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**MANONMANIAM SUNDARANAR UNIVERSITY**

**TIRUNELVELI**



**DIRECTORATE OF DISTANCE AND CONTINUING EDUCATION**



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# MANAGEMENT INFORMATION SYSTEM

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## MANGEMENT INFORMATION SYSTEM

**UNIT I: Management information system** – Concept, Need, Strategic role - Evolution of management information system- Components of Management information system – information flow.

**UNIT II: Database Management System –** Objectives and Components- Database Design- Creation and control- Recent trends in Database.

**UNIT III: Developing Information System**- Planning, Designing and Redesigning – Approaches for System Development – System Analysis and Design – System Implementation and Maintenance

**UNIT IV: Transaction Processing and Support System** - Transaction Processing System – Office Automation System – Decision Support System – Executive Information System – Artificial Intelligence and Expert System

**UNIT V: Functional Information System**: Production, Finance, Human Resource and Marketing – Management Information Resources – Information Security – Control & Audit of Information System

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# UNIT I

## Management information system

Concept, Need, Strategic role

Evolution of management information system

Components of Management information system

Information flow

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**Management Information System**

MIS is the use of information technology, people, and business processes to record, store and process data to produce information that decision makers can use to make day to day decisions. The full form of MIS is Management Information Systems. The purpose of MIS is to extract data from varied sources and derive insights that drive business growth.

**Definitions**

G.B. Davis

Management Information System (MIS) is an integrated man/machine system for providing information to hold up the operations, management and decision-making functions in an organization.

Walter I. Kenn Evan

A formal method of collecting timely information in a presentable form in order to facilitate effective decision making and implementation, in order to carry out organisational operations for the purpose of achieving the organisational goals.

Zwass

A Management Information System is an organized portfolio of formal systems for obtaining, processing, and delivering information in support of the business operations and management of an organization.

Management Information System (MIS) is one of the five major Computer Based Information Systems (CBIS). Its purpose is to meet the general information

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needs of the managers in a firm or an organization. MIS is a computer-based system that makes information available to users with similar needs.

Management Information System (MIS) consists of following three pillars: Management, Information, and System.

**1) Management:**

Management can be defined as a process of getting the work or the task done that is required for achieving the goals of an organisation in an efficient and effective manner. Process implies the functions of the management. That is, planning, organising, staffing, directing and controlling.

Management covers the planning, control, and administration of the operations of a concern. The top management handles planning; the middle management concentrates on controlling; and the lower management is concerned with actual administration.

**2) Information:**

Information, in MIS, means the processed data that helps the management in planning, controlling and operations. Data means all the facts arising out of the operations of the concern. Data is processed i.e. recorded, summarized, compared and finally presented to the management in the form of MIS Report.

**3) System:**

System is a set of inter-related components with a clearly defined boundary working together to achieve a common goal. Data is processed into information

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with the help of a system. A system is made up of inputs, processing, output and feedback or control.

Thus MIS means a system for processing data in order to give proper information to the management for performing its functions.

Management Information System or 'MIS' is a planned system of collecting, storing, and disseminating data in the form of information needed to carry out the functions of management.

## COMPONENTS OF MANAGEMENT INFORMATION SYSTEM (MIS)

The MIS has various components, which are as follows:

### 1)Executives:

Executives are the people who utilize MIS. These people are computer professionals who operate MIS for data processing to achieve organizational goals like planning and decision-making.

### 2)Hardware:

The hardware components of MIS include various input and output devices that helps in feeding data as well as displaying the information when required. The input devices include the keyboard, scanners and mouse. The output devices may be the monitor, printer, network devices, and so on.

### 3)Software:

Computer programs which are designed to do a specific task for example, MS Office, Banking Software's, Railway's applications etc, different kinds of software available to process the data/information in an organization such as ERP (enterprise resource planning) and CRM (customer relationship management).

### 4)Organizational Procedures:

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Procedures are sets of rules or guidelines that an organization establishes for the use of a computer-based information system. The procedures may vary from one organization to another. It may also vary from one department to another as per the requirement. For example, the working of production department is different from the working of sales department. The production department requires information regarding the raw material or quantity of goods to be produced. So, the production department sets its procedures in such a way that the MIS system helps in retrieving the information required by the department. In the similar way, the sales department requires information regarding the quantity of goods sold and the other expenses that occurred during the sales of the product. Therefore, the sales department sets the procedures in such a way that they get only that information which is required from the MIS.

**Functions of MIS**

The main goal to set up an MIS in a company is to utilize the information by its managers for managerial purpose for decision making. MIS performs following functions to achieve organizational goal:

**To collect useful data:**
MIS executes the data through computer system using the sources of an organization. The organizational data are stored in the computer system or as a paper record by its end users.

**Data Processing:**
Processing data includes converting the storage data into the required information to take beneficial actions. Data processing includes mathematical and logical operations like, calculations, sorting, classifying and summarizing the data. The data processing signifies processing activities as:
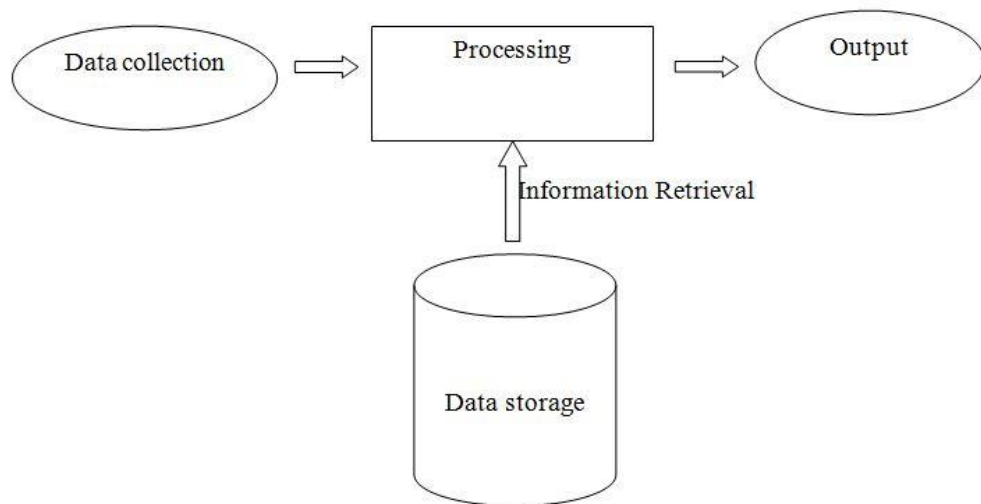
- Organize data
- Analyse data
- Apply statistical, mathematical, operations

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- create predictive modeling

- Research and forecasting

**Information storage and retrieval:**

MIS stores data as an organizational record and processed for future use. The data are organized as fields, records, files and databases for future use. Information retrieval comprises to access the stored data as per the requirements of the management users.



**Disseminating management information:**

Information of finished product is categorized and dispersed to the users in an organization as per the needs. This information could be periodic, through reports or online through computer terminals. Figure shows various functions performed by MIS.

**The major components of MIS are:**

Components of MIS

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- **People Resources**: People are required for the operation of all information system.

- **Data Resources**: Database holds processed and organized data.

- **Software Resources**: It includes all sets of information processing instruction.

- **Hardware Resources**: Include all physical devices and materials used in information processing.

- **Process**: is a step undertaken to achieve a goal.

## Objectives of MIS

The goals of an MIS are to implement the organizational structure and dynamics of the enterprise for the purpose of managing the organization in a better way and capturing the potential of the information system for competitive advantage.

**MIS has five major objectives which include:**

1. Data Capturing

2. Processing of Data

3. Storage

4. Retrieval

5. Dissemination

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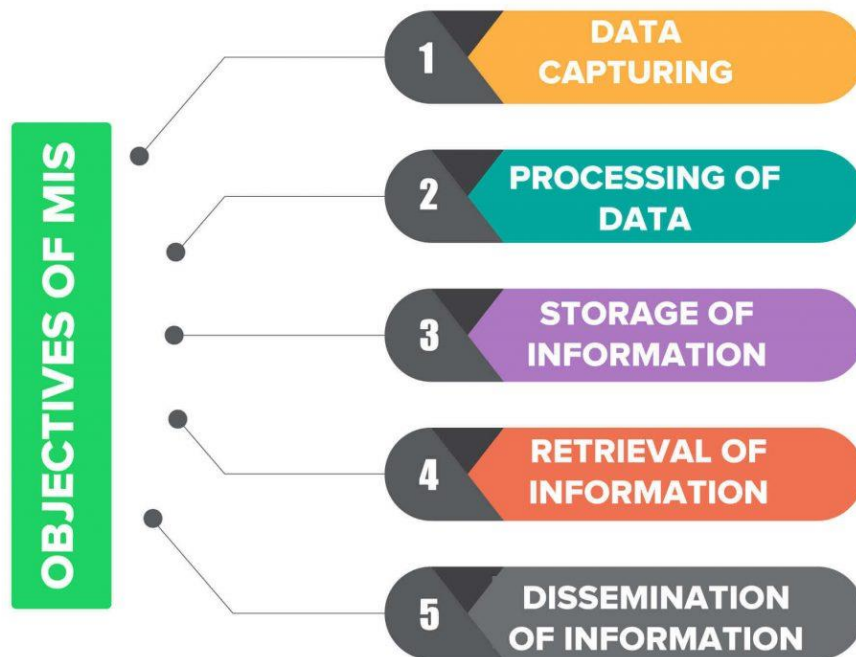


## Objectives of MIS

### Data Capturing

MIS capture data from various internal and external sources of the organization. Data capturing may be manual or through computer terminals.

### Processing of Data

The captured data is processed into information needed for planning, organizing, coordinating, directing and controlling functionalities at strategic, tactical and operational level. The captured data is processed to convert into the required information. Processing of data is done by such activities as calculating, sorting, classifying, and summarizing.

### Storage of Information

MIS stores the processed or unprocessed data for future use. If any information is not immediately required, it is saved as an organization record, for later use.

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**Retrieval of Information**

MIS retrieves information from its stores as and when required by various users.

**Dissemination of Information**

Information, which is a finished product of MIS, is disseminated to the users in the organization. It is periodic or online through a computer terminal.

**Characteristics of MIS**

Following are the characteristics of MIS:

1. System Approach

2. Management Oriented

3. Need-Based

4. Exception Based

5. Future Oriented

6. Integrated

7. Long Term Planning

8. Sub-System Concept

9. Central Database
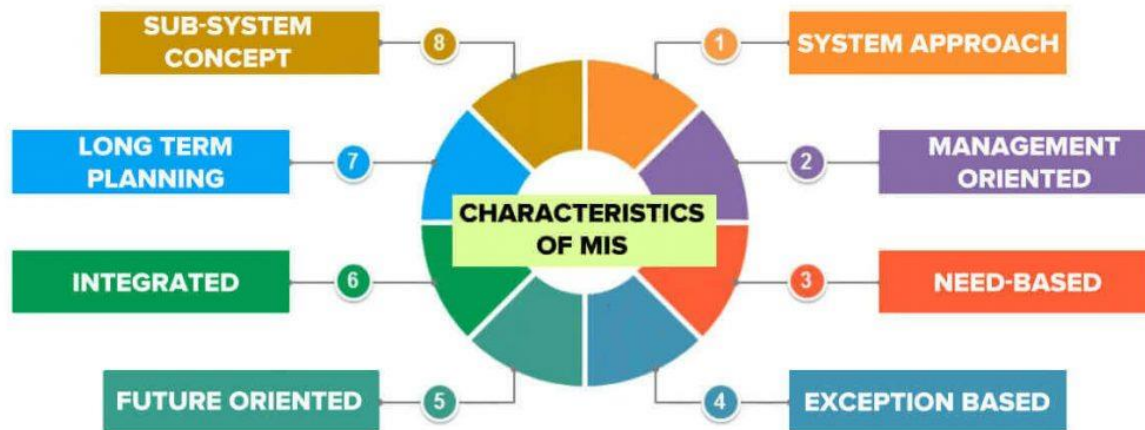
## System Approach

The information system follows a System's approach. The system's approach implies a holistic approach to the study of system and its performance in the light for the objective for which it has been constituted.

## Management Oriented

The top-down approach must be followed while designing the MIS. The top-down approach suggests that the system development starts from the determination of management needs and overall business objectives.

The MIS development plan should be derived from the overall business plan. Management oriented characteristic of MIS also implies that the management actively directs the system development efforts.

## Need-Based

MIS design and development should be as per the information needs of managers at different levels, strategic planning level, management control level and operational control level. In other words, MIS should cater to the specific needs of managers in an organization's hierarchy.

**Exception Based**

MIS should be developed on the exception-based reporting principle, which means an abnormal situation, i.e. the maximum; minimum or expected values vary beyond tolerance limits. In such situations, there should be exception reporting to the decision-maker at the required level.

**Future Oriented**

Besides exception-based reporting, MIS should also look at the future. In other words, MIS should not merely provide past or historical information; rather it should provide information, on the basis of projections based on which actions may be initiated.

**Integrated**

Integration is a necessary characteristic of a management information system. Integration is significant because of its ability to produce more meaningful information.

For example, in order to develop an effective production scheduling system, it is necessary to balance such factors as setup costs, Workforce, Overtime rates, Production capacity, Inventory level, Capital requirements and Customer services.

**Long Term Planning**

MIS is developed over relatively for long periods. Such a system is not developed overnight. A heavy element of planning is involved. The MIS designer must have the future objectives and needs of the company in mind.

**Sub-System Concept**

The process of MIS development is quite complex and one is likely to lose insight frequently. Thus, the system, though viewed as a single entity, must be broken down into digestible sub-systems which are more meaningful at the planning stage.

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**Central Database**

A central database is a mortar that holds the functional systems together. Each system requires access to the master file of data covering inventory, personnel, vendors, customers, etc. It seems logical to gather data once, validate it properly and place it on a central storage medium, which can be accessed by any other subsystem.

Thus following are the characteristics of MIS −

1. It should be based on a long-term planning.

2. It should provide a holistic view of the dynamics and the structure of the organization.

3. It should work as a complete and comprehensive system covering all interconnecting sub-systems within the organization.

4. It should be planned in a top-down way, as the decision makers or the management should actively take part and provide clear direction at the development stage of the MIS.

5. It should be based on need of strategic, operational and tactical information of managers of an organization.

6. It should also take care of exceptional situations by reporting such situations.

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7. It should be able to make forecasts and estimates, and generate advanced information, thus providing a competitive advantage. Decision makers can take actions on the basis of such predictions.

8. It should create linkage between all sub-systems within the organization, so that the decision makers can take the right decision based on an integrated view.

9. It should allow easy flow of information through various sub-systems, thus avoiding redundancy and duplicity of data. It should simplify the operations with as much practicability as possible.

10. Although the MIS is an integrated, complete system, it should be made in such a flexible way that it could be easily split into smaller sub-systems as and when required.

11. A central database is the backbone of a well-built MIS.

**Requirements of Management Information System:**

Following are the requirements of a management information system:

1. Database

2. Qualified System and Management Staff

3. Top Management Support

4. Active Participation of Operating Management

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5. Control and Maintenance of Management Information System

6. Evaluation of Management Information System

## Advantage of MIS

A good management information system can be used not only for the storage of electronic data alone but must be able to support the analysis required by management. There are many advantages of MIS which are utilised by manager to achieve organization goal.

The following are some of the benefits of a good MIS.

- Increased customer satisfaction

- Improved quantity and quality of information

- Improved quality and quantity of management decisions

- Improved responsiveness to the competitors

- Improved operational efficiency and flexibility

- Improved quality of internal and external communications

- Improved quality of planning

- Improved quality control and supervision

## Challenges of MIS

There are three major challenges of MIS: high cost, training of employees and maintenance cost. These are briefly discussed below:

1. High Cost

2. Training of Employee

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3. Maintenance Cost

**High Cost**

Development of new computerized based information system is a problem for the organization due to the cost factor and it creates problems because with the change of time there is a need to up-date the information system.

**Training of Employee**

Employees should have the capacity of learning the information system; otherwise, it will be difficult for the organization to stay in the market.

**Maintenance Cost**

Sometimes a problem arises due to server crash and website crash. It leads to the loss of information. So, maintenance cost is needed to tackle the problem.

**Limitations of MIS**

Even though MIS has many benefits but it also has its limitations.

**Limitations of MIS** are discussed below:

- While MIS may solve some critical problems but it is not a solution to all problems of an organization.

- It cannot meet the special demands of every individual.

- MIS if designed in an improper manner does not serve the management and hence is of little relevance.

- The MIS is not good if the basic data are obsolete and outdated.

- Mostly information provided by the MIS are in quantitative form. Hence, it ignores the qualitative information like the attitude of an employee.

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### EVOLUTION OF MANAGEMENT INFORMATION SYSTEMS (MIS)

From small businesses to large corporations, a management information system (MIS) is the backbone to a company's operation. Over the years, the role of MIS has evolved as technology became more sophisticated. The fascinating history of MIS and how it is currently changing are as follows.

A management information system (MIS) is a computer system that gathers data from multiple business systems, analyzes the information, and provides reports that help guide management in decision-making.

MIS started as a data capturing and processing system and evolved into a more complex and intelligent system.

**Here's how MIS evolved through the years.**

**1950-1960: Electronic Data Processing (EDP)**

Electronic Data Processing (EDP) systems, also called Transaction Processing Systems (TPS), were ground-breaking at the time. It was the first large-scale computer information system to centralize and process day-to-day transactions and activities such as cash deposits, ATM transactions, and payment orders. Shifting from manual to electronic made transaction processing and record-keeping a much faster process.

**1960-1970: Management Information Systems (MIS)**

It wasn't long before the EDP system was upgraded to a Management Information System (MIS) that was able to generate reports from the data it collected. MIS pulled reports from historical data to determine cost trends, do a sales analysis, keep track of inventory, and measure production performance.

When managers evaluated the information in these reports, they could see which areas of the business were underperforming and adjust decisions accordingly.

**1970-1980: Decision Support Systems (DSS)**

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Decision Support System (DSS) provided historical and ad hoc reports on both internal and external information. For example, internal sales reports and external market pricing**.**

This advancement brought a new level of decision-making to businesses. Management could more accurately forecast sales, perform a risk analysis, and make bolder strategic decisions.

It was during this era that personal computers entered the workplace. PCs were connected to the main server so information became accessible to employees throughout the company. This led to a significant boost in productivity.

With this came the need for expert skills to manage these computer networks. Information technology (IT) soon became a burgeoning career and a degree in Management Information Systems became sought after.

**1980-1990: Executive Information Systems (EIS)**

As PCs put power in the hands of executives, they could purchase software tailored to their department's needs, such as accounting, project management, and HR systems. It resulted in multiple systems within an organization working independently.

This led to Executive Information Systems (EIS), a more refined version of the DSS system. It allowed executives to analyze their department's output and how it impacted the business's overall performance.

**1990-2000: Enterprise Resource Management (ERP) Systems**

Multiple information systems that were not integrated resulted in employees wasting time duplicating information across systems. MIS had to become efficient.

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It did that by creating Enterprise Resource Management (ERP) systems that integrated knowledge management systems and expert systems.

Knowledge-based systems organize and disseminate business knowledge within an organization. Example: placing a best practices resource on the intranet.

Expert systems started to use artificial intelligence to provide advice and solutions. Example: proposing faster delivery routes or assessing risk profiles for credit applications. For the first time, different systems were "talking" to each other.

**HOW IS MIS CHANGING?**

MIS systems are becoming more intelligent. Most of the trends below are not new but they will continue to shape how management information systems function in the future.

1. Automation and cross-functional integration

Automation can be used for repetitive tasks and to cross-populate data with other systems. This frees up employees' time to focus on higher-value tasks. For example, automation can track inventory and alert you when stocks are low or automatically reorder stocks when needed without human intervention.

2. Big data analytics

Worldwide, around 2.5 quintillion bytes of data are being generated daily. From customers' buying habits to social media interactions, data is rolling in from everywhere.

Management information systems not only have to cope with the influx of data, but also analyze it. The information gleaned can be used to make operations more efficient, improve customer service, and create personalized marketing campaigns.

3. Artificial intelligence (AI)

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Artificial intelligence is making waves across almost every sector. AI has been the biggest disruptor in business in recent years. From chatbots to self-driving cars, AI is already a part of our lives and will continue to become more entrenched.

AI technology is capable of learning patterns and identifying anomalies when processing big data. It can detect fraud and determine the risk profile of applicants applying for credit.

4. Cyber security

Cybercrime is a threat every business faces. Most cyber-attacks are financially motivated.

A cyber-attack can be a fatal blow to a business. Research by Fundera shows that 60% of small businesses that experience a cyber-attack go out of business within six months. Companies now invest heavily in protecting their data. As cybercriminals become more sophisticated, cyber security software will have to stay one step ahead.

