has Header Row.
3. From the Sort by drop down list, select the column on which the table is to be sorted.
4. From the type drop down list, choose the type of content such as Text, Number or Date and select Ascending or Descending order.
5. Click on OK button to sort the data.

Note: When the table is created, generally the table will be displayed with gridlines. If the gridlines are not displayed, select Show Gridlines from Table menu.

9. Table Auto Format :

This can be used to format the table, using pre-defined table formats. For this, click inside the table and select Table → Table Auto Format. A dialog box of Table Auto Format will be displayed. Select the type of format like sample 1, Classic 1 etc and click on OK.

10. Merging the Cells :

To merge two or more cells and make them into one cell, select the cells to be merged and select Table → merge Cells. To split a cell into two or more columns or

rows, click on the cell to be split and select Table → Split cells. Specify the required number of columns and rows and click on OK.

11. Converting table into text and text into table :

(a) To convert the table to text by removing the gridlines, click inside the table and select Table → Select Table. Then select Table → Convert Table to text. Select how the text must be separated i.e., paragraph marks, commas, or other characters and click on OK. The table border will be removed automatically and the contents of the table will be converted into text.

(b) To convert a text written using spaces, Tabs, Commas or any other special character, block the text and select Table → Convert Text to Table. A dialog box will appear. Specify how many columns and rows are required, what is the text separator character used when typing the text and click on OK. The selected text will be converted into a table.

4. Inserting objects

You can insert date and time, symbol, pictures and word art.

1. Inserting Date and Time:

For this, click on the place where the system date and time to be inserted and select on required format. If the date insert into the file has to be changed automatically, every time the file is opened, click the check box Update automatically.

2. Insert Symbol :

For this, select Insert → Symbol. A dialog box will appear. Select symbol or special characters. Select required Font and click on desired Symbol, click on Insert and Click on Close.

3. Insert Drawings :

MS Word allows you to draw, resize, and reposition the graphics in the page layout view. To draw the designs, display the drawing tool bar if it is not visible. For this select View → Toolbars →Drawing. A drawing object can be selected using Shift + click. Selected objects can be rotated, flipped etc.

Ex: 1. Draw object and type text on it and select Draw → Order →Send behind text and also other commands.

2. Draw objects using Auto shapes.

4. Creation of Callout :

A callout is a text with the line that points to an area of interest in an illustration. Callout allows the user to type the text directly inside it. But, to type the text inside any other auto shape, right click on object and select Add text. To edit the text, simply click on text inside the object.

5. Insert Picture :

A number of pictures are available in MS Word that can be inserted into any document. To insert a picture into a word document perform following steps.

a. Click on the place, where the picture is to be inserted.
b. Select Insert → Picture → Clipart.

c. Select the required category and click on required picture from the selected category.
d. Select Insert and Click on Close.

To insert a BMP file into word document, select Insert → Picture → From File.
Select the file name to be inserted an click on Insert.

6. To type the word Art Text:

Do the following steps.

a. Click on the place where Word Art text is to be placed.
b. Select Insert → Picture → WordArt … WordArt Gallery will be displayed on the screen.
c. Click on required Word Art Style and click on OK.
d. Now Edit Word Art Text dialog box will appear.
e. In place of "Your Text Here", type the required text. Select the required font type, size, bold or italic and click on OK.
f. The text will be inserted into the document and Word Art tool bar will be displayed to make necessary changes.

5. Page Design

1. Header / Footer :

Header is a text that will be printed at the top of the page and Footer is the text that will be printed at the bottom of the page. The header and footer can include text or graphics such as page numbers, date, the logo, file name, authors name etc.

To add a Header or Footer to a document, select View → Header and Footer. A box will be displayed to type the header text along with Header and Footer toolbar displayed below the box.

Ex: Work more on Header and Footer. Insert page number, date , time etc. Align the text.

2. Footnotes and Endnotes:

These are the reference notes written at the end of the same page or at the end of the document. Footnotes will be printed at the end of same page and Endnote will be printed at the end of the document.

For this, place the cursor at a position where the note mark has to appear and select Insert → Footnote. A dialog box will appear. Select whether Footnote or Endnote has to be written and style of numbering. Instead of number, if any symbol by selecting appropriate font. To start typing the footnote or endnote text, click on OK.

If Footnote is selected the cursor will appear at the bottom of the page by displaying the footnote number or symbol where footnote text can be typed. If Endnote is selected. The cursor point will appear at the end of the document. To return to the text click outside the footnote area.

6. Mail Merge

Using Mail Merge facility, you can quickly create from letters, mailing labels, envelopes and catalogs by merging the information from two different files. Mail merge is used to print multiple copies of a particular letter addressed to many members. Mail Merge requires 3 steps.

1. Creating a Main Document.
2. Creating a Data Source

3. Merging two files.

Main document contains subject matter to the letter to be printed. It may contain, text, graphic objects, data etc. It has to be specified that, where the data from Data Source is to be inserted into it.

Data Source file contains information in the form of records, to be inserted into the main document. Each record contains one member information (say address).

1. Creating Main Document

Open a new document first to create a Main document. For this select File → New. Then select Tools → Mail Merge. A mail merge helper dialog box will be displayed on the screen.

Click on Create button to display the available formats (form letter, mailing labels, envelope or catalog) of the main document. A List will be displayed.

From the list, click on Form Letters.

Then one more dialog box will be displayed asking the place to create the main document (whether in the Active Window (current file) or in a New Document). Click on Active Window to create the main document in active window. An Edit button will be displayed to the right of Create button. Before selecting Edit in Main document, you have to specify the address of members to whom the letters must be sent by creating Data Source.

2. Creating Data Source :

2.1 To create a data file which contains address, click on Get Data Source. A data source button with Get Data List will be displayed.

2.2 Click on Create Data Source, which display a Create Data Source dialog box. Here you can retain only required Field name in header row, by removing others using Field name and Remove field name buttons. Then click on OK.

2.3 A dialog box will be displayed to specify a name for the data source. Type a name and click on Save.

2.4 Another dialog box will be displayed asking to Edit the Data Source or Edit the Main Document. Click on Edit Data Source, which display another Data Form Dialog box. Type the addresses of each record. Type the details by pressing Enter after typing the name, address etc.

2.5 To type the other addresses, click on Add New button. After the typing is completed click on OK.

2.6 Data form dialog will end and a blank screen will be displayed to type the subject matter of the letter.

2.7 Type content of the letter. Wherever the content of data source is to be included, click on Insert Merge Field icon available in Mail Merge Toolbar.

2.8 This will display a list of available fields in the data source. Click on desired field name to insert into the file.

2.9 After typing the letter, save it under any name.

2.10 To merge the data source with the main document and to print it for every address in the data source, select Tools → Mail Merge.

2.11 Mail Merge Helper dialog will be displayed. Click on Merge displayed at the bottom of the dialog box. This display a Merge dialog box.

2.12 By default the merging will be done in a new document and a letter will be printed for every address in the data source.

2.13 If the letter has to be printed for only few address in the data source, specify From and To for address numbers in Merge dialog box.

2.14 In merge dialog box, by selecting Merge button, you can merge the addresses with the letter.

The merged letters can be saved in a file and printed later.

3. Editing the Data Source :

To edit the addresses already entered in the data source, do the following steps.

1. Open the Main document.
3 Select Tools → Mail Merge. Mail Merge dialog box will be displayed.
4 Click on Edit in the Data Source. The data source name will be displayed below it. Click on the data source name to open it.
5 Addresses will be displayed one after another. Go to the address to be edited by changing the record number displaying the address, edit it and select OK.

Note: The data source can also be edited by clicking on Edit Data Source icon (last icon) in the mail merge toolbar.

7. Views and Zooming

1. Views :

In MS Word, a document can be edited by displaying it in different ways on the screen. This process is called View. There are 6 different views. They are normal View, Online Layout View, Page layout View, Print Preview, Outline View, and Master Document. Except Print Preview, others can be selected from view menu.

Ex: Study all these views in detail.

2. Full Screen :

The command View → Full Screen allows the user to view the text on the entire screen by removing the toolbars, menus, rulers, scroll bars and status line. After choosing this option, the menu bar will disappear. To return to the document, click on Close Full screen icon.

3. Ruler :

Ruler is used to quickly change the paragraph indents, to adjust page margins, to change width of table columns and newspaper style columns and set the tab stops.

To view or hide ruler, select View → Ruler. Both horizontal and vertical rulers will be displayed .

4. Zooming :

You can use zoom facility to change the display size of text on the screen. For this, select View → Zoom. A zoom dialog box will be displayed from which you can choose require zoom. The default is 100% . The Zoom control icon in the standard Toolbar can be also used for the same purpose.

5. Summary Information :

Summary Information of a file helps to search the files related to particular subject or created by a particular author. The extra information of a file like, the Title, Subject, Author, Keywords, and comments can be entered in Summary information.

To type the summary information, select File → Properties. Summary Information dialog will be displayed to type the title, subject etc. Type the required details and click on OK.

8. Printing & Protecting

1. Page Setup :

☞ Using Page Setup, you can set margins for the document, paper size, text alignment for printing etc. For this, select File → Page Setup. You will get Page Setup dialog box with 4 tabs – Margins, Paper size, Paper Source, and Layout.

☞ Margin tab can be used to specify the top, bottom, left and right margins of the document. Default top and bottom margins will be 1 inch and left and right margins will be 1.25 inch. An extra place at the left edge called gutter can be given. The position of Header and Footer

margins can also be specified. By selecting Mirror Margin button, two pages (even and odd) can be displayed to type inside and outside margins, instead of left and right margins. Finally, by selecting Apply to the settings can be applied to entire document or portion of it.

- ☞ Paper size tab can be used to specify the size of the printing paper. Default paper width is 8.5 inch and height is 11 inch. You can change this setting according to the size of the paper is used for printing. The orientation, Portrait (default, with less width and more height) or landscape (with more width an less height) specifies the manner of printing on the paper.
- ☞ Paper source tab can be used to specify the place where (manual feed or upper tray) the paper is to be taken by the printer for printing.
- ☞ Layout tab is used to specify header and footer. Vertical alignment can be used to specify whether the text must be printed starting from the top (default) or from center or from justified. Line number option is available to specify whether to print line numbers or not.

2. Print preview :

Print preview, chosen from File menu is use d to view how the document will actually appear on the printed paper. There is a facility to view one or more pages the text can also be edited in print preview screen.

3. Printing the document :

In MS word, an open file can be printed by selecting File → Print. A print dialog box will be displayed to select the name of the printer, Print range, No. of copies etc.

Ex: Study each more detail.

4. Protecting the document :

- ☞ A document can be protected from being opening or editing by others by giving a password. You can type two types of passwords : One to open the document and another to make changes in the document. A password can be given to an already existing document or a new document.
- ☞ To give the password to a file, select File → Saves As. From Save As dialog box, select options to display the save options in the form of Save dialog box.
- ☞ Here, the text box password to Open allows you to open the document only after typing the password correctly. The password is case sensitive. If the password is not known, the document cannot be opened or edited.
- ☞ The text box, Password to Modify allows you to save the modifications made in the document only if the password is known. You can open the document for Read Only and you can make some changes I the file but, you can not save Read Only and you can make some changes in the file but, you can not save under same name. If any changes are made after opening a document, save it under a new name.

5. Inserting a File into another File :

Any existing word document can be inserted into the opened document at the insertion point position, by selecting Insert → File. Select the name of the document to be inserted and click on OK.

6. Style & Templates :

1. Style :

Style is a collection of character formatting and paragraph formatting settings. Style reduces the time required for text formatting.

- For example, if the heading of the text is to be boldfaced, underlined, centered, with a required font size, color etc., the heading must be first blocked, then boldfaced, then underlined etc. On the other hand, by using required style, you can automatically boldface, underline, center the heading.

☞ Word has a number of built-in styles, which can be applied to different portions of document. You can also create your own style if it is not available in built – in styles.

☞ To see or to select the available styles, click on the drop down style list on the lower side of the Formatting Toolbar. Default style name is Normal.

2. Template :

Template is a pre-defined format of a document. Using templates is an easy way of creating documents. A template contains the format of the document which can be filled in blank places to create good documents. Generally templates are used to do repetitive work such as certificates, letters, circulars, bio-data etc.

To create a template of certificate, perform following steps.

☞ Open a blank document and type as shown in fig.1.

☞ The format of the document can contain text, drawing objects, WordArt text etc. The information to be entered must be left blank.

☞ When designing a template, it is better to view the screen small in size, say 50 % zoom control. After design is completed, to type the text, return to normal 100%

Srinivas College of Management

This is to certify that, Mr./Ms.----------

Is completed a short term course on Window Based

Applications successfully in 2003.

Principal

The Fig.1 is the template of a certificate that can be anybody who completes the course. After creating such document of the certificate, save it by selecting File → Save As… This will display Save As dialog box. Type a file name (say, Certificate) and from the Save As Type drop down list, select Document Template. Click on Save. Close the document.

- To use the template, select File → New. A list of template will be displayed. Click on the required template name (for example, Certificate) and click on OK. Displaying the information typed in the template will open a new document. Fill in the details (name and month) and print it. The original template will not be affected by typing the text (name & month) because the text is not actually written in the template, instead, it is written in the document.

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CH 15
INFORMATION & SYSTEMS

1. Information Concept :-

Information is the output of Information Systems generated using data. Information is processed data. Data is in the form of raw material and it is subjected to some manipulation or processing to generate useful information. When the data is processed and placed in a context, it becomes meaningful. Information System is analogous to light. When light is present, objects are visible. Information presents a picture of reality to a user who is not aware of that reality. Like light, too little or too much of information disturbs the picture of reality conveyed.

Information is a resource like materials and money. The purpose of information is to reduce uncertainty about decision situations and consequences. Information helps in understanding and analyzing problems and opportunities. It raises the confidence with which the decisions are made. Since the user of information places so much trust and belief on the information reported, generation and communication of information assume great importance.