Outdated technology can hold the business back. If the business still uses an old management information system, it may be time to upgrade. A more robust MIS can enhance productivity and improve customer service, and that ultimately leads to higher profits.

**Characteristics of Computerized MIS**

Following are the characteristics of a well-designed computerized MIS –

1.      It should be able to process data accurately and with high speed, using various techniques like operations research, simulation, heuristics, etc.

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2.      It should be able to collect, organize, manipulate, and update large amount of raw data of both related and unrelated nature, coming from various internal and external sources at different periods of time.

3.      It should provide real time information on ongoing events without any delay.

4.      It should support various output formats and follow latest rules and regulations in practice.

5.      It should provide organized and relevant information for all levels of management: strategic, operational, and tactical.

6.      It should aim at extreme flexibility in data storage and retrieval.

**Nature and Scope of MIS**

Management Information System is an implementation of the organizational systems and procedures. To a programmer it is nothing but file structures and file processing. However, it involves much more complexity.

The goals of an MIS are to implement the organizational structure and dynamics of the enterprise for the purpose of managing the organization in a better way and capturing the potential of the information system for competitive advantage.

The following diagram shows the nature and scope of MIS −

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## CONCEPT OF MIS

The MIS is an idea which is associated with man, machine, marketing and methods for collecting information's from the internal and external source and processing this information for the purpose of facilitating the process of decision-making of the business.

MIS is not new, only the computerization is new, before computers MIS techniques existed to supply managers with the information that would permit them to plan and control the business operations. The computer has added on more dimensions such as speed, accuracy and increased volume of data that permit the consideration of more alternatives in decision-making process.

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Management information system is an integrated set of component or entities that interact to achieve a particular function, objective or goal. Therefore, it is a computer-based system that provides information for decisions making on planning, organizing and controlling the operation of the sub-system of the firm and provides a synergistic organization in the process.

1) The component of an information system includes: a hardware which is used for input/output process and storage of data, software used to process data and also to instruct the hand-ware component, data bases which is the location in the system where all the organization data will be automated and procedures which is a set of documents that explain the structure of that management information system.

2) There are various driving factors of management information system for example:                                                                                     - Technological revolutions in all sectors make modern managers to need to have access to large amount of selective information for the complex tasks and decisions.

3) The lifespan of most product has continued getting shorter and shorter and therefore the challenge to the manager is to design product that will take a longer shelf life and in order to do this, the manager must be able to keep abreast of the factors that influences the organization product and services thus, management information system come in handy in supporting the process.

4) There is huge amount of information available to today's manager and this had therefore meant that managers are increasingly relying on management information system to access the exploding information. Management information services helps manager to access relevant, accurate, up-to-date information which is the more sure way of making accurate decisions. It also helps in automation and incorporation of research and management science

techniques into the overall management information system for example probability theory.

5) The management information services are capable of taking advantage of the computational ability of the company like processing, storage capacity among others.

6) Based on this relevancy, management information system should be installed and upgraded in various organizations since today's managers need them to access information for managerial decision making and also for management functions.

**The scope and purpose of MIS is better understood if each part of them is defined individually, thus**

**1.Management**:

Management has been defined in process or activities that describe what managers do in the operation for their organization plan, organize, initiate and control operations. They plan by setting strategies and goals and selecting the best course of action to achieve the goals. They organize the necessary tasks for the operational plan, set these tasks up into homogenous groups and assign authority delegation; they control the performance standards and avoiding deviation from standard.

The decision-making is a fundamental prerequisite of each of the foregoing process, the job of MIS is facilitating decisions necessary for planning, organizing and controlling the work and functions of the business so that specified goals of business are achieved.

**2. Information:**

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Data must be distinguished from information and the distinction is clear and important for present purpose. Data are facts and figures that are not currently being used in a decision-making process and usually are taken from the historical records that are recorded and filled without immediate intent to retrieve for decision-making.

Information consists of data that have been retrieved, processed or otherwise used for information or interference purpose, argument or as a basis forecasting or decision-making regarding any business unit. Information is knowledge that one derives from facts for effective functioning of systems placed in the right context with the purpose of reducing uncertainty regarding the alternative courses of action as they are based on description and measurement of attributes of various entities associated with the enterprise.

### 3. System:

- The system can be described as a set of elements joined together for a common objective. A subsystem is a part of a larger system with which one is concerned. All systems for our purpose the organization is the system and the parts (divisions, departments, functions, unit etc) are the subsystem.

- The system concept of MIS is, therefore one of optimizing the output of the organization by connecting the operating subsystems through the medium of information exchange.

- The Management information system (MIS) is a concept of the last two decade or two. It has been understood and described in a number of ways. It is also known as the Information System, the Information and Decision System, the computer-based Decision System.

- Information is the life blood of an organization, particularly in the case of system approach management. The MIS or Information system can be defined as the knowledge communicated by others or obtained from investigation or study. It is a

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system providing needed information to each manager at the right time in the right form and relevant one which aid understanding and stimulates the action.

- MIS is an organized method of providing past, present and projection information relating to internal operations and externals intelligence. It supports the planning, control and operational functions of an organization by furnishing uniform information in proper time frame to help the process of decision-making.

- Management Information System is generally defined as an integrated user-machine system for providing information to support operations, management and decision-making functions in an organization. The system utilizes computer hardware and software, manual procedure, models for analysis. Information is viewed as a resource much like land, labor and capital. It must be obtained processed, stored, manipulated and analyzed, distributed etc. An organization with a well-defined information system will generally have a competitive advantage over organization with poor MIS and no MIS.
    - The MIS has more than one definition, some of which are given below. The MIS is defined as a system which provides information support for decision-making in the organization.
    - The MIS is defined as an integrated system of man and machine for providing the information to support the operations, the management and the decision-making function in the organization. The MIS is defined as a system based on the database of the organization evolved for the purpose of providing information to the people in the organization.

    - The MIS is defined as a computer-based information system.

    - Though there are a number of definitions all of them converge on a single point, i.e. the MIS is a system that support the decision-making function of the organization. The difference lies in defining the elements of MIS. However, in today's world, the MIS is a computerized business processing system

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generating information for the people in the organization to meet the information needs for decision-making to achieve the corporate objective of the organization.

- MIS is a computer-based system that provides flexible and speedy access to accurate data. The organizational information system which in general relates to the planning, operation and control of an enterprise are the most important among them. MIS refers primarily to such an organizational system which is generally large, sophisticated, structured and dynamically evolving and of immense commercial values. A large number of programmers and system analysts are employed by many organizations to build a variety of MIS. Thus, the education of programmers and system analysts as well as general manager, the subject of MIS, has occupied a key position.

- Thus, MIS is a set of computer-based system and procedures implemented to help managers in their routine job of decision-making and planning, expansion and development.

- The objective of MIS is to provide information for a decision support process of management. It should help in such a way that the business goals are achieved in the most efficient manner. Since the decision-making is not restricted to a particular level, the MIS is expected to support all the levels of the management in conducting the business operations. Unless the MIS becomes a management aid, it is not useful to the organization.

- Modern management system relies on MIS, the complexity of business management and competitive nature of business requires handling of business operations with skill and foresight to advert the crisis. The management process is executed through a variety of decisions taken at each step of planning, organizing, staffing, directing, coordinating and controlling. If the management

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is able to spell out the decision required to be taken, then the MIS is designed suitably.

**The actual MIS process relates to:**

1. Collection

2. Organization

3. Distribution

4. Storage of wide information

5. Managerial control and analysis of data

Hence MIS focuses on:

1. Organization-wide information

2. Decision-making process

3. Managerial control and analysis

The MIS gets data and other resources of IT infrastructure as inputs from the environment and process them to satisfy the information needs of different entities associated with the business enterprise. There are subsystems of control over the use of IT resources and feedback system offers useful clues for increasing the benefits of information system to business. The MIS are subsystem of business system and by themselves serve the function of feedback and control in business system.

**ROLE OF MANAGEMENT INFORMATION SYSTEM**

The role of the MIS in an organization can be compared to the role of heart in the body. The information is the blood and MIS is the heart. In the body the heart plays the role of supplying pure blood to all the elements of the body including the brain. The heart works faster and supplies more blood when needed. It regulates and controls the incoming impure blood, processes it and sends it to the destination in the quantity

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needed. It fulfils the needs of blood supply to human body in normal course and also in crisis.

The MIS plays exactly the same role in the organization. The system ensures that appropriate data are collected from the various sources, processed and are sent further to all the needy destinations. The system is expected to fulfil the information needs of an individual, a group of individuals, the management functionaries: the managers and top management.

**Role of MIS**

A management information system (MIS) plays an important role in business organizations. Some of the important roles of MIS are discussed below:

1. Decision making

2. **C**oordination among the departments

3. Comparison of Business Performance

4. Finding out the Problems

5. Strategies for an Organization



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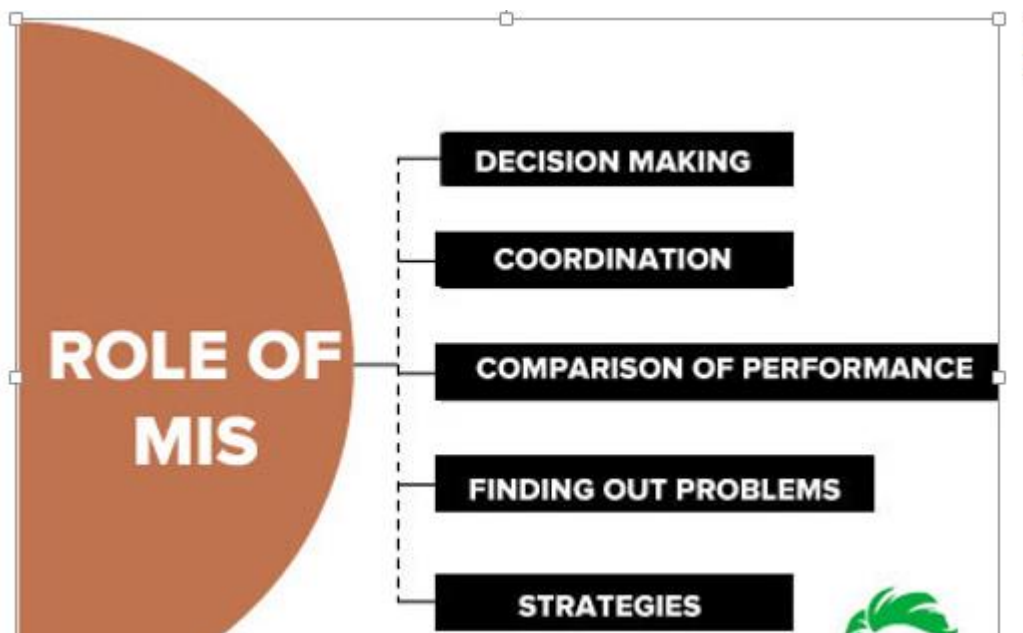
**Decision making**

Management Information System (MIS) plays a significant role in the decision-making process of any organization. In any organization, a decision is made on the basis of relevant information which can be retrieved from the MIS.

**Coordination among the department**

Management Information System satisfy multiple needs of an organization across the different functional department.

**Finding out Problems**

MIS provides relevant information about every aspect of activities. Hence, if any mistake is made by the management, MIS information will help to find out the solution to the problems.

**Comparison of Business Performance**

MIS store all past data and information in its Database. Thus the management information system is very useful to compare business organization performance.

**Strategies for an Organization**

Today each business is running in an acute competitive scenario. MIS supports the organization to evolve appropriate strategies for the business to assent in a competitive environment.

**Important roles of the MIS:**

- MIS satisfies the diverse needs through variety of systems such as query system, analysis system, modeling system and decision support system.

- MIS helps in strategic planning, management control, operational control and transaction processing. The MIS helps the clerical personal in the transaction processing and answers the queries on the data pertaining to the transaction, the status of a particular record and reference on a variety of documents.

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

- MIS helps the middle management in short term planning, target setting and controlling the business functions. It is supported by the use of the management tools of planning and control.

- MIS helps the top-level management in goal setting, strategic planning and evolving the business plans and their implementation.

- MIS plays the role of information generation, communication, problem identification and helps in the process of decision-making. MIS, therefore, plays a vital role in the management, administration and operation of an organization.

**Impact of Management Information System**

MIS plays a very important role in the organization; it creates an impact on the organization's functions, performance and productivity.

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

- The manager is kept alert by providing certain information indicating the probable trends in the various aspects of business. This helps in forecasting and long-term perspective planning. The manager's attention is bought to a situation which is expected in nature, inducing him to take an action or a decision in the matter.

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- Disciplined information reporting system creates structure database and a knowledge base for all the people in the organization. The information is available in such a form that it can be used straight away by blending and analysis, saving the manager's valuable time.

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

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

- The goals and objectives of the MIS are the products of business goals and objectives. It helps indirectly to pull the entire organization in one direction towards the corporate goals and objectives by providing the relevant information to the organization.

- A well-designed system with a focus on the manager makes an impact on the managerial efficiency. MIS motivates an enlightened manager to use a variety of tools of the management. It helps him to resort to such exercises as experimentation and modeling.

- The use of computers enables him to use the tools and techniques which are impossible to use manually. The ready-made packages make this task simple.

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The impact is on the managerial ability to perform. It improves the decision-making ability.

- Since, MIS work on the basic system such as transaction processing and database, the drudgery of the clerical work is transferred to the computerized system, relieving the human mind for better work. It will be observed that lot of manpower is engaged in this activity in the organization. Seventy (70) percent of the time is spent in recording, searching, processing and communicating. MIS has a direct impact on this overhead. It creates information –based working culture in the organization.

**Importance of MIS**

1. It goes without saying that all managerial functions are performed through decision-making; for taking rational decision, timely and reliable information are essential and are procured through a logical and well-structured method of information collection, processing and dissemination to decision makers. Such a method in the field of management is widely known as MIS.

2. In today's world of ever-increasing complexities of business as well as business organization, in order to survive and grow, information must have been properly collected, analyzed, and disseminated.

   MIS provides timely, reliable and useful information to enable the management to take speedy and rational decisions.

3. MIS has assumed all the more important role in today's environment because a manager has to take decisions under two main challenges:

   (a) First, because of the liberalization and globalization, in which organizations are required to compete not only locally but also globally, a manager has to take quick decisions, otherwise his

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business will be taken away by his competitors. This has further enhanced the necessity for such a system.

(b) Second, in this information age wherein information is doubling up every two or three years, a manager has to process a large voluminous data; failing which he may end up taking a strong decision that may prove to be very costly to the company.

4. Managers must be equipped with some tools or a system, which can assist them in their challenging role of decision-making. It is because of the above cited reasons, that today MIS is considered to be of paramount importance, sometimes regarded as the nerve centre of an organization. Such system assists decision makers in organizations by providing information at various stages of decision making and thus greatly help the organizations to achieve their predetermined goals and objectives.

5. On the other hand, the MIS which is not adequately planned, analyzed, designed, implemented or is poorly maintained may provide inaccurate, irrelevant or obsolete information which may prove fatal for the organization.

6. In other words, organizations today just cannot survive and grow without properly planned, designed, implemented and maintained MIS. It has been well understood that MIS enables even small organizations to more than offset the economies of scale enjoyed by their bigger competitors and thus helps in providing a competitive edge over other organization.

**Need for MIS**

**The following are the most important reasons to have a good management information system:**

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## 1. To control the creation and growth of records

Despite decades of using various non-paper storage media, the amount of paper in our offices continues to escalate. An effective records information system addresses both creation control (limits the generation of records or copies not required to operate the business) and records retention (a system for destroying useless records or retiring inactive records), thus stabilizing the growth of records in all formats.

## 2. To reduce operating costs

Recordkeeping requires administrative dollars for filing equipment, space in offices, and staffing to maintain an organized filing system (or to search for lost records when there is no organized system).

It costs considerably less per linear foot of records to store inactive records in a Data Records Centre versus in the office. [Multiply that by 30% to 50% of the records in an office that doesn't have a records management program in place], and there is an opportunity to effect some cost savings in space and equipment, and an opportunity to utilize staff more productively - just by implementing a records management program.

## 3. To improve efficiency and productivity

Time spent searching for missing or misfiled record is non-productive. A good records management program (e.g. a document system) can help any organization upgrade its recordkeeping systems so that information retrieval is enhanced, with corresponding improvements in office efficiency and productivity. A well designed and operated filing system with an effective index can facilitate retrieval and deliver information to users as quickly as they need it. Moreover, a well-managed information system acting as a corporate asset enables organizations to objectively evaluate their use of information and accurately lay out a roadmap for improvements that optimize business returns.

## 4. To assimilate new records management technologies

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A good records management program provides an organization with the capability to assimilate new technologies and take advantage of their many benefits. Investments in new computer systems whether this is financial, business or otherwise, don't solve filing problems unless current manual recordkeeping or bookkeeping systems are analyzed (and occasionally, overhauled) before automation is applied.

## 5. To ensure regulatory compliance

In terms of recordkeeping requirements, China is a heavily regulated country. These laws can create major compliance problems for businesses and government agencies since they can be difficult to locate, interpret and apply. The only way an organization can be reasonably sure that it is in full compliance with laws and regulations is by operating a good management information system which takes responsibility for regulatory compliance, while working closely with the local authorities. Failure to comply with laws and regulations could result in severe fines, penalties or other legal consequences.

## 6. To minimize litigation risks

Business organizations implement management information systems and programs in order to reduce the risks associated with litigation and potential penalties. This can be equally true in Government agencies. For example, a consistently applied records management program can reduce the liabilities associated with document disposal by providing for their systematic, routine disposal in the normal course of business.

## 7. To safeguard vital information

Every organization, public or private, needs a comprehensive program for protecting its vital records and information from catastrophe or disaster, because every organization is vulnerable to loss. Operated as part of a good management information system, vital records programs preserve the integrity and confidentiality of the most important records and safeguard the vital information assets according to a "Plan" to protect the records. This is especially the case for financial information whereby ERP (Enterprise Resource Planning) systems are being deployed in large companies.

## 8. To support better management decision making

In today's business environment, the manager who has the relevant data first often wins, either by making the decisions ahead of the competitors, or by making a better, more informed decisions. A good management information system can help ensure that managers and executives have the information they need when they need it. By implementing an enterprise-wide file organization, including indexing and retrieval capability, managers can obtain and assemble pertinent information quickly for current decisions and future business planning purposes. Likewise, implementing a good ERP system to take account of all the business' processes both financial and operational will give an organization more advantages than one who was operating a manual based system.

## 9. To preserve the corporate memory

An organization's files, records and financial data contain its institutional memory, an irreplaceable asset that is often overlooked. Every business day, you create the records, which could become background data for future management decisions and planning.

## 10. To foster professionalism in running the business

A business office with files, documents and financial data askew, stacked on top of file cabinets and in boxes everywhere, creates a poor working environment. The perceptions of customers and the public, and "image" and "morale" of the staff, though hard to quantify in cost-benefit terms, may be among the best reasons to establish a good management information system.

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**Strategic Management Information System**

Strategic management is a detailed set of ongoing activities and procedures that organizations use within an organization boundary to systematically organize and align resources and actions with mission, vision, and strategy.

In response to a corporate business initiative, strategic systems are information systems that are created. They are built to give the company a competitive advantage. They may offer a lower cost, differentiated product or service that focuses on a specific consumer segment, or is creative.

A SMIS offers business intelligence as well. If an information system is used in innovative ways to accomplish the objectives and fulfil the organization's mission, MIS, or any other type of system can be viewed as SMIS activities.

Strategic management activities turn the static plan into a framework that provides decision-making with strategic performance input and allows the plan to adapt and develop as requirements and other factors change. Strategy execution is generally synonymous with the structured execution of a strategy with strategy management practices.

Strategic Information Systems are different from other comparable management information systems as:

1. They change the way the firm competes.

2. They have an external (outward looking) focus.

3. They are associated with higher project risk.
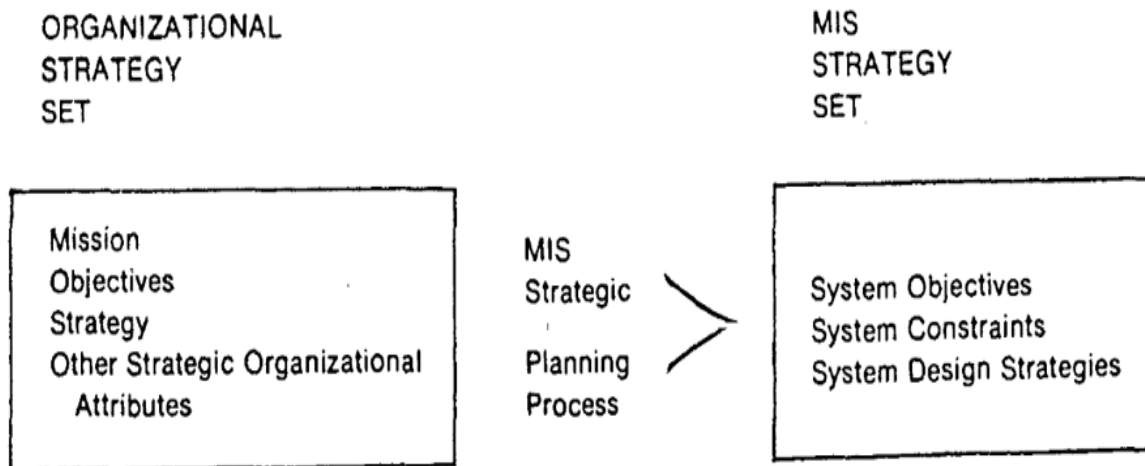
4. They are innovative (and not easily copied).