Data and Information : -

Data is the result of measurements of various attributes of entities such as product, student, inventory item and employee. The measurements may be recorded in alphabetical, numerical, image, voice or other forms. Thus, the raw and unanalyzed numbers and facts about entities constitute data. On the other hand, information results from data has to be placed in a context for it to derive meaning and relevance. Relevance in turn adds to the value of information in decisions and actions. Data-processing requires some infusion of intelligence into data to generate information. The application of intelligence may be in the form of some principles, knowledge and experience to convert data into information.

Difference between Data and Information : -

Even if the words ‘data’ and ‘information’ are often used interchangeably, there is clear distinction between the two. Some of the major differences are as follows:

1) Data is fact, but information is not fact even if it depends on data.
2) Though information arises from data, all data does not become information. There is a lot of selective filtering of data before processing it into information.
3) The relation of data to information is that of raw material to finished product.
4) Data is the result of routine recording of events and activities taking place. Generation of information is user driven which is not always automatic.

5) Data is independent of users whereas information is user dependant. Most information reports are designed to meet anticipated information needs of a user or a group of users.

Definition of Information : -

The term 'Information' is a common word and it conveys some meaning to the recipient. It is very difficult to define it comprehensively. Yet, Davis and Olson give a fairly good definition. They define information as "data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or prospective actions or decisions".

This implies that information is:

- Processed data
- It has a form
- It is meaningful to the recipient
- It has a value, and
- It is useful in current or prospective decisions or actions.

Data processing and Information Processing : -

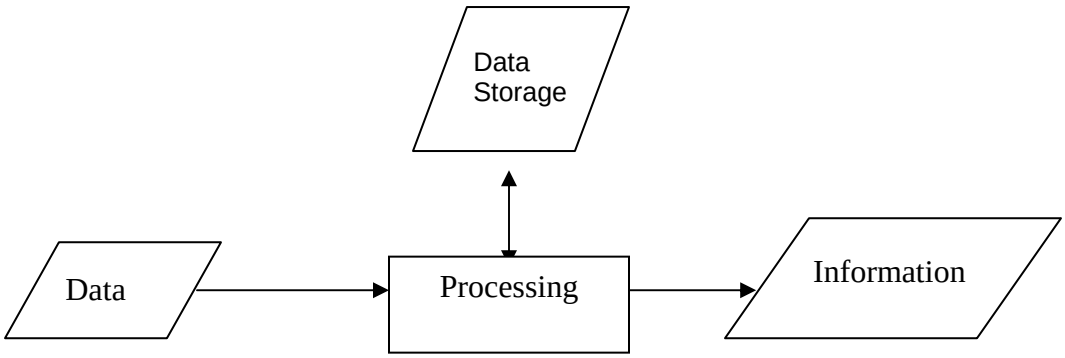


Fig 1.1: Transformation of data into information system.

Data, as it arises is ill structured. Forms, vouchers etc. are designed to capture data at source. The captured data is structured for storage or further processing. The database is huge repository for transition data. Data is retrieved from database for processing it into information. A series of operations are performed on the data to generate information. The type of operation to be performed on the data like aggregation, summarization, calculation etc, depends on the type and quality of information required. Information processing includes the traditional data processing as well as processing text, images, audio, video and animation. The focus of information processing is on creation of information products for users. The figure 1.1 shows the block diagram of transformation of data into information in an information system.

The analogy of raw material to finished product illustrates the concept that information for one person may be raw data for another – just as the finished product from manufacturing division may be the raw material for another division as given in fig 1.2. For example, shipping orders are information for the shipping-room staff, but they are raw data for the vice president in charge of inventory.

Because of this relationship between data and information, the two words are often used interchangeably.

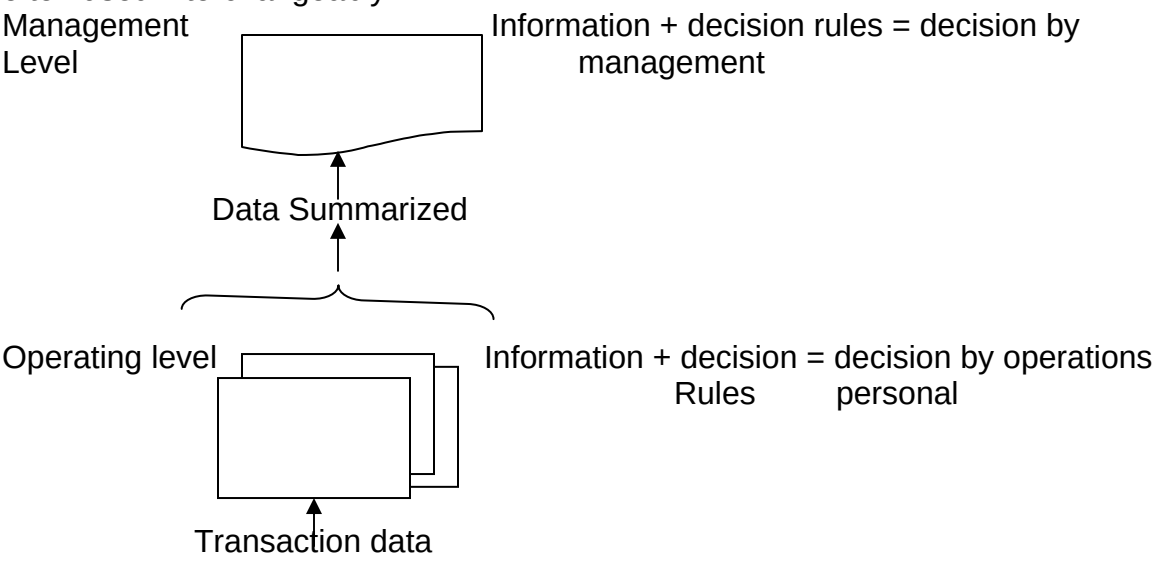


Fig .1.2: Data for one level of an organization may be information for another

Features of Information : -

Information possesses some features or attributes that give it value and usefulness. Some of the important features of information are:

- Information resources (in the sense of stored data of all types) are reusable.
- Information adds to a representation
- It corrects or confirms previous information.
- It has surprise element or news value.
- It has value in decision-making.
- It has value within the context of future decisions and actions.

Dimensions of Information : -

Information has many dimensions of interest to information system people, which are:

- Economic dimension,
- Business dimension, and
- Technical dimension.

The Economic Dimension : -

This includes both the cost of information and its benefits from use. The cost of information consists of the cost to acquire data, the cost to maintain data, and the cost for generating and communicating information. The cost is related to accuracy, speed of generation, etc. of information. If the system has to be more reliable and accurate, the costs have to be higher. In a given system beyond a certain level of accuracy the cost will rise rapidly. Costs are also related to the response time required to generate information and communicate it. For real time systems, where response time is low, the costs are very high.

The Business Dimension: -

The characteristics of information required by managers at different levels of hierarchy are different. The characteristics of information for top management are in contrast with those of operating level management. The information characteristics of middle management lie somewhere in between.

The top management requires information that is:

- future oriented,
- external,
- unstructured,
- non programmable, and
- in exact.

Whereas the operating management needs information that is:

- historical,
- internal,
- structured,
- programmable, and
- exact.

Since the top management is concerned with strategic planning and giving direction to the organization, it requires environmental information.

The Technical Dimension : -

The Technical Dimension of information is concerned with the database that is vital for any information system. The database is an orderly collection of centrally controlled data that minimizes data redundancy, facilitates storage of massive data, quick retrieval of data and ensures data security. The technical considerations of database are its capacity, response time, data interrelationships, security and validity.

Types of Information : -

Information broadly divided into two classes on the basis of its intrinsic nature and organizational use. They are

- ♣ planning information and
- ♣ control information

The strategic level management is mostly concerned with planning information and its requirement for control information is very limited as most of the control function is exercised at lower levels. On the other hand, the operational level management requires a large amount of control information and small amount of planning information.

Difference between planning and control information : -

- Planning information covers all organizational divisions and provides information about a few divisions or the entire organization. The control information covers to functions or divisions or such small area of responsibility
- Planning information covers a wider time span whereas the control information relates to a short time span say a shift to a few months at the most.
- Trends and patterns are more important in planning information. Fitness details are important in control information.
- The purpose of planning information is to guide planning by projecting trends and patterns whereas incase of control information; the purpose is to invite managerial intervention to correct a deviation. The planning information can also be classified into three categories such as
  - ➔ Strategic ➔ tactical and ➔ operational information.

1. Strategic Information : -

This relates mostly to organization as a whole and its surroundings such as information about population changes, natural resources, new technologies, new products, competitors, political, legal and economic changes, and so on. Top management needs strategic information for its long term planning which affects the whole or significant part of the organization over a fairly long period of time.

2. Tactical Information : -

This is required for short-term planning by middle level managers. Sales analysis and forecasts, cash flow projections etc. are examples of tactical information.

3. Operational Information : -

This information relates to very short period that may be a few hours to a few weeks. It may be about current stock levels of inventory, outstanding orders from customers, work schedule for next shift, etc. This information can be generated from current activity data arising from internal sources. It is of immediate use and is of interest to a few people.

2.1 System Concept :-

A system is a set of interrelated components. The systems are orderly arranged according to a design and each component has a definite function to perform in the system. The components forming a system are called subsystems. Each such subsystem can further be divided into lower level subsystems. This process of dividing system into lower level subsystems is called factoring of a system and this can be carried on until we get a unit, which is easy to manage. The hierarchy of systems is shown in fig. 2.1.

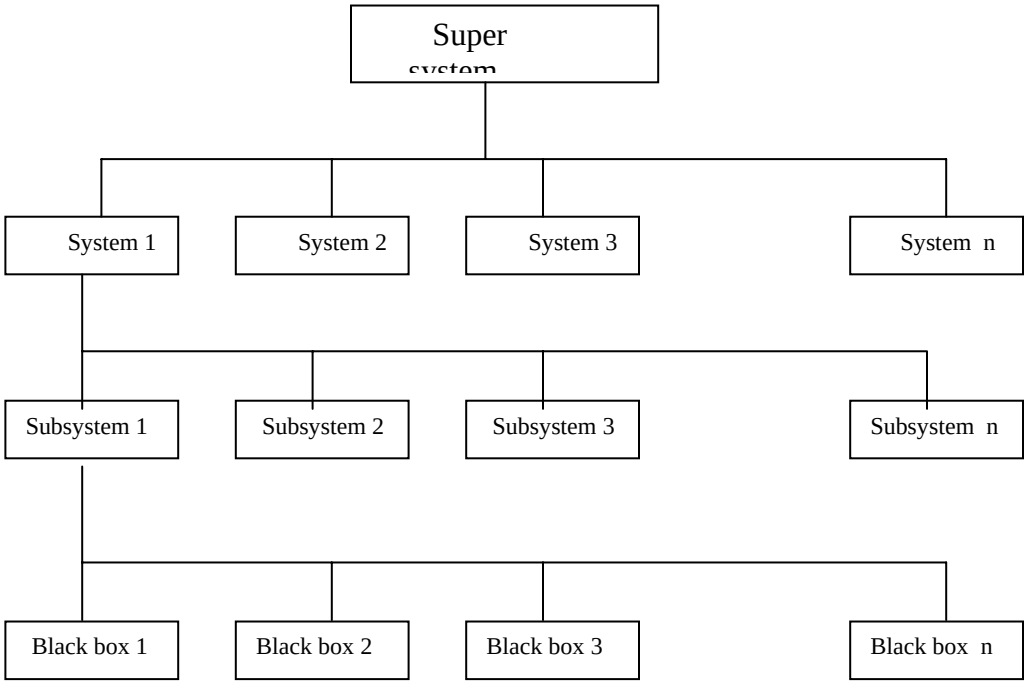


Fig. 2.1 : Hierarchy of Systems.

A system can be defined as an organized or complex entity, combination of things or parts forming a complex entity. The system may be Physical or Abstract.

The physical system is a set of elements which operate together to accomplish an objective. Physical systems are made up of objects such as land, building, machines, people and other tangible objects. An abstract system is an orderly arrangement of ideas, concepts, or constructs. For example, a system of theology is an orderly arrangement of ideas about God and the relationship of humans to God.

The physical systems produce some outputs which may help to achieve its defined objective. Organization systems are more meaningfully defined as an array of components designed to accomplish a particular objective according to a plan.

Examples for a Physical Systems :-

(1) **Animal circulatory system :-** The heart and blood vessels which move blood through the body.
(2) **Transportation system :-** The personnel, machines, and organizations which transport goods.
(3) **Weapons system :-** The equipment, producers, and personnel which make it possible to use a weapon.

(4) **School System :-** The buildings, teachers, administrators, and text books that function together to accomplish the goal.
(5) **Computer System :-** The equipment which functions together to accomplish computer processing.
(6) **Accounting system :-** The records, rules, procedures, equipment, and personnel which operate to record data, measure income, and prepare reports.

These examples shows that a system is not a randomly assembled set of elements; it consists of elements which can be identified as belonging together to accomplish a common purpose, goal, or objective. The parts of physical system (sub-systems) interact to achieve an objective.

2.2 General System Model :-

The general model of a physical system is a collection of related elements. These elements takes the form of input, process, and output and is represented as in following figure.

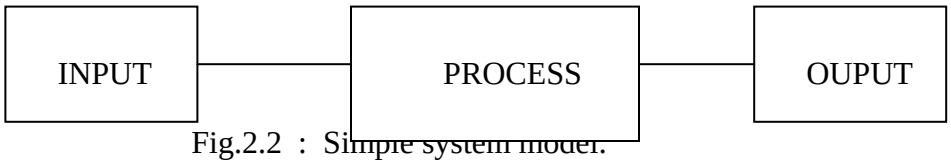


Fig.2.2 : Simple system model.

A system may also have several inputs and outputs as shown in fig 2.3.