It is mainly concerned with providing an organization and its members an assistance to perform the routine tasks efficiently and effectively. One of the major issues before any organization is the challenge of meeting its goals and objectives.

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Strategic Information System enables such organization in realizing their goals. Strategic Information System (SIS) is a support to the existing system and helps in achieving a competitive advantage over the organizations' competitors in terms of its objectives.

A strategic information system is concerned with systems which contribute significantly to the achievement of an organization's overall objectives. The body of knowledge is of recent origin and is highly dynamic, and the area has an aura of excitement about it. The emergence of the key ideas, the process whereby strategic information systems come into being is assessed, areas of weakness are identified, and directions of current and future development taken.

Information system is regarded as a tool to provide various services to different management functions. The tools have been developing year by year and the application of the tool has become more and more diverse. In management it is now a very powerful means to manage and control various activities and decision making process. The original idea of automating mechanical processes got quickly succeeded by the rationalization and integration of systems. In both of these forms, IS was regarded primarily as an operational support tool, and secondarily as a service to management. Subsequent to the development, it was during the last few years that an additional potential was discovered. It was found that, in some cases, information technology (IT) had been critical to the implementation of an organization's strategy.

An organization's strategy supported by information system fulfilling its business objectives came to be known as Strategic Information System. The strategic information system consists of functions that involved gathering, maintenance and analysis of data concerning internal resources, and intelligence about competitors, suppliers, customers, government and other relevant organizations.

ORGANIZATIONAL
STRATEGY
SET

MIS
STRATEGY
SET

```
Mission
Objectives
Strategy
Other Strategic Organizational
    Attributes
```