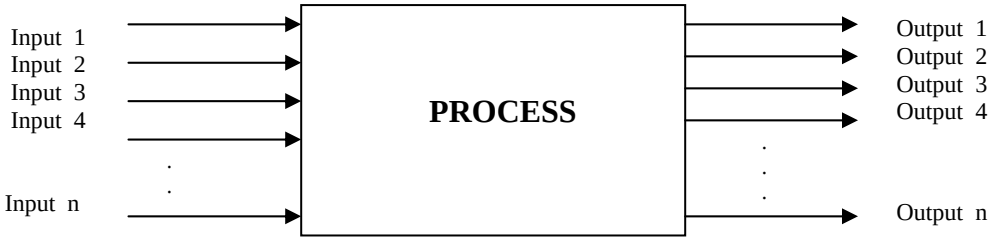


Fig. 2.3 : System with Many Inputs and Many Outputs.

System has many layers and at every level, a system can be considered to be a part of still larger system. It also means that at every level a subsystem can be a system relative to its objective. That means, it is objective that decides the system, subsystems, their functions and the systems environment. The features which define and delineate a system form its **boundary**. The system is inside its boundary and the **environment** is outside the boundary. Thus system boundary separates system and its environment. Open systems interact with other systems in the environment and exchange inputs and outputs. The boundaries of open systems are relatively flexible, whereas those of closed systems are rigid.

Total system is determined by definition. When the total system is determined, inputs of each part can be specified in relation to the objectives of the total

system. Once this is done, it is possible to analyze the functions and relationships among the parts and those of the parts in relation to the whole.

In some cases, it is easy to define what is part of the system and what is not. In other cases, the person who steady the system may arbitrarily define the boundaries. Some examples of boundaries are :

(1) In human system, skin, hair, nails, and all parts contained inside form system and all things outside the human body forms environment.
(2) In automobile system, the automobile parts in the body plus tires and all parts contained within form the system.
(3) In computer system, all parts including input, CPU, output, power system forms the system. The person working with it is an environment.

As pointed out earlier, each system is composed of subsystems, which in turn are made up of other subsystems, each subsystem is defined 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 (material, energy, or information).

There are subsystems at the lowest level where the inputs and outputs are defined, but not the process. Such systems are called a **black box**. A basic unit or black box which performs or provides the facility for performing some part of the defined transformation process can be defined as component; for example, a class room is a component in case of an educational system.

The idea of Boundary, interface and environment of a system is shown in fig. 2.4. As an example, a computer system along with its sub-systems and interfaces is shown fig. 2.5.

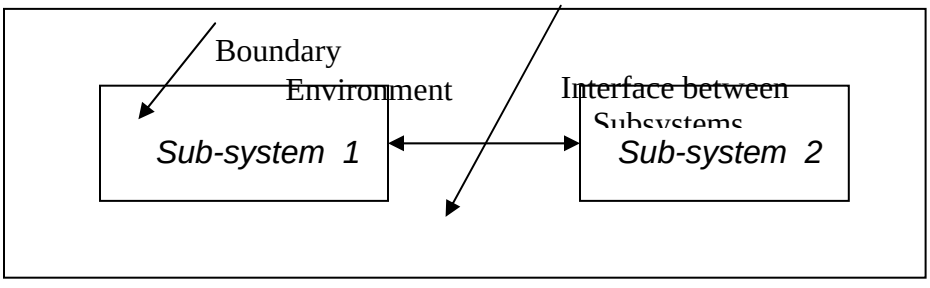
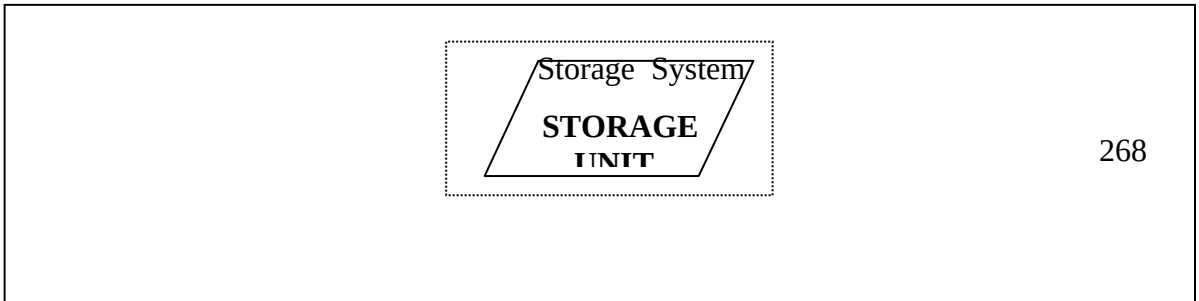


Fig. 2.4 : Boundary, Interface and environment of a system.



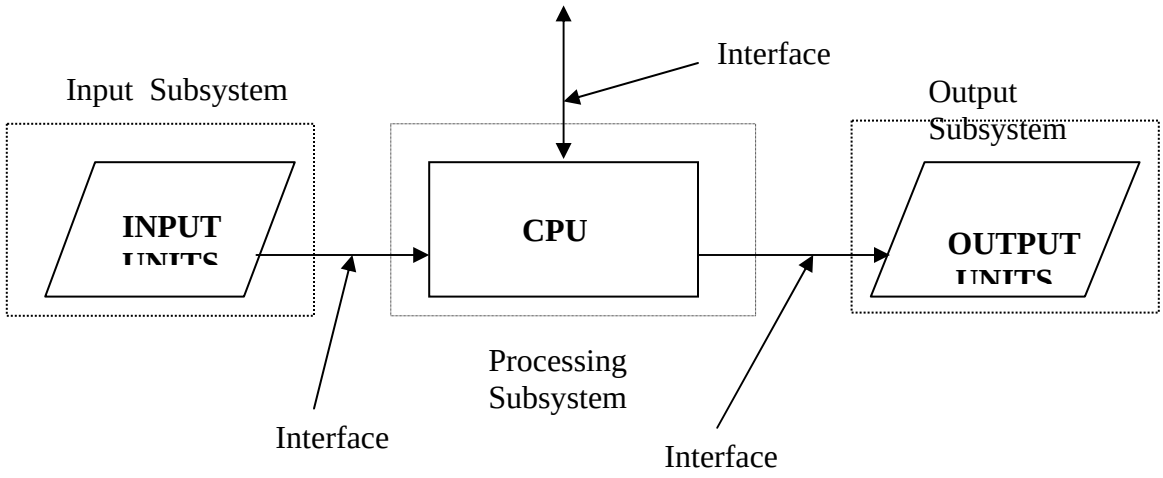


Fig. 2.5 (a) : Computer configuration as System.