MIS
Strategic

Planning
Process

```
System Objectives
System Constraints
System Design Strategies
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Strategic knowledge management, in a nutshell, allows companies and organizations to identify, store, process, and transfer the information they produce and obtain. It also provides resources to help businesses apply metrics and analytical tools to their collections of knowledge, enabling them to recognize growth opportunities and find ways to increase operational performance.

**Characteristics of Strategic Management Information System**

SMIS presents fruitful insights into the expense of the quality of the product or service that will be both appealing on the market and will produce acceptable investment returns.

- It helps to prepare a product or service with distinctive characteristics that are competitively appealing in the industry.

- IS strategy takes into account what knowledge is required to achieve its goals at the strategic and organizational levels of an organization.

- It must be in a position to provide operating productivity, improved benefit, etc.

- It includes interconnecting the activities of an agency that acquires, collects information and eventually provides information.

- This style of approach emphasizes what knowledge is required to achieve business goals.

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- It can be used to create new market opportunities by using knowledge tools.

- IS plan must be capable of fulfilling an organization's (market-oriented) demand.

- It must be functionally oriented (how well the roles, divisions and strategic business units of the company work well?)

- It assists in the study, discovery and creation of consumer niches that have not been adequately filled.

- Information technology is also able to provide a specific niche or segment with the capabilities to identify, extend, and fill.

A successful strategic process can be done only if the capabilities are in place for the routine basic work of data collection, assessment of potential equipment and software, and management of routine project status reporting. As a basis on which a strategic system can be prepared and developed when a priority situation occurs, centralized preparation and organizational work are absolutely important. To fulfil the need, information management should have laid the groundwork when a new strategic need becomes evident.

**Characteristics of Strategic Management Information System**

There are three common characteristics in all Strategic Management Information System

i. Telecommunication as a central part of Strategic Management Information System

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.

ii. Reliance on a number of vendors for providing information technologies

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

iii. Cooperation among a number of organizations

Interorganizational 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.

**Barriers to Successful Development of Strategic Management Information System:**

Chris Kemerer and Glen Sosa, from the Sloan school of management, have identified 12 barriers to successful development of Strategic MIS. These barriers fall into 3 categories:

**(1) Problem definition barriers**

(a) Generating workable idea require leadership and team work

(b) Many innovative ideas are technically infeasible

(c) Many innovative ideas are prohibitively expensive

(d) Many ideas die because they lack a sufficient market

(2) **Implementation barriers**

(a) Telecommunications increases the complexity of implementing SMIS

(b) Multiple systems are difficult to integrate

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(c) Strategic MIS systems often require inter organizational cooperation

(d) State of the art technologies are difficult to implement.

## 3) Maintenance barriers

(a) Competitors can copy SMIS

(b) Unanticipated demand can overwhelm the usefulness of an SMIS

(c) Applications can be expensive to maintain or enhance

(d) 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.

## EVALUATION OF MANAGEMENT INFORMATION SYSTEM

Evaluation of MIS is a process in which the performance of an organizational MIS is determined. According to the performance results, the organization evaluates and implements the necessary modifications in MIS. Various terms related to the evaluation of MIS are:

1. Evaluation approaches

2. Evaluation classes

3. Product-based MIS evaluation

4. Cost/benefit-based evaluation

## 1) Evaluation Approaches

Various approaches are used to evaluate the organizational MIS performance. The most common approaches are,

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- **Quality Assurance Review**: The quality assurance review is also known as a technical review. It determines the technical quality performance of MIS. The quality assurance review determines the data transmission rate, main or secondary storage, and CPU capacity.

- **Reliability and Accuracy**: Reliability and accuracy is a key indicator of measuring the performance of an MIS. The usefulness of the resulting information is usually determined by the precision of the data, it uses some parameters to find reliability and accuracy.

- **Timeliness of Information**: The results of MIS must be recent. And when evaluating patterns, management must make assumptions about the organization's future, based on MIS data. A more recent on MIS, decision making always reflects on current reality and correctly predict their impact on the business. If the data collection and processing delay its availability, the MIS must take into account its potential age-related inaccuracies and present the resulting information accordingly, with probable error ranges.

    The MIS development personnel or a quality assurance group performs the quality assurance review.

**2) Evaluation Classes**

To evaluate the performance of MIS, the following two classes are used,

- **Effectiveness**: The effectiveness class determines the quality of the MIS output. MIS is effective if the quality of its output is good and the process of producing output is right.

- **Efficiency**: The efficiency class specifies the total amount of resources required by MIS to obtain the output.

- **Completeness of Information**: For a specific decision, a successful MIS provides all the most important and valuable information completely. If any information is not available due to missing data, the gaps are highlighted and

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potential possibilities are either shown or possible implications arising from missing data are addressed.

The relationship between effectiveness and efficiency can be defined as effectiveness is a measure of the quality of an MIS output, while efficiency is a measure of the resources required to achieve the output.

### 3) Product-based MIS evaluation

The product-based MIS evaluation is also known as effectiveness evaluation. Determines the effectiveness of an MIS output. For assessing the effectiveness of MIS output, a model structure may be used.

**Model Structure**: A model structure is a structure that contains various information attributes such as timeliness and relevance. To determine the MIS effectiveness in an organization, we need to determine the information attributes for the MIS output.

Some of commonly used attributes are:

**Timeliness**: Real-time information may be called information that is evaluated in a very short period.

**Relevance**: Questions such as timeliness, authority or novelty of the outcome may include significance.

**Accuracy**: The accuracy of information or measurements is their consistency, even in small details, of being accurate or correct.

**Completeness**: Completeness refers to how comprehensive the data are.

**Adequacy**: The ability to obtain the information required for decision making in a timely and reliable manner.

**Explicitness**: The degree to which MIS is consistent with the particular organization.

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**Exception-based**: MIS should be built based on the exception-based reporting concept, which implies an irregular condition where the maximum, minimum, or predicted values differ outside the limits. Exception reporting should be given to the decision-maker at the appropriate level in such cases.

### 4) Cost/benefit-based evaluation

Cost-based evaluation of the MIS system determines the benefits expected from the developed system. Different approaches are used to measure the cost and evaluate the various benefits to organizations. The approaches of cost-benefit analysis are used to find out the feasible solution. The benefits to be expected from the system and expected benefits are carried out in the cost/benefit calculation of the different expected costs. The measurement of cost/benefit decides the system's cost-effectiveness.

**Types of Evaluation**

**1. Qualitative evaluation** is an assessment process that answers the question, 'How well did we do?' The areas of focus of qualitative evaluation include:

- Content, quality, and relevance of a program;

- Attitudes and achievements of the participants;

- Quality of resources employed and environment adopted;

- Efficiency of strategies and activities;

- Social Costs in relation to what was achieved and

- Social Benefits

**2. Quantitative evaluation** is an assessment process that answers the question, 'How much did we do?' The areas of focus of qualitative evaluation include: Numbers of offerings, amount of good and bad outcomes, economic costs, economic benefits and so on.

**3. Formative evaluation** is a process of ongoing feedback on performance review. The purposes are to identify aspects of performance that need to improve and to offer corrective suggestions.. Formative evaluation is needed if safety concerns arise.

**4. Summative evaluation** is a process of ongoing feedback on performance review with the purpose of identifying larger patterns and trends in performance and judgment against criteria to obtain performance ratings.

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## UNIT II

**UNIT II: Database Management System –** Objectives and Components- Database Design- Creation and control- Recent trends in Database.

**Introduction**

**Database Management System ( DBMS)**

Database is a collection of interrelated data which helps in the efficient retrieval, insertion, and deletion of data from the database and organizes the data in the form of tables, views, schemas, reports, etc. For Example, a university database organizes the data about students, faculty, admin staff, etc. which helps in the efficient retrieval, insertion, and deletion of data from it.

**There are four types of Data Languages**

1. Data Definition Language (**DDL**)

2. Data Manipulation Language (**DML**)

3. Data Control Language (**DCL**)

4. Transactional Control Language (**TCL**)

 **DDL** is the short name for Data Definition Language, which deals with database schemes and descriptions, of how the data should reside in the database.

- CREATE: creates a database and its objects like (table, index, views, store procedure, function, and triggers)

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- ALTER: alters the structure of the existing database

- DROP: deletes objects from the database

- TRUNCATE: removes all records from a table, including all spaces allocated for the records are removed

- COMMENT: adds comments to the data dictionary

- RENAME: renames an object


**DML** is the short name for Data Manipulation Language which deals with data manipulation and includes most common SQL statements such SELECT, INSERT, UPDATE, DELETE, etc., and it is used to store, modify, retrieve, delete and update data in a database.

- SELECT: retrieves data from a database

- INSERT: inserts data into a table

- UPDATE: updates existing data within a table

- DELETE: Deletes all records from a database table

- MERGE: UPSERTs operation (insert or update)

- CALL: calls a PL/SQL or Java subprogram

- EXPLAIN PLAN: interpretation of the data access path

- LOCK TABLE: concurrency Control


**DCL** is the short form for Data Control Language which acts as an access specifier to the database. (Basically, to grant and revoke permissions to users in the database

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- GRANT: grant permissions to the user for running DML (SELECT, INSERT, DELETE) commands on the table

- REVOKE: revoke permissions to the user for running DML (SELECT, INSERT, DELETE,) command on the specified table

**TCL** is the short form for Transactional Control Language which acts as an manager for all types of transactional data and all transactions. Some of the commands of TCL are

- Role Back: It is used to cancel or Undo changes made in the database

- Commit: It is used to apply or save changes in the database

- Save Point: It is used to save the data on the temporary basis in the database

**Database Management System**

The software which is used to manage database is called Database Management System (DBMS). For Example, MySQL, Oracle, etc. are popular commercial DBMS used in different applications. DBMS allows users the following tasks:

- **Data Definition:** It helps in the creation, modification, and removal of definitions that define the organization of data in the database.

- **Data Updating:** It helps in the insertion, modification, and deletion of the actual data in the database.

- **Data Retrieval:** It helps in the retrieval of data from the database which can be used by applications for various purposes.

- **User Administration:** It helps in registering and monitoring users, enforcing data security, monitoring performance, maintaining data

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integrity, dealing with concurrency control, and recovering information corrupted by unexpected failure.

**Database Management System and DBMS Objectives**

A database is a repository for a collection of related data or faces. Data are arranged in certain order and form which are useful and are called information. Data are the raw material to generate information. Data are to be processed to produce information.

**Database Management System (DBMS)**

Database Management System (DBMS) is a software that defines a database, stores data, supports a query language, produces reports, and creates a data entry screen. Database systems are designed to manage large bodies of information.

**OBJECTIVES OF DBMS (Database Management System)**

DBMS applications must be capable of solving challenging problems of different organizations. Some of the objectives of DBMS are given below:

- Provide for mass storage of relevant data

- Provide easy access to data for the authorized user.

- Provide prompt response to users' requests for data.

- Eliminate redundant (Duplicate) data.

- Allow multiple users to be active at one time.

- Allow the growth of the database system

- Provide data integrity.

- Protect the data from physical harm and unauthorized access.

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- Serve different types of users.

- Provide security with a user access privilege.

- Combine interrelated data to generate a report

- Provide multiple views for the same data.

**Relational Database Management System (RDBMS)**

The DBMS in which relations between different tables can be formed using a common field or attribute in those tables to draw relations in between is called Relational Database Management System. A relational Database implements data in a series or two- dimensional table that is related to one another through the foreign key.

**Concepts for Relational Database Management System (RDBMS**)

**Entity:** An entity is a class of persons, places, events, objects, or concepts in the real world that is distinguishable from other objects. An entity is also called an entity type or entity class.

**Attributes:** Attributes are descriptive properties possessed by each member of an entity. Attributes are also called elements, the property of the field.

**Relationships:** A relationship is a natural business association that exists between one or more entities. The relationship may represent an event that links the entities.

**Functions of Data Base Management System (DBMS):**

Every computer application has unique requirements. For example, special purpose software systems that handle personnel, inventory, and marketing data, may differ not only in the type of information but also in the facilities they provide for data entry and retrieval.

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The cost of designing and building special purpose software systems for Data management tasks often prohibits otherwise cost effective automation. Data base management systems are general purpose programs that dramatically reduce the time necessary to computerise an application.

**The purpose of DBMS is to provide for the following main functions:**

1. A mechanism for organising, structuring and storing data.

2. A mechanism for accessing data that provides a measure of data independence, i.e., to some extent it insulates application programs from changes to the data structure.

3. Creating program for data independence. Either one can be altered independently of the other.

4. Reducing data redundancy.

5. Providing security to the user's data. Access is limited to authorized users by pass words or similar schemes.

6. Reducing physical storage requirements by separating the logical and physical aspects of the data base.

**Advantages of DBMS**

1. Integrity

2. Security

3. Data independence

4. Shared data

5. Conflict resolution

6. Reduction of redundancies.

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## 1. Integrity:

Centralised control can also ensure that adequate checks are incorporated in the DBMS to provide data integrity. Data integrity means that the data contained in the data base is both accurate and consistent. Therefore, Data values being entered for storage could be checked to ensure that they fall within a specified range and are of the correct format.

For example, the value for the age of an employee may be in the range of 16 and 75.

Another integrity check that should be incorporated in the data base is to ensure that if there is a reference to certain object, that object must exist. In the case of an automatic teller machine, for example, a user is not allowed to transfer funds from a non-existent savings account to a checking account.

## 2. Security:

Data are of vital importance to an organisation and may be confidential. Such confidential data must not be accessed by un-authorised persons. The data base administrator (DBA) who has the ultimate responsibility for the data in the DBMS can ensure that proper access procedures are followed, including proper authentication schemes for access to the DBMS and additional checks before permitting access to sensitive data.

Different levels of security could be implemented for various types of data and operations. The enforcement of security could be data value dependent (e.g., a manager has access to the salary details of employees in his department only), as well as data type dependent (but the manager cannot access the medical history of any employee, including those in his department).

## 3. Data Independence:

Data independence is usually considered from two points of view; physical data independence and logical data independence. Physical data independence allows changes in the physical storage devices or organisation of the files to be made without

requiring changes in the conceptual view or any of the external views and hence in the application programs using the data base.

Thus, the files may migrate from one type of physical media to another or the file structure may change without any need for changes in the application programs. Logical data independence implies that application programs need not be changed if fields are added to an existing record; nor do they have to be changed if fields not used by application programs are deleted.

Logical data independence indicates that the conceptual schemes can be changed without affecting the existing external schemes. Data independence is advantageous in the data base environment since it allows for changes at one level of the data base without affecting other levels. These changes are absorbed by the mappings between the levels.

**4. Shared Data:**

A data base allows the sharing of data under its control by any number of application programs or users. The applications for the public relations and payroll departments could share the data for the record type employee.

**5. Conflict Resolution:**

Since the data base is under the control of the data base administrator (DBA), he should resolve the conflicting requirements of various users and applications. In essence, the DBA chooses the best file structure and access method to get optimal performance for the critical applications, while permitting less critical applications to continue to use the data base, albeit with the relative response.

**6. Reduction of Redundancies:**

Backup and recovery operations are very complex in a data base management system (DBMS) environment and this is evident in concurrent multi user data base system. A data base system requires a certain amount of controlled redundancies and duplication to enable assess to related data items.

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Centralised control of data by the DBA avoids unnecessary duplication of data and effectively reduces the total amount of data storage required. It also eliminates the extra processing necessary to trace the required data in a large mass of data.

Another advantage of avoiding duplication is the elimination of the inconsistencies that tend to be present in redundant data files. Any redundancies that exist in the DBMS are controlled and the system ensures that these multiple copies are consistent.

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**Disadvantages of DBMS: Disadvantages or limitations of the database management system are as follows:**

**1. High Cost**

The high cost of software and hardware is the main disadvantage of the database management system.

Database users require a high-speed processor and huge memory size to use the database on the DBMS. Sometimes, users require costly machines for maintaining databases.

Organizations need a trained and highly paid technical database administrator for using and maintaining the large database systems.

**2. Huge Size**

The size of the database is not big at the initial state, but when the user stores a large amount of data, then it creates many problems. Due to the huge data, database systems do not provide good results and do not run efficiently. That's why the size is another limitation of the database systems.

**3. Database Failure**

In the database systems, all the data or information of an organization is stored in one centralized database. If the database of that organization fails, then the data is lost, and the organization will collapse. So, database failure is a big problem with the database management system.

**4. Complexity**

Database management system (DBMS) is so complex for non-technical users. So, it isn't easy to manage and maintain database systems. Therefore, training for the designers, users, and administrators is necessary to efficiently run the database systems.

**5. Increased Staff Cost**

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DBMS requires an educated and skilled staff for managing and maintaining the databases. So, Organisation needs to spend a lot of money to get this level of trained and experienced staff.

## 6. Requirement of Technical Staff

A non-technical people can't understand the complexity of the database. So, the technical staff is required for maintaining and handling the database management system.

## 7. Cost of Data Conversion

It is one of the big disadvantages of the database management system because the cost of data conversion is very high. There is a requirement for trained, skilled, and experienced database administrators for converting the data smoothly.

## 8. Performance

Performance is another big disadvantage of database systems because the speed of the database systems for small firms and organizations is very slow. Hence, the performance of the database systems in small organizations is poor.

## Paradigm Shift from File System to DBMS

File System manages data using files on a hard disk. Users are allowed to create, delete, and update the files according to their requirements. Example - file-based University Management System. Data of students is available to their respective Departments, Academics Section, Result Section, Accounts Section, Hostel Office, etc. Some of the data is common for all sections like Roll No, Name, Father Name, Address, and Phone number of students but some data are available to a particular section only like Hostel allotment number which is a part of the hostel office. The issues with this system are as follows:

- **Redundancy of data:** Data are said to be redundant if the same data are copied at many places. If a student wants to change the Phone number,

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he or she has to get it updated in various sections. Similarly, old records must be deleted from all sections representing that student.

- **Inconsistency of Data:** Data are said to be inconsistent if multiple copies of the same data do not match each other. If the Phone number is different in Accounts Section and Academics Section, it will be inconsistent. Inconsistency may be because of typing errors or not updating all copies of the same data.

- **Difficult Data Access:** A user should know the exact location of the file to access data, so the process is very cumbersome and tedious. If the user wants to search the student hostel allotment number of a student from 10000 unsorted students' records, how difficult it can be.

- **Unauthorized Access:** File Systems may lead to unauthorized access to data. If a student gets access to a file having his marks, he can change it in an unauthorized way.

- **No Concurrent Access:** The access of the same data by multiple users at the same time is known as concurrency. The file system does not allow concurrency as data can be accessed by only one user at a time.

- **No Backup and Recovery:** The file system does not incorporate any backup and recovery of data if a file is lost or corrupted


**Database Management System**

- Database management system is a software which is used to manage the database. For example: MySQL, Oracle, etc are a very popular commercial database which is used in different applications.

- DBMS provides an interface to perform various operations like database creation, storing data in it, updating data, creating a table in the database and a lot more.

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- It provides protection and security to the database. In the case of multiple users, it also maintains data consistency.

   **DBMS allows users the following tasks:**

- **Data Definition:** It is used for creation, modification, and removal of definition that defines the organization of data in the database.

- **Data Updating:** It is used for the insertion, modification, and deletion of the actual data in the database.

- **Data Retrieval:** It is used to retrieve the data from the database which can be used by applications for various purposes.

- **User Administration:** It is used for registering and monitoring users, maintain data integrity, enforcing data security, dealing with concurrency control, monitoring performance and recovering information corrupted by unexpected failure.

**Characteristics of DBMS**

- It uses a digital repository established on a server to store and manage the information.
- It can provide a clear and logical view of the process that manipulates data.
- DBMS contains automatic backup and recovery procedures.
- It contains ACID properties which maintain data in a healthy state in case of failure.
- It can reduce the complex relationship between data.
- It is used to support manipulation and processing of data.
- It is used to provide security of data.
- It can view the database from different viewpoints according to the requirements of the user.

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**Advantages of DBMS**

- **Controls database redundancy:** It can control data redundancy because it stores all the data in one single database file and that recorded data is placed in the database.

- **Data sharing:** In DBMS, the authorized users of an organization can share the data among multiple users.

- **Easily Maintenance:** It can be easily maintainable due to the centralized nature of the database system.

- **Reduce time:** It reduces development time and maintenance need.

- **Backup:** It provides backup and recovery subsystems which create automatic backup of data from hardware and software failures and restores the data if required.

- **Multiple user interface:** It provides different types of user interfaces like graphical user interfaces, application program interfaces.

**Disadvantages of DBMS**

- **Cost of Hardware and Software:** It requires a high speed of data processor and large memory size to run DBMS software.

- **Size:** It occupies a large space of disks and large memory to run them efficiently.

- **Complexity:** Database system creates additional complexity and requirements.

  **Higher impact of failure:** Failure is highly impacted the database because in most of the organization, all the data stored in a single database and if the database is damaged due to electric failure or database corruption then the data may be lost forever

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Database management systems can be classified based on a variety of criteria such as the data model, the database distribution, or user numbers. The most widely used types of DBMS software are relational, distributed, hierarchical, object-oriented, and network.

### Distributed database management system

A distributed DBMS is a set of logically interrelated databases distributed over a network that is managed by a centralized database application. This type of DBMS synchronizes data periodically and ensures that any change to data is universally updated in the database.

### Hierarchical database management system

Hierarchical databases organize model data in a tree-like structure. Data storage is either a top-down or bottom-up format and is represented using a parent-child relationship.

### Network database management system

The network database model addresses the need for more complex relationships by allowing each child to have multiple parents. Entities are organized in a graph that can be accessed through several paths.

### Relational database management system

Relational database management systems (RDBMS) are the most popular data model because of its user-friendly interface. It is based on normalizing data in the rows and columns of the tables. This is a viable option when you need a data storage system that is scalable, flexible, and able to manage lots of information.

### Object-oriented database management system

Object-oriented models store data in objects instead of rows and columns. It is based on object-oriented programming (OOP) that allows objects to have members such as fields, properties, and methods is software that

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allows access to data stored in a database and provides an easy and effective method of database system.

**Structure of Database Management System**

- Defining the information.

- Storing the information.

- Manipulating the information.

- Protecting the information from system crashes or data theft.

- Differentiating access permissions for different users.

**Data Theft:** When somebody steals the information stored on databases, and servers, this process is known as Data Theft.

Structure of Database Management System is also referred to as Overall System Structure or Database Architecture but it is different from the tier architecture of Database.

The database system is divided into three components: Query Processor, Storage Manager, and Disk Storage. These are explained below.

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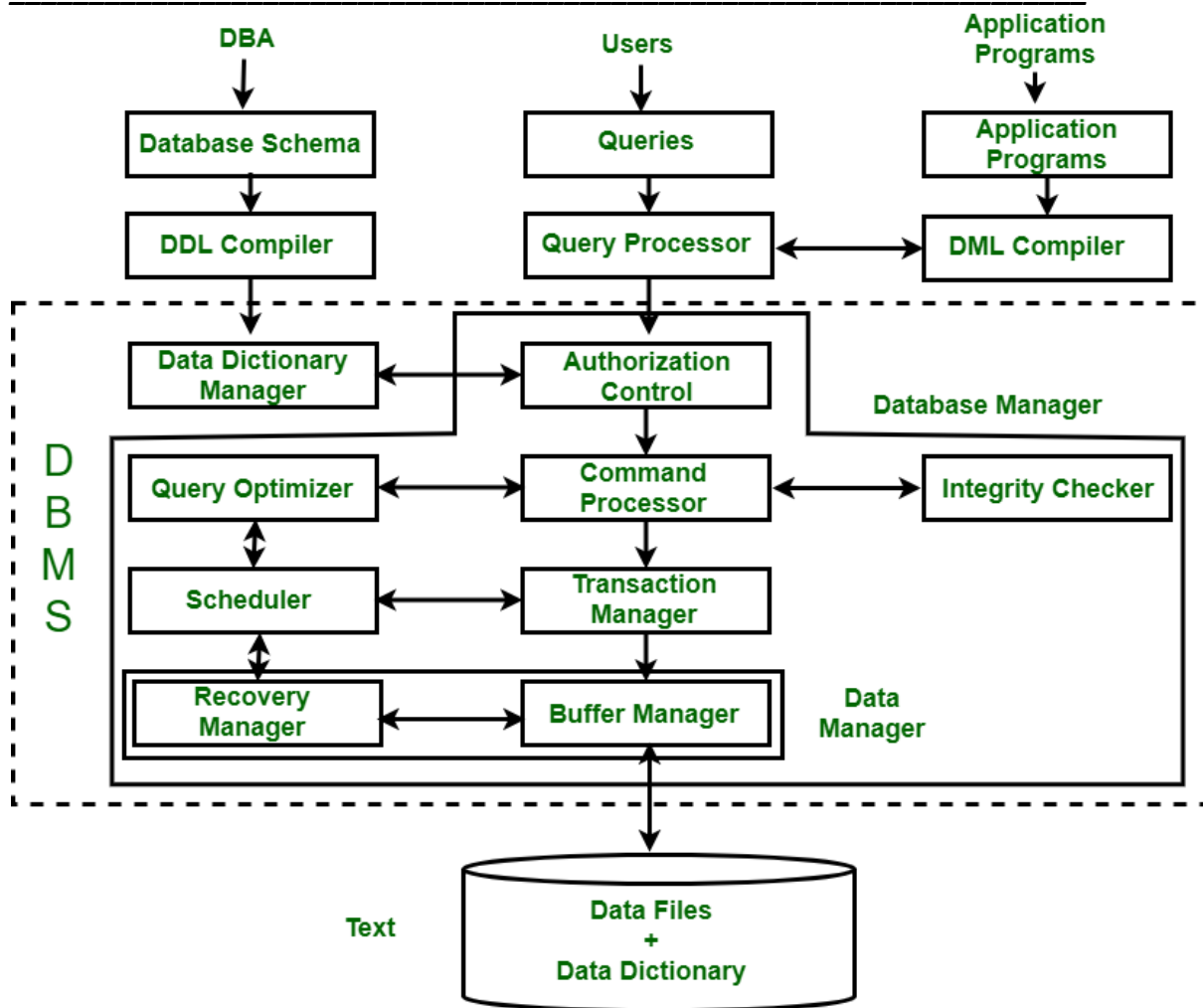
**Architecture of DBMS**

**1. Query Processor:** It interprets the requests (queries) received from end user via an application program into instructions. It also executes the user request which is received from the DML compiler.

Query Processor contains the following components –

- **DML Compiler:** It processes the DML statements into low level instruction (machine language), so that they can be executed.

- **DDL Interpreter:** It processes the DDL statements into a set of table containing meta data (data about data).

- **Embedded DML Pre-compiler:** It processes DML statements embedded in an application program into procedural calls.

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- **Query Optimizer:** It executes the instruction generated by DML Compiler.

## 2. Storage Manager:

Storage Manager is a program that provides an interface between the data stored in the database and the queries received. It is also known as Database Control System. It maintains the consistency and integrity of the database by applying the constraints and executing the DCL statements. It is responsible for updating, storing, deleting, and retrieving data in the database.

It contains the following components –

- **Authorization Manager:** It ensures role-based access control, i.e,. checks whether the particular person is privileged to perform the requested operation or not.

- **Integrity Manager:** It checks the integrity constraints when the database is modified.

- **Transaction Manager:** It controls concurrent access by performing the operations in a scheduled way that it receives the transaction. Thus, it ensures that the database remains in the consistent state before and after the execution of a transaction.

- **File Manager:** It manages the file space and the data structure used to represent information in the database.

- **Buffer Manager:** It is responsible for cache memory and the transfer of data between the secondary storage and main memory.

### 3. Disk Storage:

It contains the following components –

- **Data Files:** It stores the data.

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- **Data Dictionary:** It contains the information about the structure of any database object. It is the repository of information that governs the metadata.

- **Indices:** It provides faster retrieval of data item.

**COMPONENTS OF A DBMS**

A DBMS is a sophisticated piece of system software consisting of multiple integrated components that deliver a consistent, managed environment for creating, accessing and modifying data in databases. These components include the following:

- **Storage engine:**

  This basic element of a DBMS is used to store data. The DBMS must interface with a file system at the operating system (OS) level to store data. It can use additional components to store data or interface with the actual data at the file system level.

- **Metadata catalogue:**

  Sometimes called a system catalogue or database dictionary, a metadata catalogue functions as a repository for all the database objects that have been created. When databases and other objects are created, the DBMS automatically registers information about them in the metadata catalogue. The DBMS uses this catalogue to verify user requests for data, and users can query the catalogue for information about the database structures that exist in the DBMS. The metadata catalogue can include information about database objects, schemas, programs, security, performance, communication and other environmental details about the databases it manages.

- **Database access language:**

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The DBMS also must provide an API to access the data, typically in the form of a database access language to access and modify data but may also be used to create database objects and secure and authorize access to the data. SQL is an example of a database access language and encompasses several sets of commands, including Data Control Language for authorizing data access, Data Definition Language for defining database structures and Data Manipulation Language for reading and modifying data.

- **Optimization engine:**

  A DBMS may also provide an optimization engine, which is used to parse database access language requests and turn them into actionable commands for accessing and modifying data.

- **Query processor**

  After a query is optimized, the DBMS must provide a means for running the query and returning the results.

- **Lock manager**

  This crucial component of the DBMS manages concurrent access to the same data. Locks are required to ensure multiple users aren't trying to modify the same data simultaneously.

- **Log manager**

  The DBMS records all changes made to data managed by the DBMS. The record of changes is known as the log, and the log manager component of the DBMS is used to ensure that log records are made efficiently and accurately. The DBMS uses the log manager during shutdown and start-up to ensure data integrity, and it interfaces with database utilities to create backups and run recoveries.

- **Data utilities.** A DBMS also provides a set of utilities for managing and controlling database activities. Examples of database utilities include

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reorganization, run stats, backup and copy, recover, integrity check, load data, unload data and repair database
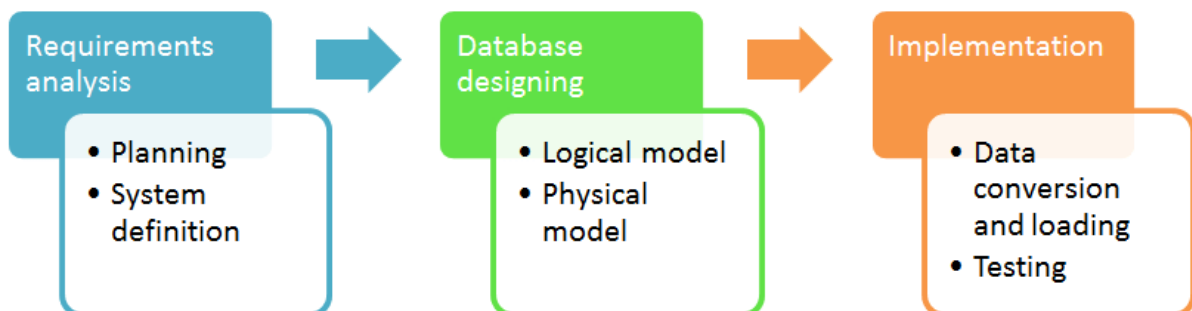
## DATABASE DESIGN

**Database Design** is a collection of processes that facilitate the designing, development, implementation and maintenance of enterprise data management systems. Properly designed database is easy to maintain, improves data consistency and are cost effective in terms of disk storage space. The database designer decides how the data elements correlate and what data must be stored.

The main objectives of database design in DBMS are to produce logical and physical designs models of the proposed database system.

The logical model concentrates on the data requirements and the data to be stored independent of physical considerations. It does not concern itself with how the data will be stored or where it will be stored physically.

The physical data design model involves translating the logical DB design of the database onto physical media using hardware resources and software systems such as database management systems (DBMS).

**Database development life cycle**



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- The database development life cycle has a number of stages that are followed when developing database systems.

- The steps in the development life cycle do not necessarily have to be followed religiously in a sequential manner.

- On small database systems, the process of database design is usually very simple and does not involve a lot of steps.

- In order to fully appreciate the above diagram, let's look at the individual components listed in each step for overview of design process in DBMS.

**Requirements analysis**

**Planning** –This stages of database design concepts are concerned with planning of entire Database Development Life Cycle. It takes into consideration the Information Systems strategy of the organization.

**System definition** – This stage defines the scope and boundaries of the proposed database system.

**Database designing:**

**Logical model** – This stage is concerned with developing a database model based on requirements. The entire design is on paper without any physical implementations or specific DBMS considerations.

**Physical model** – This stage implements the logical model of the database taking into account the DBMS and physical implementation factors.

**Implementation:**

**Data conversion and loading** – this stage of relational databases design is concerned with importing and converting data from the old system into the new database.

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**Testing** – this stage is concerned with the identification of errors in the newly implemented system. It checks the database against requirement specifications

**Database on Relational Database Service (RDS) of Amazon Web   Services**

### Introduction to Cloud

Cloud computing is an information technology paradigm that enables ubiquitous access to shared pools of configurable system resources and higher-level services that can be rapidly provisioned with minimal management effort, often over the Internet

**Amazon Web Services** is a subsidiary of Amazon.com that provides on-demand cloud computing platforms to individuals, companies, and governments, on a paid subscription basis.

### Features of cloud

1.  No up-front investment

2.  Lowering operating cost

3.  Highly scalable

4.  Easy access

5.  Reducing business risks and maintenance expenses

### RDS

RDS belongs to Amazon Relational Database Service. It is a distributed Relational Database Service by Amazon Web Services.

### Features of Cloud Database

1.  A database service built and accessed through a cloud platform

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2. Enables enterprise users to host databases without buying dedicated hardware

3. Can be managed by the user or offered as a service and managed by a provider

4. Can support SQL (including MySQL) or NoSQL databases

5. Accessed through a web interface or vendor-provided API

**Advantages of Cloud Database**

**1. Cost efficient:**

The lack of on-premises infrastructure also removes their associated operational costs in the form of power, air conditioning, and administration costs.

**2. Reliability:**

With a managed service platform, cloud computing is much more reliable and consistent than in-house IT infrastructure. Organization can benefit from a massive pool of redundant IT resources, as well as quick failover mechanism – if a server fails, hosted applications and services can easily be transited to any of the available servers.

**3. Manageability:**

Cloud computing provides enhanced and simplified IT management and maintenance capabilities through central administration of resources, vendor managed infrastructure and SLA backed agreements.

**Disadvantages of Cloud Database**

**1. Security:**

Using cloud-powered technologies means service provider should be provided with access to important business data. Meanwhile, being a public service opens up cloud service providers to security challenges on a routine

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basis. The ease in procuring and accessing cloud services can also give nefarious users the ability to scan, identify and exploit loopholes and vulnerabilities within a system.

### 2. Limited Control:

The customer can only control and manage the applications, data, and services operated on top of that, not the backend infrastructure itself. Key administrative tasks such as server shell access, updating, and firmware management may not be passed on to the customer or end user

## CONTROL METHODS OF DATABASE SECURITY

**Database Security:** means keeping sensitive information safe and prevent the loss of data. Security of data base is controlled by Database Administrator (DBA).

The following are the main control measures are used to provide security of data in databases:

**1.** Authentication

**2.** Access control

**3.** Inference control

**4.** Flow control

**5.** Database Security applying Statistical Method

**6.** Encryption

These are explained as following below:

### 1.**Authentication:**

Authentication is the process of confirmation that whether the user log in only according to the rights provided to him to perform the activities

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of data base. A particular user can login only up to his privilege but he can't access the other sensitive data. The privilege of accessing sensitive data is restricted by using Authentication. By using these authentication tools for biometrics such as retina and figure prints can prevent the data base from unauthorized/malicious users.

## 2.**Access Control:**

The security mechanism of DBMS must include some provisions for restricting access to the data base by unauthorized users. Access control is done by creating user accounts and to control login process by the DBMS. So, that database access of sensitive data is possible only to those people (database users) who are allowed to access such data and to restrict access to unauthorized persons. The database system must also keep the track of all operations performed by certain user throughout the entire login time.

## 3. **Inference Control:**

This method is known as the countermeasures to statistical database security problem. It is used to prevent the user from completing any inference channel. This method protect sensitive information from indirect disclosure. Inferences are of two types, identity disclosure and attribute disclosure.

## 4. **Flow Control:**

This prevents information from flowing in a way that it reaches unauthorized users. Channels are the pathways for information to flow implicitly in ways that violate the privacy policy of a company are called convert channels.

## 5. **Database Security applying Statistical Method:**

Statistical database security focuses on the protection of confidential individual values stored in and used for statistical purposes and used to retrieve the summaries of values based on categories. They do not permit to retrieve the individual information. This allows to access the database to get statistical information about

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the number of employees in the company but not to access the detailed confidential/personal information about the specific individual employee.

6.**Encryption:**

This method is mainly used to protect sensitive data (such as credit card numbers, OTP numbers) and other sensitive numbers. The data is encoded using some encoding algorithms.

An unauthorized user who tries to access this encoded data will face difficulty in decoding it, but authorized users are given decoding keys to decode data.

**Database Management Trends in 2022**

Historically, Database Management systems (DBMS) were simple software programs and associated hardware that allowed users to access data from different geographical locations. The system offers its users the ability to store data without concerns about structural changes, or the data's physical location. Additionally, a Database Management system (DBMS) can set restrictions on the data being used, and the services available to each user.

1. DBMSs are changing, however. They are expanding, taking on more responsibilities, and providing smarter answers. As new goals and problems present themselves, the desire to find new ways to use Database Management systems prompt unique solutions. Many of these innovations are available only in cloud-based DBMSs.

2. As Database Management systems develop new features and new options, it makes sense to re-examine the organization's current system, and consider all new options.

3. The coronavirus pandemic, with its emphasis on isolation, has accelerated the acceptance of online shopping and working remotely.

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4. The coronavirus pandemic, with its emphasis on isolation, has accelerated the acceptance of online shopping and working remotely. Many small businesses have made the decision to digitize and are shifting to the cloud at an accelerated rate.

5. The market for Database Management systems is growing fast and, according to Research and Markets, the global DBMS market was estimated to have reached $63.9 trillion in 2020, and is projected to reach $142.7 trillion by 2027.

6. Increasingly, organizations are merging their data warehouses and data lakes into cloud storage systems. Shifting to the cloud requires a Database Management system (DBMS) for working with a broad range of new data formats.

**DATABASE MANAGEMENT TRENDS IN 2022 INCLUDE:**

- Cloud-based DBMS

- Automation and DBMS

- Augmented DBMS

- Increased security

- In-memory databases

- Graph databases

- Open-source DBMSs

- Databases-as-a-service

These trends are based, to a large extent, on businesses wanting to provide access to their products and services over the internet, with the goal of maintaining (or increasing) profits during the pandemic.

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### Cloud-based DBMS

The Gartner report The Future of the DBMS Market Is Cloud *predicts* the use of cloud-based DBMSs will increase. The market for Database Management systems is being driven increasingly by cloud services, and no longer by on-premise systems. Certainly, there are large organizations still using on-premises DBMS solutions, however, they are combining it with a cloud-based DBMS and using a "hybrid" approach.

The choice of using a cloud-based DBMS service is being supported, in part, by a shift toward using software-as-a-service applications. This is a very reasonable alternative to the upfront expenses required for deploying an on-premise Data Management system. Improved data sharing, improved data integration, and data security are also reasons for using a cloud-based Database Management system.

### Database Management Trends & Automated Services

Automated services can help streamline the process of Database Management. An automated DBMS can help significantly in sifting through the massive amounts of data generated by eCommerce, mobile applications, customer relationship management, and social media. As a consequence, organizations are experiencing enormous surges in the amounts of data being stored. These massive amounts of data can be used to the business' advantage, providing useful insights about their customers and products.

Data automation supports the uploading, handling, and processing of data by automated tools, rather than performing the tasks manually. Automating data processing improves efficiency by working much faster than could be done manually, and by eliminating human error.

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Having automation as part of the data analytics process allows researchers to focus on analyzing the data instead preparing it. Automation also helps improve the integration of data from multiple data sources to a single one. Examples of DBMS automation that is used on a daily basis include:

- Customer support

- Employee analytics

- Purchase order automation

- Desk support

- Scheduling meetings

DBMS automation is also being used to provide security, data integration, and Data Governance. Most organizations must meet several compliance requirements, and DBMS automation helps to meet them. The GDPR, for instance, requires user data be anonymous and used for statistical purposes before it is shared with external partners, and this can be done with automated services.

**Augmented Data Management (ADM)**

Augmented Data Management uses machine learning and artificial intelligence to automate Data Management tasks, such as spotting anomalies within large amounts of data and resolving Data Quality issues.

The AI models are specifically designed to perform Data Management tasks, taking less time and making fewer errors. Todd Ramlin, a manager of Cable Compare, in describing the benefits of augmented Data Management, said,

"Historically, data scientists and engineers have spent the majority of their time manually accessing, preparing, and managing data, but Augmented Data Management is changing that. ADM uses artificial intelligence and machine learning to automate manual tasks in Data Management. It simplifies, optimizes, and automates operations in Data Quality, Metadata Management, Master Data Management, and Database Management systems. AI/ML can offer smart recommendations based on pre-learned models of solutions to specific data tasks. The automation of manual tasks will lead to increased productivity and better data outcomes."

**Data Security (and Avoiding Data Breaches)**

There have been several high-profile data breaches in the last year. For example, LinkedIn was breached in June 2021, resulting in 700 million users having their information sold online. In September, the retailer Neiman Marcus was breached, with 4.8 million customers being affected. In October of 2021, it was announced the information of 1.5 billion Facebook users was put up for sale in a hacker's forum. And those are just a few of the hundreds of data breaches taking place in 2021. In the state of Washington, the number of known breaches went up from 220 last year to 280 in 2021.

Security has always been a consideration for database administrators, but the recent breaches have made it a primary concern. As a result, increased database security has become a trending issue.

**In-Memory Databases**

In-memory databases are gaining popularity because they respond faster than traditional systems. An in-memory database (IMDB) eliminates the disk drive, and instead stores data in the computer's main memory – its random access memory or RAM. This tactic reduces response times.

The lowered response times is made possible because there is no need for translation and caching. The data being used remains in the same form as when it arrived, and in the same form as the application working with it. These databases are commonly used by applications that depend on rapid response times and offer real-time Data Management. The industries operating and benefitting from in-memory databases include banking, travel, gaming, and telecommunications.

**The Graph Database**

Graph databases provide an excellent way to establish and research relationships in a quick and easy way. They use nodes and edges to form data relationships (nodes represent entities, and edges represent their relationships). Graph databases are designed to assign the relationship between data entities with the same importance the data receives. The design results in only the data which is needed being accessed, while unnecessary data remains untouched, making data retrieval more efficient.

Currently, graph databases are being used with network and IT management. They have been used for accessing social media and providing business intelligence, and for finding anomalies and enhancing security. More recently, graph databases have started being used successfully with:

- Network management

- Telecommunications

- Impact analysis

- Data centre and IT asset management

- Cloud platform management

**Open-Source Databases**

Ten years ago, "open source" Database Management systems were not as commonly used as they are now. They are now used by 7% of the market. Open-source technologies generally evolve and develop quickly, and this includes databases. Open-source technologies are typically designed to minimize the barriers of adoption, and are extremely attractive to apps developers working with cloud-native platforms.

Gartner has predicted that by 2022, over 70% of the new in-house applications created will be developed using an open-source DBMS (OSDBMS), or a cloud-based OSDBMS platform-as-a-service. Open source has shown itself to be a successful method for tapping into creativity and problem-solving skills. It has been used to develop and distribute useful business-critical software, and its use will continue to grow.

**The Database-as-a-Service**

Generally speaking, in the past databases were not designed to work with microservices. Databases were normally monolithic. Monolithic architecture is the traditional way of developing applications. Monolithic software is developed as a single, indivisible unit. Monolithic applications typically lack modularity and use one large code base.

The Database Management trend of using databases-as-a-service is based on the behavior of development teams designing and building applications, while using a microservice. When an application "interacts with a database," the data is shared by all the application's components.

With a micro services app, however, the data is not shared, but decentralized. Each microservice is autonomous and comes with its own

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private data storage, relevant to its functionality. One service cannot modify the data stored inside another service's database. This creates a conflict for integrating microservices with a DBMS.

Fortunately, many new database offerings support the flexibility, redundancy, and scalability requirements.

**Database Management Trends and Evolution**

Until recently, DBMSs have been considered consistent, trustworthy structures that offered reliability without drama. However, with the pandemic acting as an accelerant, databases are evolving to process data more efficiently, while simultaneously becoming more intelligent. To access this evolution, and embrace the economic benefits offered by the cloud, businesses are increasingly shifting to cloud databases.

Currently, a large part of the DBMS market's growth is being driven by organizations moving their Database Management systems to the cloud, which provides faster integration and configuration. Additionally, improved security protocols and superior tools have made remote work a more reasonable option, and has had significant impact on the market's current growth. The increasing number of demands being made on DBMSs – and the increasing number of solutions – makes research a key step in selecting a new Database Management system.

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## UNIT III

### Developing Information System

Planning, Designing and Redesigning – Approaches for System Development – System Analysis and Design – System Implementation and Maintenance.

## DEVELOPING INFORMATION SYSTEM

### Meaning of Information Systems Development:

Information system development or commonly known as SLC (Systems Life Cycle) or SLDC (Software Development Life Cycle) is a process of making and changing the system and the model and methodology used. In other words, an SDLC is the preparation of a new system to replace the old system, both in whole and only partially.

Development of information systems is generally done because of problems that cannot be accommodated by the old system. because of applications that previously could not do bridging with BPJS. Considering the fact that the government has required it, then inevitably the hospital must adjust the SIMRS it already has.

As for carrying out an information system development, the related team will consist of several personnel, namely the project coordinator, system analyst and design, network designer, programmer, technician (hardware), administrator, software tester, graphic designer, and documentary

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**Information System Development Stages**

An information system development consists of six important stages, system survey, needs analysis, design, implementation, testing, change and maintenance.

### 1) System Survey

The SLDC phase also consists of three main points: system identification, selection, and system planning.

### 2) System Identification

This process is to identify the problems facing the company and the system it has. The team will look for any opportunities that can be done to overcome this.

### 3) Selection

The selection phase will apply evaluation points to the development project to ensure the solutions are created in accordance with the company's expected targets.

### 4) System Planning

This step is the step of developing a formal plan to start working on and implementing the information system development concept that has been chosen.

### 5) Needs Analysis

System requirements analysis is a technique for solving problems by decomposing the components of the system. The aim is none other than to find out more about how each component works and the interaction between one components with other components.

Some aspects that need to be targeted in the needs analysis in the development of information systems include business users, job

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analysis, business processes, agreed rules, problems and solutions, business tools, and business plans.

### 6) Design

The design or design of system development is intended to provide a complete blueprint as a guideline for the IT team (especially programmers) in making applications. Thus the IT team no longer makes decisions or works in a sporadic way.

### 4) Implementation

The stage of developing this information system is to work on a previously designed development.

### 5) Testing

A system needs to be tested to ensure that the development carried out is appropriate or not with the expected results. Tests that are applied are various, such as performance, input efficiency, syntax (program logic), output, and so on.

This information system development stage requires preparation of various supporting aspects. In addition to applications, hardware readiness and several other related facilities also need to be prepared. As for implementation, several activities carried out include data migration (conversion), training for users, and trials.

### 6) Change and Maintenance

This step covers the whole process in order to ensure the continuity, smoothness and improvement of the system. In addition to monitoring the system at a certain time, maintenance also includes activities to anticipate minor bugs (bugs), system improvements, and anticipation of some risks from factors outside the system.

## PLANNING FOR MIS

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MIS design and development process has to address the following issues successfully –

There should be effective communication between the developers   and users of the system.

- There should be synchronization in understanding of management, processes and IT among the users as well as the developers.

- Understanding of the information needs of managers from different functional areas and combining these needs into a single integrated system.

- Creating a unified MIS covering the entire organization will lead to a more economical, faster and more integrated system, however it will increase in design complexity manifold.

- The MIS has to be interacting with the complex environment comprising all other sub-systems in the overall information system of the organization. So, it is extremely necessary to understand and define the requirements of MIS in the context of the organization.

- It should keep pace with changes in environment, changing demands of the customers and growing competition.

- It should utilize fast developing in IT capabilities in the best possible ways.

- Cost and time of installing such advanced IT-based systems is high, so there should not be a need for frequent and major modifications.

- It should take care of not only the users i.e., the managers but also other stakeholders like employees, customers and suppliers.

Once the organizational planning stage is over, the designer of the system should take the following strategic decisions for the achievement of MIS goals and objectives −

- Development Strategy − Example - an online, real-time batch.

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- System Development Strategy − Designer selects an approach to system development like operational verses functional, accounting verses analysis.