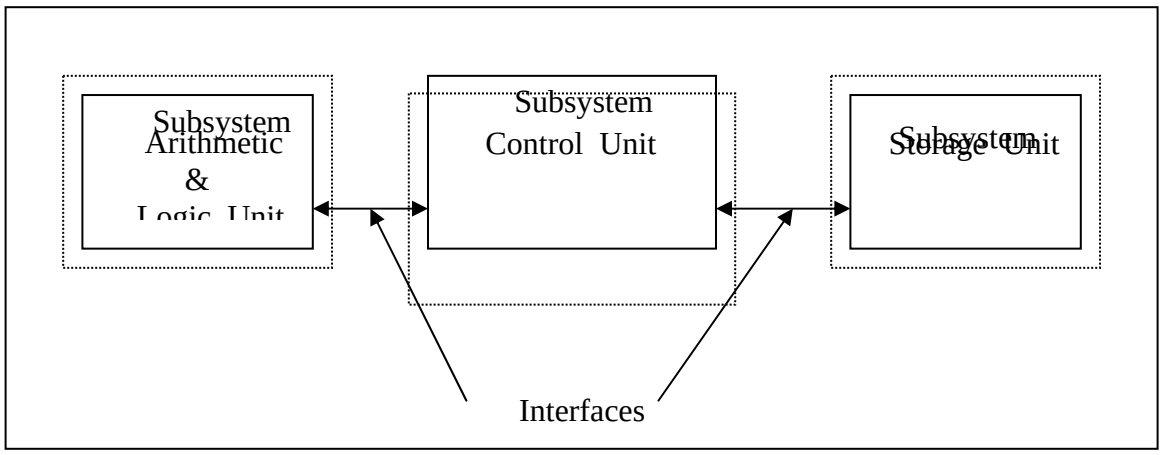


Fig. 2.5 (b) : CPU as a sub system.

A system permits flow of information, energy and other resources to ensure its survival. The flow from the environment into the system forms the input for processing and after input is processed, the output again flows out from the system into the environment.

Concept of Black Box :-

The concept of black box is used to simplify design work during systems development. In a new system development process, according to the concept of black-box, the output of the system is defined first. Once the output requirement are clearly defined, the designers turn to identifying and defining input requirements to generate the specified output. After defining output and input, the last step to design is to specify black box operation. The black box represents the conversion process. The steps in conversion process are to be identified to

convert a specified input into the specified output. This approach to the system design is highly specific and is often used in information system design.
The concept of black box is shown in fig. 2.6 .

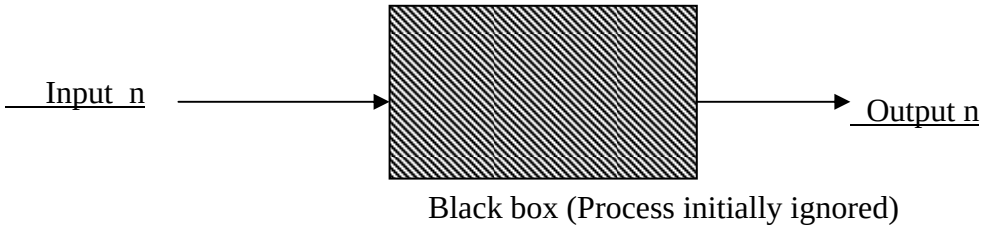


Fig. 2.6 : Concept of black box.

2.3 : System Concept :-

A system contains subsystems, interfaces, boundaries, environments and black box and is represented diagrammatically in following figure 2.7 :

2.4 Characteristics of systems : -

Systems possess some characteristics that enable them to be distinguished from components. They are:

i. Objective orientation
ii. Design of components in a particular arrangement (i.e. Structure)
iii. Inputs of information, energy and materials
iv. Processing of inputs
v. Outputs or result, and
vi. Interdependence

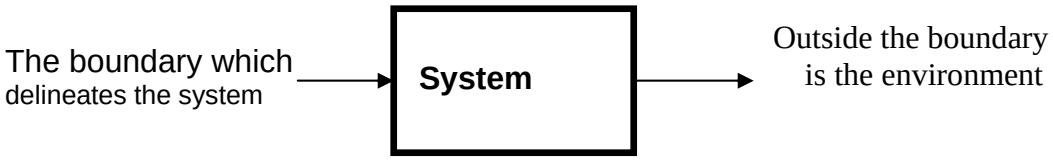


Fig. 2.7 (a) The boundary concept.

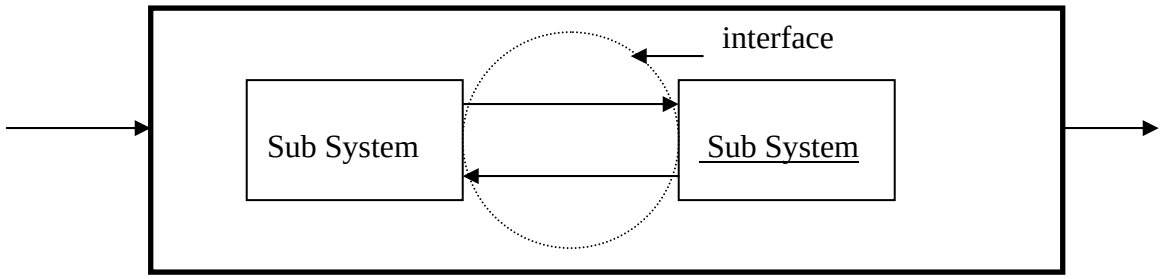


Fig. 2.7 (b) Interface

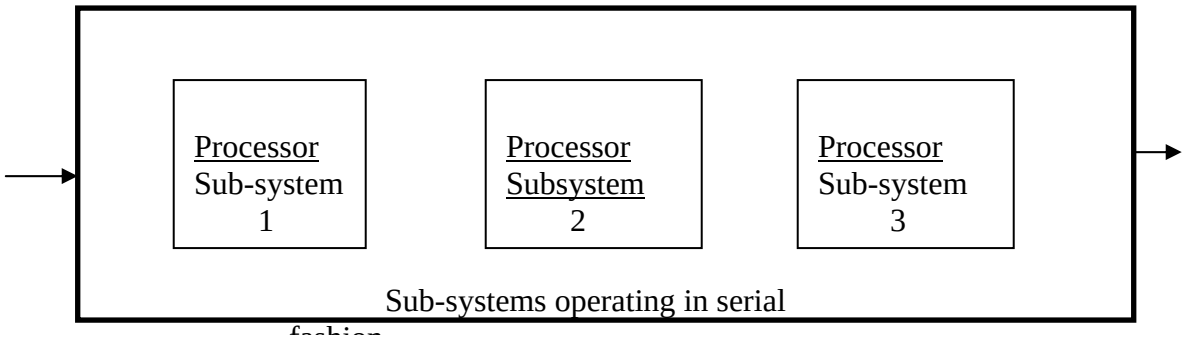


Fig. 2.7 (c) System divided into sub-systems

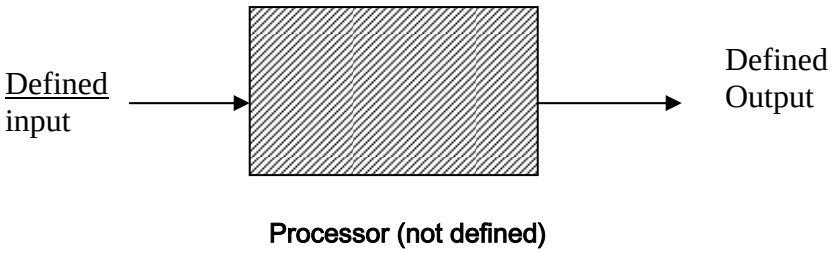


Fig. 2.7 (d) A block box representation

2.5 : Systems Classification (Types of Systems) : -

Systems are classified into a number of groups, some of them are explained below.

i. **Probabilistic and deterministic systems : -** This classification of systems is based on their predictability of outcomes. In a probabilistic system, some states can be predicted from the previous state only with certain amount of error. For example, in an inventory system, the average stock, average demand, etc. may be predicted but the exact values of these factors at any given time cannot be known in advance.
A deterministic system is perfectly predictable. That is, it is possible to predict the output accurately from the inputs without any error. For example, a given electric motor and an input of particular voltage will produce an output of a known number of revolutions per minute (rpm). Similarly, a computer program which performs exactly according to a set of instructions.