- Resources for the Development − Designer has to select resources. Resources can be in-house verses external, customized or use of package.

- Manpower Composition − The staffs should have analysts, and programmers.

**Information system planning essentially involves**

- Identification of the stage of information system in the organization.

- Identification of the application of organizational IS.

- Evolution of each of this application based on the established evolution criteria.

- Establishing a priority ranking for these applications.

- Determining the optimum architecture of IS for serving the top priority applications.
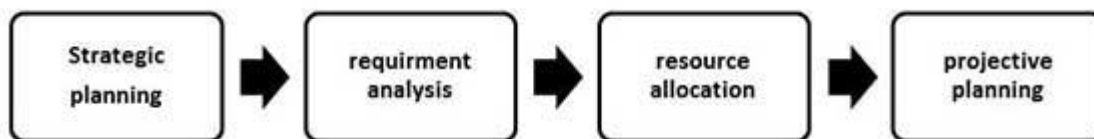


**Information System Requirements**

The following diagram illustrates a brief sketch of the process of information requirement analysis −

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The following three methodologies can be adopted to determine the requirements in developing a management information system for any organization −

- Business Systems Planning (BSP) − this methodology is developed by IBM.
- It identifies the IS priorities of the organization and focuses on the way data is maintained in the system.
- It uses data architecture supporting multiple applications.
- It defines data classes using different matrices to establish relationships among the organization, its processes and data requirements.
- Critical Success Factor (CSF) − this methodology is developed by John Rockart of MIT.
- It identifies the key business goals and strategies of each manager as well as that of the business.
- Next, it looks for the critical success factors underlying these goals.
- Measure of CSF effectiveness becomes an input for defining the information system requirements.
- End/Means (E/M) analysis − this methodology is developed by Wetherbe and Davis at the University of Minnesota.
- It determines the effectiveness criteria for outputs and efficiency criteria for the processes generating the outputs.
- At first it identifies the outputs or services provided by the business processes.
- Then it describes the factors that make these outputs effective for the user.

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- Finally, it selects the information needed to evaluate the effectiveness of outputs

**Information System Analysis and Design**

System analysis and design follows the typical System/Software Design Life Cycle (SDLC).

It generally passes through the following phases −

- Problem Definition

- Feasibility Study

- Systems Analysis

- System Design

- Detailed System Design

- Implementation

- Maintenance

In the analysis phase, the following techniques are commonly used −

- Data flow diagrams (DFD)

- Logic Modeling

- Data Modeling

- Rapid Application Development (RAD)

- Object Oriented Analysis (OOA)

SAD refers to the process of examining a business situation with the intent of improving it through better procedures & methods. System Development generally is thought of as having two major components:

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a) System Analysis

b) System Design

**System Analysis**:

It is the process of gathering and interpreting facts diagnosing problems and using information to recommend improvement to system. It specifies what the system should do. The system analysis is management between techniques which helps in designing a new system or improving an existing system.

**System Design:**

It is the process of planning. System design specifies how to achieve objectives.

**System Development Life Cycle:**

System Development life cycle (SDLC) is used to plan and manage the system development process. Although it is primarily identified with structured analysis, the SDLC describes activities and functions that systems developers typically perform, regardless of how those activities and functions fit into a particular methodology.

**The SDLC model includes the following steps:**

Systems Planning

Systems Analysis

Systems Design

Systems Implementation

In reality, the systems development process is dynamic, and constant change is common.

**Systems Planning:**

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A system planning usually begins with a formal request to the IT department, called a system's request that describes problems or desired changes in an information system or a business process. A system's request can come from a top manager, a planning team, a department head, or the IT department itself. The request can be very significant or relatively minor. A major request might involve a new information system or the replacement of an existing system that cannot handle current requirements. In contrast, a minor request might ask for a new feature or a change to the user interface in current system.

The purpose of the planning phase is to identify clearly the nature and scope of the business opportunity or problem by performing a preliminary investigation, often called a feasibility study. The preliminary investigation is a critical step because the outcome will affect the entire development process. The end product, or deliverable, is a report that describes business considerations, reviews anticipated benefits and costs, and recommends a course of action based on economic, technical, and operational factors.

**Systems Analysis**:

The purpose of the systems analysis phase is to understand business requirement and build a logical model of the new system. The first step is requirement modeling, where business processes are defined and described. Requirement modeling continue the investigation that began during systems planning and involves various fact-finding techniques, such as interview, surveys, observation, and sampling. During the next tasks, data modeling, process modeling, and object modeling, a logical model of business process the system must support is developed. The model consists of various types of diagrams, depending on the methodology being used. The end product for the systems analysis phase is the System Requirements Document. The systems requirements document describes management and user requirements, alternative plans and costs, and analysis.

**Systems Design:**

The purpose of systems design is or create a blueprint for the new system that will satisfy all documented requirements, whether the system is being developed in-

house or purchased as a package. During systems design, all necessary outputs, inputs, interfaces, and processes are identified. In addition, internal and external controls are designed. The design is documented in the System Design Specification and presented to management and users for their review and approval. Management and user involvement is critical to avoid any misunderstandings about what the new system will do, how it will do it, and what it will cost.

### Systems Implementation:

During systems implementation, the new system is constructed. Programs are written, tested, and documented, and the system is installed. If the system was purchased as a package, systems analysts perform any necessary modifications and configurations. The objective of the implementation phase is to deliver a completely functioning and documented information system. At the conclusion of this phase, the system is ready for use. Final preparations include converting data to the new system's files, training of users, and performing the actual transition to the new system. The systems implementation phase also includes and assessment, called a systems evaluation, to determine whether the system operates properly and its costs and benefits are within expectations.

### Systems Operation and Support (Maintenance):

During systems operation and support, the IT staff maintains and enhances the system. Maintenance change correct errors and adapt to changes in the environment, such as new tax rates. Enhancements provide new features and benefits. The objective during this phase is to maximize return on the IT investment. A well-designed system will be reliable, maintainable, and scalable. A scalable design can expand to meet new business requirements and volumes. Information systems development is always a work in progress. Business process change rapidly, and most information systems need to be replaced or significantly updated after several years of operation.
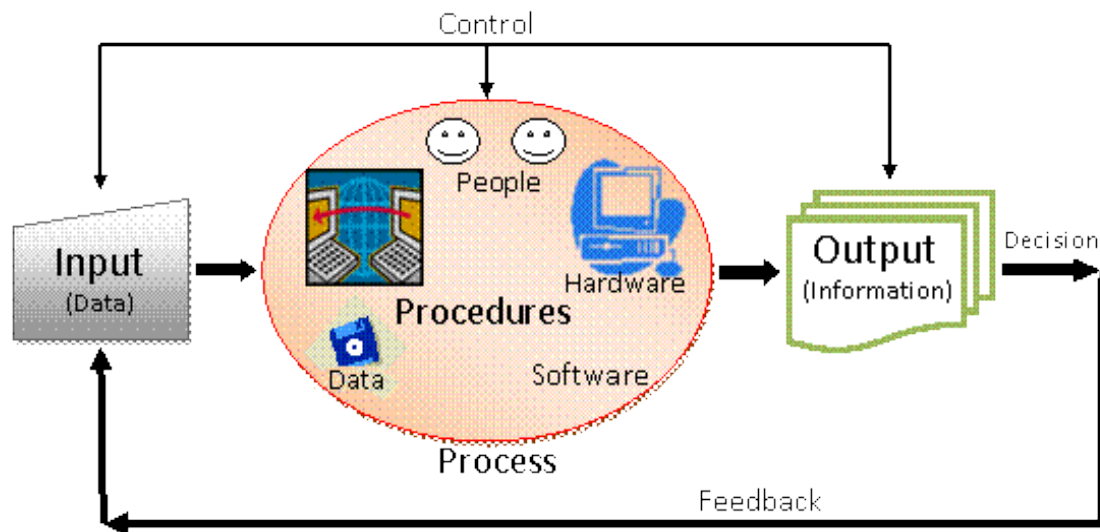
**System with input and output**

**Characteristics of a System**

As defined, a system is an organized relationship of various subsystems or components to achieve some objectives. For example, a computer system has a number of subsystems like Keyboard, Monitor, CPU, Mouse, etc. A Computer system is just an organized relationship of these subsystems in a planned way. These subsystems are also dependent of each other to achieve set targets. Thus the definition of a system suggests the following characteristics that are present in all systems.

**Organization:**

This refers to a systematic order of components working together as per order to achieve centralized objective. It is the arrangement of subsystems in a specific structure and order that help to achieve objectives.

**Interaction:**

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This refers to the manner in which each subsystem functions, interacts or communicates with other components of the system. Special interfaces are designed to share data/ information among subcomponents.

### Interdependence:

It means that subsystems of a system are dependent on one another to achieve objectives of a system. This can be compared with a situation like a complex task which is divided into number of simple tasks (i.e. subsystems). Each simple task performs its work and produces output. Output of one task may become input of some other task. Like this a given complex problem is finally solved. Similarly in a system output of one subsystem may be an input of some other subsystem. These subsystems are coordinated and linked together according to a plan.

### Integration:

This refers to holistic view of the system that how different subsystems are tied together to achieve central objective. A Bottom-up approach is followed to integrate subsystems.

### Planned approach:

In order to achieve centralized objectives, a system should work according to a planned approach. The planned approach is a set of pre-laid policies, procedures, rules, budget, strategies and schedules to achieve goals.

### Central objective:

Each system is developed to achieve specified centralized objectives. All subsystems are developed and integrated to achieve centralized objectives keeping the unique identity of each subsystem. Each subsystem works independently and interacts with other subsystems. Each subsystem contributes something directly or indirectly in achieving the system objectives.

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**Elements of a System:**

In general, an information system accepts input data and processes it to produce information as output for decision making. System is evaluated on the produced output and feedbacks are given to improve the system. A system has following key elements:

**Output:**

One of the major objectives of a system is to produce an output that has value to its user. Nature of output may be goods, services, information etc. Output is outcome of processing and end result of the system.

**Inputs:**

Inputs are the elements like material, manpower, data, information etc. that is entered into the system for processing.

**Processor(s):**

Processor is the element of a system that involves actual transformation of input into output. It is an operational component of a system.

**Control:**

Control element guides a system. It is a decision-making subsystem that controls various activities of a system such as governing input, processing, and output. Control is achieved by correcting the deviation between output and standard.

**Feedback:**

Control in a dynamic system is achieved by feedback. Feedback compares output of a system against performance standards and accordingly information is communicated to system for necessary action. This may yield to change in input or processing and consequently the output.

**Environment:**

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Environment is a super system within which an organization operates. It is the source of external elements that affect a system. It often determines how a system should work. For example, vendors, competitors, Govt. policies, tax department, etc. may provide constraints and consequently influence actual performance of the system.

**Boundaries and interface:**

A system is defined by its boundaries the limits that identify its components, processes, and interrelationships when it interfaces with another system. A system boundary indicates where one system ends and another starts. Generally, boundaries between systems are not always clear cut. A complex system may have many interfaces with other systems. For example the market & sale section is concerned with sale of milk and milk products, collection of sale amount, determining demand of products in near future. This section is not concerned about how the products are being manufactured, manufacturing losses for production, etc.

**System Development Approaches**

Developing a successful information system for business application is a challenging task. System development process includes the activities like understanding, planning, designing, implementation and maintenance of systems. System development approaches have undergone reforms as per the changes in software development technology. Software technology has changed from modular to structure and now to object oriented technology. Basic goal in system development process is to produce high quality information system for solving business applications. It provides a framework that is used to structure, plan and control the process of developing a system. Various methods have been evolved and being practiced over the years. A few major methods are:

I.  System Development Life Cycle method (or traditional method))

II.  Structured Analysis Development method

III.  Waterfall method

IV.  Prototype method

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V.      Spiral method

VI.     Object oriented Development method

Each of these methods has its own strengths and weaknesses. One method may not be suitable for all type of systems. It depends on technical nature of a system, organizational requirements, knowledge of developers etc. Basically all these methods follow either linear or iterative approach or combination of these two approaches for development of systems. In linear approach, above mentioned activities are followed in a sequence with or without overlapping of some activities to develop a system. In iterative approach, the activities may or not be repeated for improvement after getting users feedback.
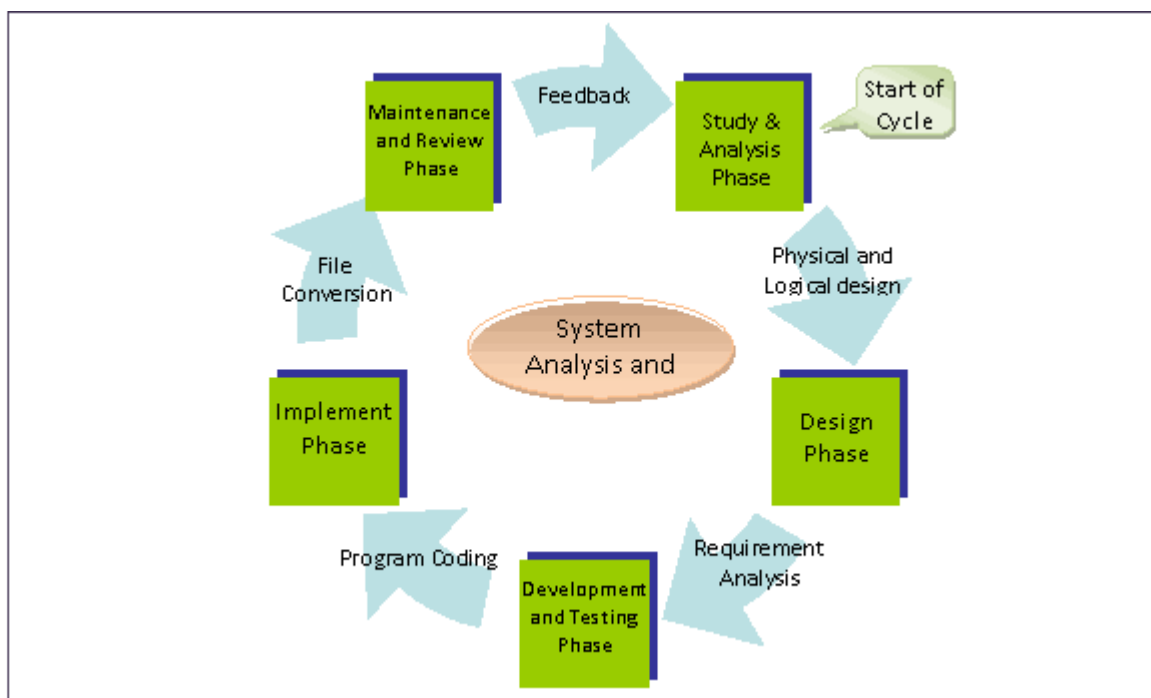
**System development life cycle**

The most prevalent and important method for system development is System Development Life Cycle (SDLC) method. Though it is traditional method but still it holds good in any methodology or approach as it is generic term for system development. System development process has a life cycle just like a living system. Systems are conceived, designed, developed and maintained. Over a period, numbers of changes in the existing computer system are made to accommodate new requirements of users and technological developments that give a totally different look to the system which was conceived and developed in the beginning. This is a continuous process which shows that information systems are just like living systems which came into existence and after some time they die (i.e., replaced with new one).

System analysis and design are important factors of system development life cycle. For computer professionals, SDLC is a systematic method to develop a computer based system to solve a business or scientific problems in order to fulfill the needs of an organization or a customer. SDLC method helps to monitor the progress while the application development is in progress. This method monitors and controls system development beginning from fact gathering, designing, implementation and maintenance in cyclic way as a continuous process. There has been much criticism for this approach. However, other methods only supplement SDLC method rather than replace it. Different phases in SDLC are as follows:

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- Study and analysis phase

- Systems design

- System development

- System implementation

- System maintenance

System development and maintenance is a continuous process as long as the system exists as the organizational requirements keep on changing throughout the year. Business processes changes rapidly in globally competitive age, and most of the systems need to be replaced or significantly updated after few years of operation. The updated system looks like a new system different from original one. This completes life cycle of a system like living entities (from origin to death). The following Figure shows all steps involved in SDLC method.



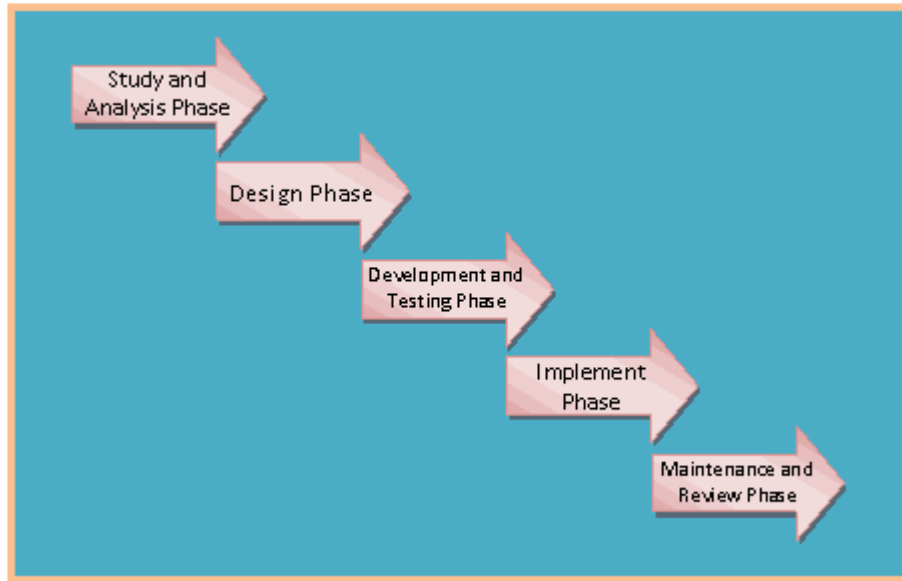**System development life cycle method**

**Structured analysis**

Structured analysis is a traditional system development method which is time tested and easy to understand. This technique / methodology describes the system through a set of process models therefore; it is also known as process-centric method.

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System is viewed from perspective of data flowing through different processes. Function of a system is described by processes that transform data into useful information which leads to achieve the systems objectives. The system is decomposed into sub processes, sub processes into further sub processes and so on. This allows concentrating on the relevant part only by keeping other details aside. Process modeling identifies data flowing into a process, business rules that transform data to resulting output data.

In addition to process modeling, structured analysis includes data organizations, database design and user interface design. Result of structured analysis is a set of related graphical diagrams, process descriptions, and data definitions. A variety of structured tools such as data flow diagram, decision table, decision tree, data dictionary, structured English are used to document the data items, data flow, logical complexities etc. All steps mentioned in SDLC are followed to develop a system in this method.

**Waterfall method**

This method follows SDLC approach for system development. System is divided into sequential phases and organized in linear order i.e., output of one phase becomes input of next phase. There may be some overlap and splash back between phases. Emphasis is given on planning, time schedules, target dates, budgets and implementation of an entire system at one time i.e. complete the system development and implementation at once. Tight schedule is maintained while developing a system in form of time table, documentation and approval of managers/ users at the end phases and before beginning the next phase. The following figure shows all steps involved in Waterfall method.

**Waterfall method for system development (linear approach)**

### Prototyping method

This method is based on an iterative approach for system development. In this method, a prototype of the system i.e. a small working model of the system is developed instead of a complete system. Though, it is comprehensive system but does not include all requirements of users. This model is released to users at an early stage for trial and to understand the requirements before developing a complete system. This method is useful where users' requirements are difficult to identify in the beginning and requirements may also change during system development process. The system is finally developed based on the advice and feedback of the users. This approach is cantered towards user involvement in analysis as well as design phase to provide satisfactory system which reduces the chances of product rejection. The activities that are involved in SDLC are also taken care of in this approach but here the emphasis is on the involvement of user. The prototype model is based on the evolutionary method of system development.
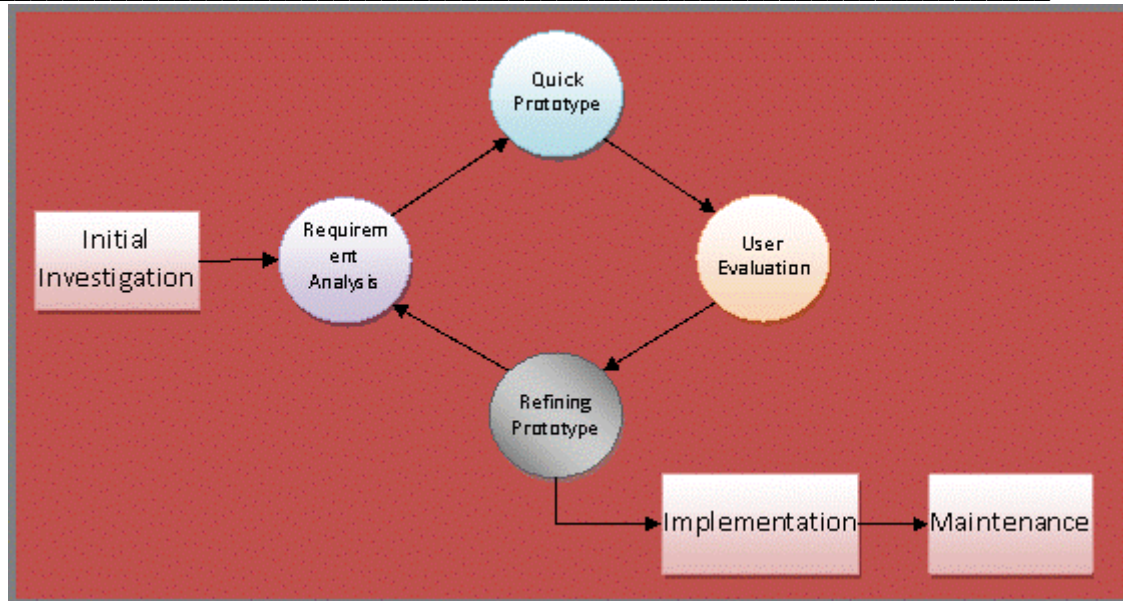
**Prototype model (iterative approach)**

**Reasons for developing a prototype system**

**High cost:**

System, involving high cost or high-risk situation, will be most suited to prototyping approach as prototyping provides an opportunity to user for directly interacting in the process of system analysis and design. Consequently, reduces cost of system development.

**Information not well defined:**

Where information requirements are not well defined and the same gets identified and streamlined while working by the user in interactive mode, the prototyping provide a good opportunity to identify the system requirements in a better way.

**Unknown information requirements:**

There may be a very unique situation when one has neither information nor experience of information requirements. The prototyping approach is a good process for giving a time to gain experience and identify information requirement

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**SYSTEM ANALYSIS AND DESIGN**

As businesses grow and develop, their systems may become outdated or less efficient. Creating complements to an existing system or replacing it as required often helps companies improve their performance. To complete this process effectively, business professionals interested in developing methods to improve their organization's efficiency may benefit from learning about system analysis and design.

**Benefits of system analysis and design**

The most common benefit of system analysis and design is improving upon a previous system and enjoying increased operational efficiency.

List of other benefits the organization may enjoy from this practice are as follows:

- Enabling comprehension of complicated structures

- Allowing for better management of any business changes

- Aligning the organization with its environment and strategic priorities

- Minimizing IT issues and reducing the workload of IT employees

- Reducing costs in certain areas, saving the organization money and resources for use in other departments

- Identifying potential risks and threats to the processes before they arise

- Improving the overall quality of the system

- Improving the usability of the system by employees

- Increasing productivity and customer satisfaction

**Tools and techniques of system analysis and design:**

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## 1. Data flow diagrams (DFD) or bubble charts

This technique helps organizations by organizing the initial requirements of a system in graphical form. Many companies find this technique helpful when users want a notational communication language, but the required system design remains unclear. DFDs illustrate how information flows between various system functions and demonstrate the current implementation process of the system. They also summarize what information the system processes, which transformations it performs, where it stores data, what result it produces and where those results go. DFD graphic design often makes communication easier between a user and an analyst or an analyst and a designer.

These diagrams come in two forms. A physical DFD describes how a current system operates and how an organization can implement a new one. It reveals which functions a system performs and provides details on hardware, software, files and people. A logical DFD focuses only on the data flow between processes. It describes how the business operates, not just the system. Logical DFDs also explain system events and the data required for each event.

## 2. Data dictionaries

A data dictionary is a structured receptacle for data elements in a system. It stores descriptions of all data elements in data flow diagrams. These data elements may include processes, details and definitions of data flows, data stores and data within those data stores. It also stores information about the relationship between data elements. Data dictionaries generally improve the communication between users and system analysts. They're also an important part of building a database because analysts can use them to manipulate and control access of the database.

There are two types of data dictionaries. An active dictionary relates to a specific database and updates automatically with a data management system. Its connection to a specific database sometimes makes it more challenging to transfer data. A passive data dictionary doesn't connect to a specific server or database, which can improve data transference efforts. These dictionaries don't update automatically and require manual maintenance to prevent asynchronous metadata.

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### 3. Decision trees

Decision trees assist businesses with defining complex relationships and decisions in an organized diagram. These diagrams reveal alternate conditions and actions in a horizontal tree shape and demonstrate which conditions an organization may consider first, then each one in order of importance. A decision tree illustrates the relationship of each condition to its action, which allows analysts to consider decision sequences and identify the best one. This depicts a single representation of relationships between the conditions and actions, which may limit information about other combinations of actions an analyst can test.

### 4. Decision tables

Decision tables can improve the general understanding of a complex logical relationship by providing a matrix of rows and columns for defining an issue and possible actions. Organizations may find this tool useful in situations where certain actions rely on the occurrence of one or a combination of conditions. In a decision table, decision rules define the relationships between decisions, conditions and actions. Here are the general components of a decision table:

- **Condition stub:** This section is the upper left quadrant and lists all the conditions a professional can check in a situation.

- **Action stub:** This is the lower left quadrant and defines the actions the system can perform to meet a specific condition.

- **Condition entry:** This is the upper right quadrant and provides answers to questions an organization asks in the condition stub section.

- **Action entry:** This is the lower right quadrant and identifies the appropriate action from the answers to the conditions in the condition entry section.

### 5. Structured English

System analysts often use structured English because it often provides more understandable and precise descriptions of a process. It often helps non-technical users understand a computer program's design by separating it into logical steps using

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straightforward English words. Organizations may benefit from this method when they consider sequences and loops in a program and an issue requires sequences of actions with decisions.

This process results from a structured programming language based on procedural logic that employs imperative sentences and construction to perform operations for an action. It doesn't contain a strict syntax rule and expresses all logic through sequential decision structures and iterations. Here are a few of the guidelines that professionals typically follow when using Structured English:

- Write clear and unambiguous statements.

- Use one line per logical element.

- Capitalize keywords.

- Underline words or phrases that appear in a data dictionary.

- Mark comment lines with an asterisk.

## 6. Pseudocodes

A pseudocode typically uses structural rules of a normal programming language, but professionals use it for human interpretation instead of machine interpretation. This means that pseudocodes often omit details required for machine-reading, such as language-specific code. It expresses logic in plain English and often uses physical programming logic while not using actual coding. Professionals may use this alongside structured programming as well. They typically create a pseudocode while initially managing a new algorithm and then translate that code into the target programming language. It often replaces flowcharts in a program.

## 7. Simulations

A simulation usually involves developing a numerical model that illustrates a system's activity in the form of individual events in the system's individual segments. This method helps system analysts conduct testing investigations on the general

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model of a system. It often helps organizations evaluate the effects of changes in a process or segment. Analysts can also use simulations to predict how new systems may function and perform compared to an old system

## SYSTEM IMPLEMENTATION AND MAINTENANCE

Implementation is a process of ensuring that the information system is operational. It involves −

- Constructing a new system from scratch

- Constructing a new system from the existing one.

Implementation allows the users to take over its operation for use and evaluation. It involves training the users to handle the system and plan for a smooth conversion.

### Training

The personnel in the system must know in detail what their roles will be, how they can use the system, and what the system will or will not do. The success or failure of well-designed and technically elegant systems can depend on the way they are operated and used.

### Training Systems Operators

Systems operators must be trained properly such that they can handle all possible operations, both routine and extraordinary. The operators should be trained in what common malfunctions may occur, how to recognize them, and what steps to take when they come.

Training involves creating troubleshooting lists to identify possible problems and remedies for them, as well as the names and telephone numbers of individuals to contact when unexpected or unusual problems arise.

Training also involves familiarization with run procedures, which involves working through the sequence of activities needed to use a new system.

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**User Training**

- End-user training is an important part of the computer-based information system development, which must be provided to employees to enable them to do their own problem solving.

- User training involves how to operate the equipment, troubleshooting the system problem, determining whether a problem that arose is caused by the equipment or software.

- Most user training deals with the operation of the system itself. The training courses must be designed to help the user with fast mobilization for the organization.

**Training Guidelines**

- Establishing measurable objectives

- Using appropriate training methods

- Selecting suitable training sites

- Employing understandable training materials

**Instructor-led training**

It involves both trainers and trainees, who have to meet at the same time, but not necessarily at the same place. The training session could be one-on-one or collaborative. It is of two types −

**Virtual Classroom**

In this training, trainers must meet the trainees at the same time, but are not required to be at the same place. The primary tools used here are: video conferencing, text based Internet relay chat tools, or virtual reality packages, etc.

**Normal Classroom**

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The trainers must meet the trainees at the same time and at the same place. They primary tools used here are blackboard, overhead projectors, LCD projector, etc.