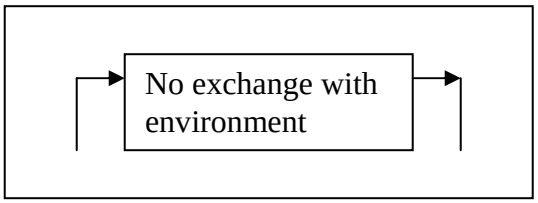
ii. Open and closed systems : -

Open systems interact with the environment and exchange information, material or energy with environment. They are difficult to study. Examples for open systems are biological systems, organizational systems, etc. Open systems tend to have form and structure to allow them to adapt to changes in their environment in such a way as to continue their existence. They are "self-organizing" in the sense that they change their organization in response to changing conditions. Living systems like cells, plants, humans etc are open systems. They attempt to maintain equilibrium by homeostasis, the process of adjusting to keep the systems operating within prescribed limits. An example is the body which maintains its temperature within very narrow limits.

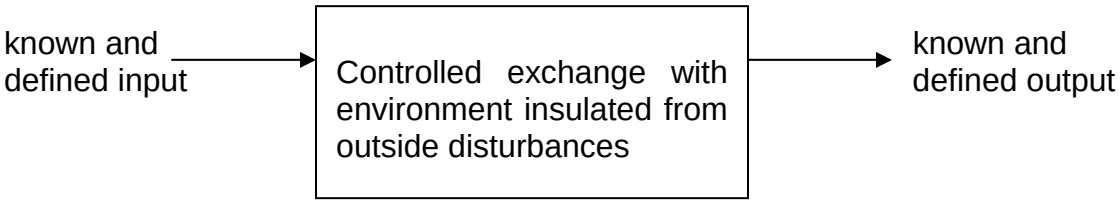
Organizations are open systems. A critical feature of their existence is their capability to adapt in the face of changing competition, changing markets etc.

A closed system is a self-contained system and does-not interact with its environment. It has a well defined boundary which keeps the environment from influencing the system directly. Most computer systems may be considered as closed systems. This is because, it accepts only previously defined inputs, processes them and provides previously defined outputs. In summary, the relatively closed system is one that has only controlled and well defined inputs and outputs. It is not subject to disturbances from outside the system.

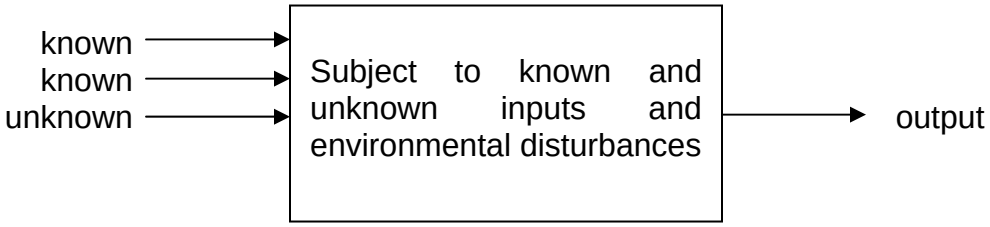
The concept of open and closed system is diagrammatically shown in fig 2.8



Closed System



Relatively Closed System



disturbance ⟶
inputs

Open System
Fig 2.8: Concept of Open and Closed Systems.

iii. Social and Machine Systems: -

Systems made up of people may be viewed purely as social system. Business organizations, government agencies, political parties, etc are examples of social systems.

Machine system is made up of machine or machines only. Such systems would have to their own inputs and maintain themselves. Solar power system may be in this category except for its creation. Most empirical systems are man-machine or socio-technical systems with people and machines forming part of the system.

iv. Adaptive and non-adaptive systems: -

A system that reacts to its environment in such a way as to improve its functioning is called an adaptive system. Most biological systems are adaptive systems. They change with the changes in their environment to ensure their survival. A non adaptive system does not change with changes in its environment. It is free from its environmental influences and may degenerate eventually.

v. Natural and Artificial Systems : -

Natural systems abound in nature such as solar systems and water system. They are not the result of human effort. Artificial systems are man-made. Examples of artificial systems are transport system, communication system etc.

vi. Permanent and temporary systems : -

Systems enduring for a long time relative to the people belonging to the system are called permanent systems. Most man-made systems are permanent systems. Temporary systems are designed to last only for limited period of time. Once the purpose is achieved such systems cease to exist.

2.6 Subsystem :-

Each system seems to be nested in a larger system. Smaller systems within a system are called subsystems. Super systems refer to extremely large and complex systems. Systems exist at an infinite number of levels of scale. Foe example, the system of education can be classified into global education system, national educational system, state education system, block education system, panchayat education system and so on. Each subsystem may have many inputs and many outputs. Between subsystems many interconnections are required for the exchange of input and output. The number of interconnections or interfaces rapidly rises when the number of subsystems rises.

Algebraically, the number of interconnections (N) in a system is

N = ½ n (n-1) - - - - - - - (1)

Thus a system with eight subsystems (n) will have 28 interconnections, and a system with 10 subsystems will have 45 interconnections. Though not all subsystems interconnect with all others, yet very large number of interconnections exist in most systems. Since such large number of interconnections cause problems in the normal functioning of a system, steps are taken to reduce them.

The need for forming subsystems arises because of the following reasons.

1. simplification
2. decoupling, and
3. decomposition.

1. Simplification: -

Most system are complex with large number of interrelated and interdependent elements. The complex systems are broken down into lower level systems to simplify design, operation and control of systems. Thus simplification is the process of organizing subsystems so as to reduce the number of interconnections. Some methods of simplification are:

i. clusters of subsystems are established which interact with each other, then a single interface path is defined from the cluster to other subsystems or clusters of subsystems (Fig 2.9). An example is a database which is accessed by many programs, but the interconnection is only through a database management interface.

ii. methods are established for decoupling systems so that the need for interconnection is reduced.

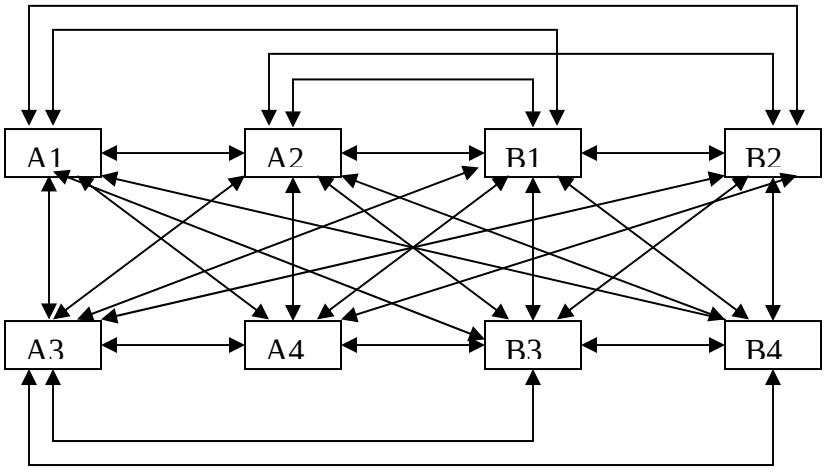


Fig 2.9: (a) All systems are interconnected.

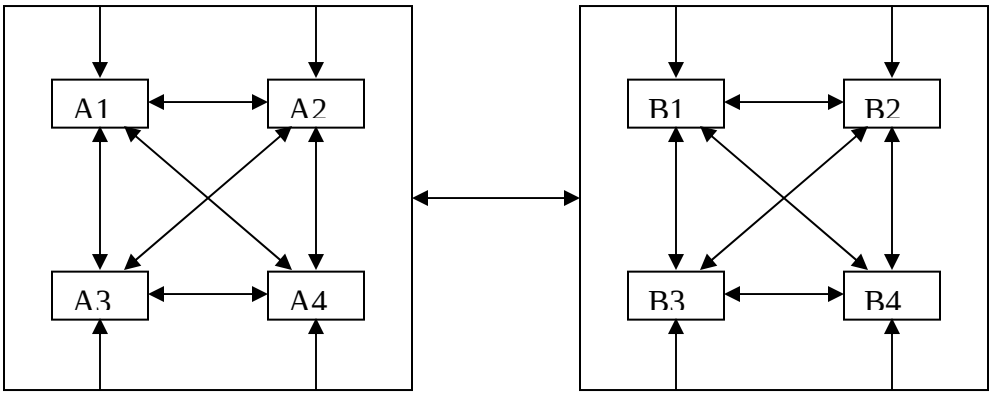


Fig 2.9: (b) Systems connected within cluster and clusters interconnected with single interface.

2. Decoupling : -

Subsystems of a system constantly interact with each other for inputs and passing of outputs etc. if subsystems are tightly coupled or connected, close so-ordination is necessary for the smooth functioning of the system. For example, exact matching of output of one subsystem with the input of the next subsystem requires detailed planning and close co-ordination. The kind of co-ordination is very difficult to obtain always. It is therefore common to decouple subsystems. Decoupling means loosing the connection, so that the two systems can operate in the short run with some measure of independence. Some of the techniques of decoupling are described below.

a. Stock capacity is one way of decoupling. For example, if machine center 'A' stocks raw material enough for a couple of days, even if raw material is not issued to it from the store, for a day or two, it does not affect its functioning. Similarly, stocking some processed goods at machine center 'A' enables it to transfer output to machine center 'B' (which forms input to machine center 'B') without any pressure on it to immediately process and transfer output to B. This kind of decoupling reduces the need for communication and co-ordination among subsystems.

b. Data buffers are used in some computer systems to compensate for different rates of input and output of data.

c. Standardization is another technique of decoupling which enables subsystems to plan and organize their processes without continual reference to other subsystems.

d. Advantages of Decoupling : -

Decoupling allows subsystems more independence in planning and control. Decoupling by increasing flexibility and independence may encourage initiative and self-reliance within individual subsystems. It is likely that with some decoupling of subsystems, the system as a whole is better able to deal with random and probabilistic movements.

3. Decomposition :-

This is a process of breaking down a system into hierarchical subsystems. The purpose of decomposition is to make subsystems efficient and effective. The process of decomposition is combined with subsystems divided into smaller subsystems until the smallest subsystems are of manageable size. The subsystems resulting from decomposition process generally form hierarchical structure as shown in fig 2.10. In the hierarchy, a subsystem is one element of a super system.

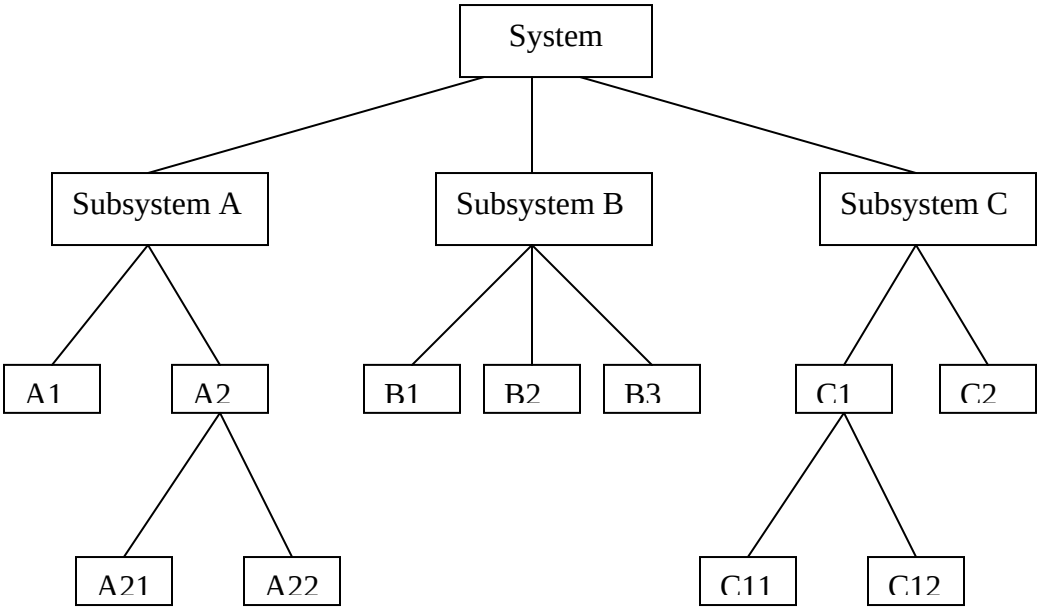


Fig 2.10: Hierarchical relations of subsystems.

An example of decomposition is the factoring of an information processing system into subsystems. Information system divided into subsystems as

1. Sales and order entry
2. Inventory
3. Production
4. Personnel and payroll
5. Purchasing
6. Accounting and control
7. Planning
8. Environmental intelligence

Each subsystems can be further divided into subsystems. For Example, the personnel and payroll subsystem might be divided into the following smaller subsystems:

1. Creation and update of personnel-payroll records
2. personnel reports
3. payroll data entry and validation
4. hourly payroll processing
5. salaried payroll processing
6. payroll reports for management
7. payroll reports for government

The above subsystems can be further divided into smaller subsystems or modules. For example, the hourly payroll processing subsystem might be further divided into

1. calculation of gross pay, deductions and net pay
2. preparation of payroll register and audit controls
3. check printing
4. payroll register and controls output

decomposition into subsystems is used both 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 later should be minimized.

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