## Self-Paced Training

It involves both trainers and trainees, who do not need to meet at the same place or at the same time. The trainees learn the skills themselves by accessing the courses at their own convenience. It is of two types −

### Multimedia Training

In this training, courses are presented in multimedia format and stored on CD-ROM. It minimizes the cost in developing an in-house training course without assistance from external programmers.

### Web-based Training

In this training, courses are often presented in hyper media format and developed to support internet and intranet. It provides just–in-time training for end users and allow organization to tailor training requirements.

## Conversion

It is a process of migrating from the old system to the new one. It provides understandable and structured approach to improve the communication between management and project team.

## Conversion Plan

It contains description of all the activities that must occur during implementation of the new system and put it into operation. It anticipates possible problems and solutions to deal with them.

It includes the following activities −

- Name all files for conversions.

- Identifying the data requirements to develop new files during conversion.

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- Listing all the new documents and procedures that are required.

- Identifying the controls to be used in each activity.

- Identifying the responsibility of person for each activity.

- Verifying conversion schedules.

## Conversion Methods

The four methods of conversion are −

- Parallel Conversion

- Direct Cutover Conversion

- Pilot Approach

- Phase-In Method

For successful conversion, a conversion plan is required, which includes −

- Knowledge of the target system and understanding of the present system

- Teamwork

- Automated methods, testing and parallel operations

- Continuous support for correcting problems

- Updating systems/user documentation, etc

Many popular applications support opening and saving to other file formats of the same type. For example, Microsoft Word can open and save files in many other word processing formats.

## Post-Implementation Evaluation Review (PIER)

PIER is a tool or standard approach for evaluating the outcome of the project and determine whether the project is producing the expected benefits to the

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processes, products or services. It enables the user to verify that the project or system has achieved its desired outcome within specified time period and planned cost.

PIER ensures that the project has met its goals by evaluating the development and management processes of the project.

**Objectives of PIER**

The objectives of having a PIER are as follows −

- To determine the success of a project against the projected costs, benefits, and timelines.

- To identify the opportunities to add additional value to the project.

- To determine strengths and weaknesses of the project for future reference and appropriate action.

- To make recommendations on the future of the project by refining cost estimating techniques.

**The following staff members should be included in the review process**

- Project team and Management

- User staff

- Strategic Management Staff

- External users

**System Maintenance / Enhancement**

Maintenance means restoring something to its original conditions. Enhancement means adding, modifying the code to support the changes in the user specification. System maintenance conforms the system to its original requirements and enhancement adds to system capability by incorporating new requirements.

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Thus, maintenance changes the existing system, enhancement adds features to the existing system, and development replaces the existing system. It is an important part of system development that includes the activities which corrects errors in system design and implementation, updates the documents, and tests the data.

**Maintenance Types**

System maintenance can be classified into three types −

- **Corrective Maintenance** − Enables user to carry out the repairing and correcting leftover problems.

- **Adaptive Maintenance** − Enables user to replace the functions of the programs.

- **Perfective Maintenance** − Enables user to modify or enhance the programs according to the users' requirements and changing needs.

**Methodologies**

Once a new system is developed or purchased, the organization must determine the best method for implementation. Convincing a group of people to learn and use a new system can be a very difficult process. Asking employees to use new software as well as follow a new business process can have far reaching effects within the organization.

There are several different methodologies an organization can adopt to implement a new system. Four of the most popular are listed below.

**Direct cutover**.

In the direct cutover implementation methodology, the organization selects a particular date to terminate the use of the old system. On that date users begin using the new system and the old system is unavailable. Direct cutover has the advantage of being very fast and the least expensive implementation method. However, this

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method has the most risk. If the new system has an operational problem or if the users are not properly prepared, it could prove disastrous for the organization.

**Pilot implementation**.

In this methodology a subset of the organization known as a pilot group starts using the new system before the rest of the organization. This has a smaller impact on the company and allows the support team to focus on a smaller group of individuals. Also, problems with the new software can be contained within the group and then resolved.

**Parallel operation**.

Parallel operations allow both the old and new systems to be used simultaneously for a limited period of time. This method is the least risky because the old system is still being used while the new system is essentially being tested. However, this is by far the most expensive methodology since work is duplicated and support is needed for both systems in full.

**Phased implementation**.

Phased implementation provides for different functions of the new application to be gradually implemented with the corresponding functions being turned off in the old system. This approach is more conservative as it allows an organization to slowly move from one system to another.

**The choice of an implementation methodology depends on the complexity of both the old and new systems. It also depends on the degree of risk organisation is willing to take.**

## UNIT IV

## Transaction Processing and Support System

Transaction Processing System – Office Automation System – Decision Support System – Executive Information System – Artificial Intelligence and Expert Systems

## TRANSACTION PROCESS SYSTEM (TPS)

A transaction process system and transaction processing are often contrasted with a batch process system and batch processing, where many requests are all executed at one time. The former requires the interaction of a user, whereas batch processing does not require user involvement. In batch processing the results of each transaction are not immediately available. Additionally, there is a delay while the many requests are being organized, stored and eventually executed. In transaction processing there is no delay and the results of each transaction are immediately available. During the delay time for batch processing, errors can occur. Although errors can occur in transaction processing, they are infrequent and tolerated, but do not warrant shutting down the entire system.

To achieve performance, reliability and consistency, data must be readily accessible in a data warehouse, backup procedures must be in place and the recovery process must be in place to deal with system failure, human failure, computer viruses, software applications or natural disasters.

### Transaction Processing System Features

There are several features involved in a good transaction processing system. A few of these critical features are described below.

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- **Performance**

     The concept behind the use of TPS is to efficiently generate timely results for transactions. Effectiveness is based on the number of transactions they can process at a particular time.

- **Continuous availability**

     The transaction processing system should be a very stable and reliable system that must not crash easily. Disruption of TPS in an organization can lead to work disturbance and financial loss.

- **Data integrity**

     The TPS must maintain the same method for all transactions processed, the system must be designed to effectively protect data and overcome any hardware/ software issues.

- **Ease of use**

     The TPS should be user-friendly in order to encourage the use and also decrease errors from inputting data. It should be structured in such a way that it makes it easy to understand as well as guarding users against making errors during data-entry.

- **Modular growth**

     The TPS hardware and software components should be able to be upgraded individually without requiring a complete overhaul.

- **Controlled processing**

     Only authorized personnel, staff members, or employees should be able to access the system at a time.

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## Types of Transaction Processing Systems

- ### Batch processing

    Batch processing is when clusters of transactions are refined simultaneously using a computer system. This method, although designed to be efficient for breaking down bulky series of programs, has a drawback as there is a delay in the transaction result.

- ### Real-time Processing

    Real-time processing carries out its transactions exclusively; this method ensures a swift reply on the condition of the transaction result. It is an ideal technique for dealing with singular transactions.

## Components of Transaction Processing System

Below are some of the components involved in a TPS:

- **Inputs**: These are source documents gotten from transactions which serve as inputs into the computer's accounting system examples are invoices, and customer orders.

- **Processing**: This requires the breaking down of information provided by the inputs.

- **Storage**: This is saved information in TPS memory, it may be in the form of ledgers.

- **Output**: Any generated record may serve as the output

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**Limitations of Transaction Processing Systems**

- Managing operations with the TPS can be complicated if the company is not big enough to efficiently use the transaction processing system.

- TPS needs both hardware and software components to efficiently manage high data volume. This capacity makes TPSs susceptible to software security breaches in the form of the virus and faulty hardware issues such as power outage can disrupt the whole system.

- Effective integration of a TPS in a company operation requires skilled personnel, it also requires a link with associate company branches to maintain a secure flow of information. This high requirement can create instability and flux in the company's daily operations.

**Functions of Transaction Processing System**

Transaction Processing Systems can execute input, output, storage, and processing functions.

- **Input functions**: This includes the securing of data on the source document, entering of input data in the system and also validate data.

- **Output functions**: This includes the production of the report of the transaction via monitor or paper, examples are exception reports, detail reports, and summary reports.

- **Storage functions**: This is the process by which data is stored. It entails the storage of information, accessing, sorting, and updating stored data.

- **Processing functions**: This entails the transformation of data, it includes calculation, computation, and apt result.

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**Databases for Transaction Processing Systems**

Some types of database systems for transaction processing include the following:

- **Hierarchical Database**

  It comprises a network of nodes and branches. This structure arranges data in a top-down system, where a higher-level node branches out to lower-level nodes.

- **Network Database**

  It arranges data as a chain of nodes linked via branches. Higher-level nodes can have as many branches as possible, lower-level nodes can also be connected to more than one higher-level node.

- **Relational Database**

  This involves the use of related tables to present and combine data effectively.

  **Backup Procedures (Storing and Retrieving Data)**

  Backup procedures are required by organizations to counter breakdowns and reduce data loss. A copy of data used to restore the system in case of system failure is known as a backup. Data can be stored in magnetic tapes, partial backups or updated in real-time.

  The success of a backup relies on the implementation of appropriate procedures. The success of a backup depends on a resourceful recovery process.

**Types of Recovery**

- **Backup Recovery**: this can be used to reverse required changes to a record.

- **Forward Recovery**: this can be used to save transactions made between the last backup and the up-to-date time.it works by backing up a copy of the

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database and it is more proficient because it does not need to save each transaction.

**Office Automation Systems**

- The term office automation is a method that is used for office activities and makes it possible to process the data using a computer system. An office automation system can be considered as a tool that majorly includes a word processing application, a spreadsheet application, a presentation application, and a database management system.

- With implementation, an office automation system will enable the automation of most of the administrative work in the office and would also concentrate on the more repeatable and routine aspects of individual and group work.

- An office automation system is a mechanism that allows data transformation from one system to another on its own without human interference and inaccuracies. These tools may be used to capture, organize, and process the data to achieve day-to-day activities.

- It is an automated process, explicitly supporting business activities and processes. Office automation is intended to provide elements that make it possible to simplify, develop, and automate the organization of the activities of a company or a group of people.

- A basic building block of Office Automation Systems described below –



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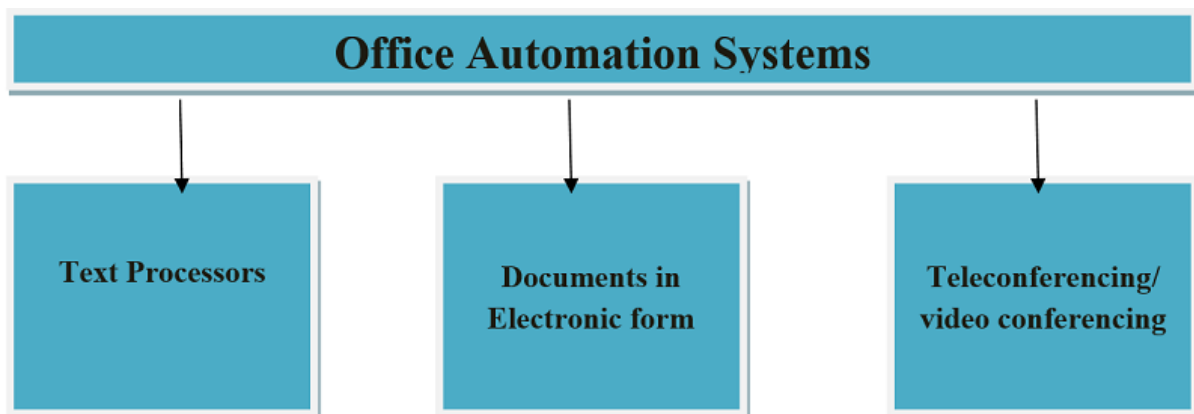
Office automation systems make it simple for office staff to handle day to day organizational activities like E-mail, word processing, electronic filing, scheduling, calendaring, and other technical support resources. Personal digital assistants (PDAs) were also introduced as the concept of groupware apps, which became important when more people started to bring digital assistants such as PDAs. It is made up of word processing, telecommunications, and data processing, which handles office information, official communication, and reports, as well as the processing of documents.

The most commonly used application areas of office automation are as follows

- Exchange of information.

- Management of administrative records.

- Handling of results.

- Meeting arrangements, preparation, and control of job schedules.

**Office automation features**

Office automation functionality could include -.

- It eliminates the manual effort to complete basic chores.

- Avoiding mistakes by computers or devices.

- Decreasing the time taken to process an object.

- Provides key insights into the process efficiency metrics.

- Gaining greater access to the method and finding possible bottlenecks.

- Controlling the company by making sound decisions based on results.

- Enhancement in business activities with sound improvement.

- Data organization, storage and its management.

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Human errors are not only inefficient in that they have to be corrected and can lead to production delays as well as financial losses. For example, an error occurring at the time of financial transaction is a serious mistake and can be a cause of the biggest loss. Human intervention is minimal when the office automation system allows for the transfer of data, rather than taking an active role in the processing.

**The 5 Essentials of Office Automation Tools**

**1. Easy workflow designer**

Creating workflows used to be the domain of hard-core system coders. So, as workflow software evolved, it assumed the people using it would be programmers as well.

However, a modern office automation system should start with the business user in mind, not the coder.

A piece of software shouldn't determine how your business should set its operations. It should instead aid your teams to strengthen the existing processes.

**2. Mobile compatibility**

Organisation should be able to run the core processes from a secure cloud and never have to worry about where the data is or who is protecting it. If the organisation uses an office automation tool, then the organisation can go over the marketing plan on the mobile.

***3.*** **Integration with other software**

Organisation has got internal database, a CRM, a marketing automation tool, and the financial software.

Of all the software out there, office automation should be the easiest to integrate with the other tools. If it doesn't, company would get stuck pushing data around from one system to another.

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When doing an evaluation, see what kind of pre-integrations the office automation software provides, or if it takes advantage of connecting to a tool like Zapier to open access to thousands of other cloud tools.

### *4.* Reports and analytics

Organisation can't just evaluate process performance based on how happy the team is. Data is the ultimate decision-maker, and it's important for the business to compare a process' history, its speed, the outcome quality, etc.

Adopting another software to measure the workflow data is time-consuming and unnecessary. A single piece of software embedded with reporting and analytics features has been developed as part of the fundamental offering.

### 5. Access control options

A good workflow automation system will have access control as part of its integral features.  This capability should not be overlooked when considering office automation software for the business.

**What are the functions of office automation software?**

An ideal office automation software:

- Requires less space to store data

- Streamlines data storage and retrieval

- Retrieves information instantly

- Eliminates the need to preserve paperwork

- Removes any chance for data redundancy

- Allows multiple people to access data

- Reduces the possibility of errors

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Offices that automate can save a tremendous amount of time and money and let the workforce focus on the things that actually bring value to the company.

## MIS - DECISION SUPPORT SYSTEM

Decision support systems (DSS) are interactive software-based systems intended to help managers in decision-making by accessing large volumes of information generated from various related information systems involved in organizational business processes, such as office automation system, transaction processing system, etc.

DSS uses the summary information, exceptions, patterns, and trends using the analytical models. A decision support system helps in decision-making but does not necessarily give a decision itself. The decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.

## Programmed and Non-programmed Decisions

There are two types of decisions - programmed and non-programmed decisions.

Programmed decisions are basically automated processes, general routine work, where −

- These decisions have been taken several times.

- These decisions follow some guidelines or rules.

For example, selecting a reorder level for inventories, is a programmed decision.

Non-programmed decisions occur in unusual and non-addressed situations, so −

- It would be a new decision.

- There will not be any rules to follow.

- These decisions are made based on the available information.

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- These decisions are based on the manger's discretion, instinct, perception and judgment.

For example, investing in a new technology is a non-programmed decision.

Decision support systems generally involve non-programmed decisions. Therefore, there will be no exact report, content, or format for these systems. Reports are generated on the fly.

**Attributes of a DSS**

- Adaptability and flexibility

- High level of Interactivity

- Ease of use

- Efficiency and effectiveness

- Complete control by decision-makers

- Ease of development

- Extendibility

- Support for modeling and analysis

- Support for data access

- Standalone, integrated, and Web-based

**Characteristics of a DSS**

- Support for decision-makers in semi-structured and unstructured problems.

- Support for managers at various managerial levels, ranging from top executive to line managers.

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- Support for individuals and groups. Less structured problems often requires the involvement of several individuals from different departments and organization level.

- Support for interdependent or sequential decisions.

- Support for intelligence, design, choice, and implementation.

- Support for variety of decision processes and styles.

- DSSs are adaptive over time.

**Benefits of DSS**

- Improves efficiency and speed of decision-making activities.

- Increases the control, competitiveness and capability of futuristic decision-making of the organization.

- Facilitates interpersonal communication.

- Encourages learning or training.

- Since it is mostly used in non-programmed decisions, it reveals new approaches and sets up new evidences for an unusual decision.

- Helps automate managerial processes.

**Components of a DSS**

Following are the components of the Decision Support System −

- **Database Management System (DBMS)** − To solve a problem the necessary data may come from internal or external database. In an organization, internal data are generated by a system such as TPS and MIS. External data come from a variety of sources such as newspapers, online data services, databases (financial, marketing, human resources).

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- **Model Management System** − It stores and accesses models that managers use to make decisions. Such models are used for designing manufacturing facility, analyzing the financial health of an organization, forecasting demand of a product or service, etc.

  **Support Tools** − Support tools like online help; pulls down menus, user interfaces, graphical analysis, error correction mechanism, facilitates the user interactions with the system.

**Classification of DSS**

There are several ways to classify DSS. One such example of classification of DSS is as follows −

- **Text Oriented DSS** − It contains textually represented information that could have a bearing on decision. It allows documents to be electronically created, revised and viewed as needed.

- **Database Oriented DSS** − Database plays a major role here; it contains organized and highly structured data.

- **Spreadsheet Oriented DSS** − It contains information in spread sheets that allows create, view, modify procedural knowledge and also instructs the system to execute self-contained instructions.

- **Solver Oriented DSS** − It is based on a solver, which is an algorithm or procedure written for performing certain calculations and particular program type.

- **Rules Oriented DSS** − It follows certain procedures adopted as rules.

- **Rules Oriented DSS** − Procedures are adopted in rules oriented DSS. Export system is the example.

- **Compound DSS** − It is built by using two or more of the five structures explained above.

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**Types of DSS**

Following are some typical DSSs −

- **Status Inquiry System** − It helps in taking operational, management level, or middle level management decisions, for example daily schedules of jobs to machines or machines to operators.

- **Data Analysis System** − It needs comparative analysis and makes use of formula or an algorithm, for example cash flow analysis, inventory analysis etc.

- **Information Analysis System** − In this system data is analyzed and the information report is generated. For example, sales analysis, accounts receivable systems, market analysis etc.

- **Accounting System** − It keeps track of accounting and finance related information, for example, final account, accounts receivables, accounts payables, etc. that keep track of the major aspects of the business.

- **Model Based System** − Simulation models or optimization models used for decision-making are used infrequently and creates general guidelines for operation or management.

**Definitions of Executive Information System**

**According to Meall:**

"EIS is a resource tool; a system that delivers rapid access to the selected key information executives need for their decision making. User should need no IT or keyboarding skills. Access is more likely to be via icons and a mouse or a touch screen, than a keyboard. Data is presented with the help of color and graphics, in a form which is highly structured and easy to understand".

*According to Matthews and Shoe Bridge :*

"Executive Information System (EIS) is 1 computer-based information delivery and communication system designed to support the needs of top executives".

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**Characteristics of Executive Information System (EIS)**

The Executive support system characteristics are explained below:

**1) Drill-Down Capabilities:**

This helps the executive to get the details from particular information, e.g., drop in corporate sales in a particular region. In systems that use graphical user interface, hypertext-style connections are used for information gathering. In menu-driven systems, sub-menus are used to access the detailed information at each level.

**2) Designed with Management's Critical Success Factors in Mind:**

Each company has its own critical aspects to achieve the organisational objectives. These aspects can be at the individual, departmental and organisational level.

**3) Status Access, Trend Analysis and Exception Reporting:**

This permits executives to get the recent data on any key variable. Trend analysis supports the executive to study data over a given timeline. Hence, timing and significance of information are too crucial. Permission to highlight deviations from the established norm in the organisation is allowed in case of exception reporting, which also include reason of deviation.

**4) Personalized Analysis:**

Built-in functions are used to examine problematic situations in EIS. With the help of these functions, executives become capable to specify the data required for the analysis and the format type (in which results are displayed) of results.

**5) Navigation of Information:**

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This allows access of large amounts of data in a very short time span with accurate results. Forward and backward path access, skipping screens while accessing a selected part of the system are the examples of it.

**6) Presents Graphical, Tabular and/or Textual Information:**

Terminal presentation of gathered information to executive users may be in various formats like textual formats, tabular and/or graphical.

**Advantages of Executive Information System (EIS)**

Importance of executive support system are explained below

- Executive Support System or Executive Information System can be easily used by upper-level executives for decision-making, as extensive computer knowledge is not required for this.

- It has trends analysis capability.

- Enhances the manager's leadership skills.

- Helps in better personal thinking and decision making.

- It involves strategic control flexibility.

- Leads to healthy competition in the market place.

- Existing information can be easily accessed.

- Acts as an instrument of change.

- An executive time horizon is increased.

- Leads to a better reporting system.

- Helps executives to get a better mental model of business.

- Assists in consensus building and communication.

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- Adds to the efficiency, timeliness, and accuracy of office automation.

- Considerably reduces time taken for finding and integrating information.

- Organisation's performance can be recognized early.

- Detailed scrutiny of critical success factors.

- Provides better understanding of enterprise operations.

- Increases productivity by helping time and team coordination.

- Capacity and quality of communication is increased.

## ARTIFICIAL INTELLIGENCE

According to the father of Artificial Intelligence, John McCarthy, it is *"The science and engineering of making intelligent machines, especially intelligent computer programs".*

Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think.

AI is accomplished by studying how human brain thinks, and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems.

### Philosophy of AI

While exploiting the power of the computer systems, the curiosity of human, lead him to wonder, *"Can a machine think and behave like humans do?"*

Thus, the development of AI started with the intention of creating similar intelligence in machines that we find and regard high in humans.

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**Goals of AI**

- **To Create Expert Systems** − The systems which exhibit intelligent behavior, learn, demonstrate, explain, and advice its users.

- **To Implement Human Intelligence in Machines** − Creating systems that understand, think, learn, and behave like humans.

**What is AI Technique?**

In the real world, the knowledge has some unwelcomed properties −

- Its volume is huge, next to unimaginable.

- It is not well-organized or well-formatted.

- It keeps changing constantly.

AI Technique is a manner to organize and use the knowledge efficiently in such a way that −

- It should be perceivable by the people who provide it.

- It should be easily modifiable to correct errors.

- It should be useful in many situations though it is incomplete or inaccurate.

AI techniques elevate the speed of execution of the complex program it is equipped with.

**Applications of AI**

AI has been dominant in various fields such as −

- **Gaming** − AI plays crucial role in strategic games such as chess, poker, tic-tac-toe, etc., where machine can think of large number of possible positions based on heuristic knowledge.

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- **Natural Language Processing** − It is possible to interact with the computer that understands natural language spoken by humans.

- **Expert Systems** − There are some applications which integrate machine, software, and special information to impart reasoning and advising. They provide explanation and advice to the users.

- **Vision Systems** − These systems understand, interpret, and comprehend visual input on the computer. For example,

  o A spying aeroplane takes photographs, which are used to figure out spatial information or map of the areas.

  o Doctors use clinical expert system to diagnose the patient.

  o Police use computer software that can recognize the face of criminal with the stored portrait made by forensic artist.

- **Speech Recognition** − Some intelligent systems are capable of hearing and comprehending the language in terms of sentences and their meanings while a human talks to it. It can handle different accents, slang words, noise in the background, change in human's noise due to cold, etc.

- **Handwriting Recognition** − The handwriting recognition software reads the text written on paper by a pen or on screen by a stylus. It can recognize the shapes of the letters and convert it into editable text.

- **Intelligent Robots** − Robots are able to perform the tasks given by a human. They have sensors to detect physical data from the real world such as light, heat, temperature, movement, sound, bump, and pressure. They have efficient processors, multiple sensors and huge memory, to exhibit intelligence. In addition, they are capable of learning from their mistakes and they can adapt to the new environment

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## ARTIFICIAL INTELLIGENCE - EXPERT SYSTEMS

Expert systems (ES) are one of the prominent research domains of AI. It is introduced by the researchers at Stanford University, Computer Science Department.

The expert systems are the computer applications developed to solve complex problems in a particular domain, at the level of extra-ordinary human intelligence and expertise.

### Characteristics of Expert Systems

- High performance

- Understandable

- Reliable

- Highly responsive

### Capabilities of Expert Systems

The expert systems are capable of −

- Advising

- Instructing and assisting human in decision making

- Demonstrating

- Deriving a solution

- Diagnosing

- Explaining

- Interpreting input

- Predicting results

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- Justifying the conclusion

- Suggesting alternative options to a problem

They are incapable of −

- Substituting human decision makers

- Possessing human capabilities

- Producing accurate output for inadequate knowledge base

- Refining their own knowledge

**Components of Expert Systems**

The components of ES include −

- Knowledge Base

- Inference Engine

- User Interface

**Requirements of Efficient ES User Interface**

- It should help users to accomplish their goals in shortest possible way.

- It should be designed to work for user's existing or desired work practices.

- Its technology should be adaptable to user's requirements; not the other way round.

- It should make efficient use of user input.

**Expert Systems Limitations**

No technology can offer easy and complete solution. Large systems are costly, require significant development time, and computer resources. ESs have their limitations which include −

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- Limitations of the technology

- Difficult knowledge acquisition

- ES are difficult to maintain

- High development costs

**Expert System Technology**

There are several levels of ES technologies available. Expert systems technologies include −

- **Expert System Development Environment** − The ES development environment includes hardware and tools. They are −

o Workstations, minicomputers, mainframes..

- **Tools** − They reduce the effort and cost involved in developing an expert system to large extent.

o Powerful editors and debugging tools with multi-windows.

o They provide rapid prototyping

o Have Inbuilt definitions of model, knowledge representation, and inference design.

- **Shells** − A shell is nothing but an expert system without knowledge base. A shell provides the developers with knowledge acquisition, inference engine, user interface, and explanation facility. For example, few shells are given below −

o Java Expert System Shell (JESS) that provides fully developed Java API for creating an expert system.

o *Vidwan*, a shell developed at the National Centre for Software Technology, Mumbai in 1993. It enables knowledge encoding in the form of IF-THEN rules.

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**Development of Expert Systems: General Steps**

The process of ES development is iterative. Steps in developing the ES include −

**Identify Problem Domain**

- The problem must be suitable for an expert system to solve it.

- Find the experts in task domain for the ES project.

- Establish cost-effectiveness of the system.

**Design the System**

- Identify the ES Technology

- Know and establish the degree of integration with the other systems and databases.

- Realize how the concepts can represent the domain knowledge best.

**Develop the Prototype**

From Knowledge Base: The knowledge engineer works to −

- Acquire domain knowledge from the expert.

- Represent it in the form of If-THEN-ELSE rules.

**Test and Refine the Prototype**

- The knowledge engineer uses sample cases to test the prototype for any deficiencies in performance.

- End users test the prototypes of the ES.

**Develop and Complete the ES**

- Test and ensure the interaction of the ES with all elements of its environment, including end users, databases, and other information systems.

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- Document the ES project well.

- Train the user to use ES.

**Maintain the System**

- Keep the knowledge base up-to-date by regular review and update.

- Cater for new interfaces with other information systems, as those systems evolve.

**Benefits of Expert Systems**

- **Availability** − They are easily available due to mass production of software.

- **Less Production Cost** − Production cost is reasonable. This makes them affordable.

- **Speed** − They offer great speed. They reduce the amount of work an individual puts in.

- **Less Error Rate** − Error rate is low as compared to human errors.

- **Reducing Risk** − They can work in the environment dangerous to humans

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## UNIT V:

**Functional Information System**: Production, Finance, Human Resource and Marketing – Management Information Resources – Information Security – Control & Audit of Information System

## Financial Information System

Financial information system is a sub-system of organizational management information system. This sub-system supports the decision-making process of financial functions at the level of an organization.

Functional Information System is based on the various business functions such as Production, Marketing, Finance and Personnel etc. These departments or functions are known as functional areas of business. Each functional area requires applications to perform all information processing related to the function. The popular functional areas of the business organization are

- Production/Manufacturing Information System

- Finance Information system

- Human Resource Information System

- Marketing Information System

## Production /manufacturing Information System

Manufacturing or production information system provides information on production operation activities of an organization and thus facilitates the decision-making process of production managers of an organization.

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Manufacturing information system means- "A computer-based system that works in conjunction with other functional information systems to support the firm's management in solving problems that relate to manufacturing the firm's products."

The manufacturing information system refers to the management information system that is designed for use anywhere manufacturing or production is occurring. Generally, nowadays management information systems are computerized and are planned for collecting and presenting the data which managers require for planning and directing functions within the organization.

The manufacturing information system is a system that supports the manufacturing functions of purchasing, receiving, quality control, inventory management, material requirements planning, capacity planning, production scheduling, and plant design.

## Finance Information System

A financial information system is an organized approach to collecting and interpreting information, which is usually computerized. A well-run financial information system is essential to a business, since managers need the resulting information to make decisions about how to run the organization.

A financial information system (FIS) accumulates and analyzes financial data used for optimal financial planning and forecasting decisions and outcomes. An FIS is used in conjunction with a decision support system, and it helps a firm attain its financial objectives because they use a minimal amount of resources relative to a predetermined margin of safety. An FIS can be thought of as a financial planner for electronic commerce that can also produce large amounts of market and financial data at once obtained from financial databases worldwide.

Financial data analysis may be conducted through trend evaluations, ratio analyses and financial planning modeling. Data outputs that are produced by FIS can include

Operating and capital budgets

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Working capital reports

Accounting reports

Cash flow forecasts

The management of financial information in an e-commerce business is paramount in order to gain maximum operating results in the shortest amount of time. An FIS can also yield huge amounts of data for daily business operations. Financial markets traders and salespeople have the greatest demand for FIS because they work in very fast environments and their on-demand computing systems must keep up with real-time activities in order to allow these professionals to operate in real time. Broker investigating, investment and trade data along with fiscal asset classes can be relayed through an FIS. This also works for smaller businesses that need to obtain financial data about local markets. FIS is a form of real-time operating system that works to enhance financial information exchanges.

**Human Resources Information System**

The human resource management function, in its narrow sense, it also known as personnel management. The function involves:

• Manpower planning.

• Staffing

• Training and development

• Performance evaluation,

and
• Separation activities

HRIS stands for Human Resources Information System. The HRIS is a system that is used to collect and store data on an organization's employees. This functional information system supports the functions of human resource management of an organization.

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In most cases, an HRIS encompasses the basic functionalities needed for end-to-end Human Resources Management (HRM). It is a system for recruitment, performance management, learning & development, and more.

An HRIS is also known as HRIS software. This is a bit confusing as it implies that different systems can have different software running on them. However, this is not the case. The HRIS is, in essence, an HR software package.

The HRIS can either run on the company's own technical infrastructure, or, more common nowadays, be cloud-based. This means that the HR software is running outside of the company's premises, making it much easier to update.

**Benefits of an HRIS**

HRIS has a number of clear benefits. That's why companies of all sizes implement this tool to support their people operations. Centrally, the HRIS holds employee information. A wide range of employee data is then easily accessible, in one system.

Record-keeping. An HRIS is a record-keeping system that keeps track of changes to anything related to employees. The HRIS can be seen as the single source of truth when it comes to personnel data.

Compliance. Some data is collected and stored for compliance reasons. This includes material for the identification of employees in case of theft, fraud, or other misbehaviors, first contact information in case of accidents, citizens identification information for the tax office, and expiration dates for mandatory certification. All this information can be stored in the HRIS. It is essential that data is stored safely and securely, in line with GDPR regulations.

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Efficiency. Having all this information stored in one place not only benefits accuracy but also saves time. Some companies still keep a lot of data about employees as physical paperwork. Finding the right folder, and locating the right sheet, can take up a lot of staff time.

HR strategy. The HRIS permits the tracking of data required to advance the HR and business strategy. Depending on the priorities of the organization, different data will be essential to track. This is where the HRIS shines.

Self-Service HR. A final benefit is the ability to offer self-service HR to employees and managers. This enables employees to manage their own affairs. When done right, the HRIS can offer a good employee experience.

**HRIS functions**

There are different kinds of HRIS systems and software. Because an HRIS encompasses all the functionalities for HR, all separate functionalities are part of the system. These functionalities include:

Applicant Tracking System (ATS). This software handles all the company's recruiting needs. It tracks candidate information and resumes, enables recruiters to match job openings to suitable candidates from the company's application pool, and helps in guiding the hiring process.

Payroll. Payroll automates the pay process of employees. Contractual data and information on new hires is often entered into this system – sometimes combined with time & attendance data – and at the end of the month, payments orders are created.

Benefits administration. Another functionality of the HRIS is benefits management. Employee benefits are an important aspect of compensation and are also managed in this system. More advanced systems offer an employee self-service model for employee benefits. In this case, employees can select the benefits they are looking for themselves. One may want more paternity

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leave, the other one a more expensive company car. This self-service approach to benefits is also called a cafeteria model.

Time & Attendance. This module gathers time and attendance data from employees. These are especially relevant for shift workers where employees clock in and out. Back in the day, employees often wrote down their working hours on a piece of paper. Then, the manager would manually enter the data into a time tracking system. Based on this data, payment orders were generated and paid to all employees. Nowadays, workers often check into work by fingerprint or a card that is synced with an HRIS. This gives an exact time for arrival and departure. Any issues with lateness are easily detected.

Training. Learning and development is a key element when it comes to employee management. This module allows HR to track qualification, certification, and skills of the employees, as well as an outline of available courses for company employees. This module is often referred to as an LMS, or Learning Management System, when it's a stand-alone. An LMS usually includes available e-learning and other courses to be followed by employees.

Performance management. Performance management is a key part of managing people. Performance ratings are generated once or multiple times a year by the direct manager or peers of the employee.

Succession planning. Creating a talent pipeline and having replacements available for key roles in the organization is another key component of an HRIS.

Employee self-service. Employee self-service has already been mentioned. Organizations are focusing increasingly on having employees and their direct supervisors manage their own data. Requests like holidays can be asked for by the employee him/herself. After approval, these are then immediately saved into the system (and registered to track for payroll and benefits purposes).

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Reporting & Analytics. A much rarer module in HRIS systems is reporting and analytics. Modern systems enable the creation of automated HR reports on various topics like employee turnover, absence, performance, and more. Analytics involves the analysis of these insights for better-informed decision making.

## Marketing Information System

"A marketing information system is a continuing and interacting structure of people, equipment and procedures to gather, sort, analyse, evaluate, and distribute pertinent, timely and accurate information for use by marketing decision makers to improve their marketing planning, implementation, and control".

This sub-system of management information system provides information about various functions of the marketing system of an organization. Marketing is another functional area of the business organization, which is engaged in marketing (selling) of its products to its customers.

**Important functions of the marketing process include the following.**

• The marketing identification function

• The purchase motivation function.

• The product adjustment function

• The physical distribution function

• The communication function

• The transaction function

• The post-transaction function

The Marketing Information System refers to the systematic collection, analysis, interpretation, storage and dissemination of the market information, from both the internal and external sources, to the marketers on a regular, continuous basis.

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The marketing information system distributes the relevant information to the marketers who can make the efficient decisions related to the marketing operations viz. Pricing, packaging, new product development, distribution, media, promotion, etc.

Every marketing operation works in unison with the conditions prevailing both inside and outside the organization, and, therefore, there are several sources ( viz. Internal, Marketing Intelligence, Marketing Research) through which the relevant information about the market can be obtained.

Components of Marketing Information System



Internal Records: The Company can collect information through its internal records comprising of sales data, customer database, product database, financial data, operations data, etc. The detailed explanation of the internal sources of data is given below:

The information can be collected from the documents such as invoices, transmit copies, billing documents prepared by the firms once they receive the

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order for the goods and services from the customers, dealers or the sales representatives.

The current sales data should be maintained on a regular basis that serves as an aide to a the Marketing Information System. The reports on current sales and the inventory levels help the management to decide on its objectives, and the marketers can make use of this information to design their future sales strategy.

The Companies maintain several databases such as*Customer Database- wherein the complete information about the customer's name, address, phone number, the frequency of purchase, financial position, etc. is saved.

*Product Database- wherein the complete information about the product's price, features, variants, is stored.

*Salesperson database, wherein the complete information about the salesperson, his name, address, phone number, sales target, etc. is saved.

The companies store their data in the data warehouse from where the data can be retrieved anytime the need arises. Once the data is stored, the statistical experts mine it by applying several computer software and techniques to convert it into meaningful information that gives facts and figures.

Marketing Intelligence System: The marketing intelligence system provides the data about the happenings in the market, i.e. data related to the marketing environment which is external to the organization. It includes the information about the changing market trends, competitor's pricing strategy, change in the customer's tastes and preferences, new products launched in the market, promotion strategy of the competitor, etc.

In order to have an efficient marketing Information System, the companies should work aggressively to improve the marketing intelligence system by taking the following steps:

Providing the proper training and motivating the sales force to keep a check on the market trends, i.e. the change in the tastes and preferences of customers and give suggestions on the improvements, if any.

Motivating the channel partners viz. Dealer, distributors, retailers who are in the actual market to provide the relevant and necessary information about the customers and the competitors.

The companies can also improve their marketing intelligence system by getting more and more information about the competitors. This can be done either by purchasing the competitor's product, attending the trade shows, reading the competitor's published articles in magazines, journals, financial reports.

The companies can have an efficient marketing information system by involving the loyal customers in the customer advisory panel who can share their experiences and give advice to the new potential customers.

The companies can make use of the government data to improve its marketing Information system. The data can be related to the population trends, demographic characteristics, agricultural production, etc. that help an organization to plan its marketing operations accordingly.

Also, the companies can purchase the information about the marketing environment from the research companies who carry out the researches on all the players in the market.

The Marketing Intelligence system can be further improved by asking the customers directly about their experience with the product or service via feedback forms that can be filled online.

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Marketing Research: The Marketing Research is the systematic collection, organization, analysis and interpretation of the primary or the secondary data to find out the solutions to the marketing problems.Several Companies conduct marketing research to analyze the marketing environment comprising of changes in the customer's tastes and preferences, competitor's strategies, the scope of new product launch, etc. by applying several statistical tools. In order to conduct the market research, the data is to be collected that can be either primary data (the first-hand data) or the secondary data (second-hand data, available in books, magazines, research reports, journals, etc.)

The secondary data are publicly available, but the primary data is to be collected by the researcher through certain methods such as questionnaires, personal interviews, surveys, seminars, etc.

A marketing research contributes a lot in the marketing information system as it provides the factual data that has been tested several times by the researchers.

Marketing Decision Support System: It includes several software programs that can be used by the marketers to analyze the data, collected so far, to take better marketing decisions.With the use of computers, the marking managers can save the huge data in a tabular form and can apply statistical programs to analyze the data and make the decisions in line with the findings.

Thus, the marketers need to keep a check on the marketing environment, i.e. both the internal (within the organization) and the external (outside the organization, so that marketing policies, procedures, strategies can be designed accordingly.

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## Characteristics of Functional Information System

Functional Information System is based on the various business functions such as Production, Marketing, Finance and Personnel etc. These departments or functions are known as functional areas of business. Each functional area requires applications to perform all information processing related to the function.

## Characteristics:
Many small changes in a large database

Systematic records (mostly numerical)

Routine actions & updating

Data preparation is a large & important effort

Equipment's Requirements of Functional Information Systems

- Large auxiliary storage
- Dual use files
- Moderate input / output requirements
- Flexible printing capacity
-  Offline data entry
- Fast random access to large storage capacity
- Versatile inquiry stations

A functional information system is a system that supports the activities of a specific business function within an organization. The term is most commonly used in reference to management information systems (MIS).

A functional information system typically consists of a database, application software, and user interfaces. The system may also include middleware and other components as needed to support the specific business function.

The term functional information system is sometimes used interchangeably with the term business function, but the two terms are not synonymous. A business function is a broader concept that includes the

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people, processes, and resources involved in carrying out a specific business activity. A functional information system supports one or more business functions.

The most common type of functional information system is a management information system (MIS). MISs are designed to provide decision makers with the information they need to effectively manage an organization.

MISs typically consist of a database, application software, and user interfaces.

MISs are often organized around the major business functions of an organization, such as finance, marketing, human resources, and operations. Each MIS is designed to support the specific decision-making needs of the managers in that business function.

While MISs are the most common type of functional information system, there are other types of functional information systems as well. For example, customer relationship management (CRM) systems and enterprise resource planning (ERP) systems are also functional information systems.

CRM systems are designed to help organizations manage their relationships with customers. ERP systems are designed to help organizations manage their businesses more effectively by integrating all of the major business functions into a single system.

The primary function of business functional information systems is to track the various parts of a company's operations, such as production, marketing, finance, and human resources.

Applications must perform the same function in order to retrieve all data associated with each functionality.

ERP systems are designed to integrate business information silos into a single system.

Five information systems operate in a variety of ways: input, storage, processing, output, and feedback loops. A cross-functional team is made up

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of people from various functional areas within a company. The server stores the data, which means that all information can be found there.

A decision support system is an information system that aids in the decision-making process in an organization. It is a software-based system designed to assist decision makers in gathering useful information from raw data, documents, personal knowledge, and/or business models in order to make better decisions and identify and solve problems.

A functional information system (FIS) is a system that enables an organization to track and manage its activities and operations.

The main features of a FIS include:

1. The ability to track and manage data: A FIS enables an organization to track and manage data related to its activities and operations. This data can be used to improve the efficiency and effectiveness of the organization.

2. The ability to generate reports: A FIS can generate reports that can be used to assess the performance of the organization. These reports can help the organization to identify areas where improvements can be made.

3. The ability to streamline processes: A FIS can streamline processes by automating tasks. This can help to improve the efficiency of the organization.

4. The ability to integrate with other systems: A FIS can be integrated with other systems, such as accounting and customer relationship management (CRM) systems. This integration can provide the organization with a comprehensive view of its activities and operations.

## What is Information Resources

Information resources are defined as the data and information used by an organization. Examples of information resources are databases with customer purchase information.

It is a collection of valuable information generated by human activities. In a broader sense, it also includes related equipment, personnel and

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capital. Resources required to produce information, including hardware, software, technical support, users, facilities, data systems, and data.

Information resources are defined as the data and information used by an organization. Examples of information resources are databases with customer purchase information

An Information System is generally integrated and co-ordinated network of components, which combine together to convert data into information. The information system provides access of information when it is required. The information system is a set of the component which generally helps a system.

Information is an important and key resource for every organization and is an essential input for all types of organizations. Libraries are organized information centers as they have limited resources with which they have to satisfy the information needs of users.

**Resources of Information System:**

There are 5 resources of information system which are given below:

1. **Hardware:**

The system components which can physically touch – the system unit (tower, desktop, laptop), internal devices and peripheral devices (keyboards and monitors) – are called hardware and it is important to remember that basic definition: The hardware are the parts of the computer that are tangible and can be touched.

Peripheral devices are provided in many other ways, but think of them as hardware that surrounds the system unit. These peripherals devices may be connected by wired or wireless technology to the system unit. Generally peripherals devices communicate with the interior components of the system unit via installed software. The software itself is intangible and can't be touched physically.

2 **Software:**

The hardware needs to know what to do, and that is the role of

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software. The software may be divided into two types: first system software and second application software. Primary piece of system software is the operating system, such as Windows or iOS, which manages the hardware's operation. Application software is perform for specific tasks, such as handling a spreadsheet, creating a document, or designing a Web page.

3 **People:**

The human element is the most important component of information system and the people that are needed to run the system and the procedures they follow so that the knowledge in the huge databases and data warehouses can be turned into learning that can interpret what has happened in the past and guide future action.

4 **Data:**

Data is one of the most important component which is generally store in form of information in a database system and a database is a place where data is collected and from which it can be retrieved by querying it using one or more specific criteria. All types of data store in warehouse without knowing whatever form that an organization needs. The databases and data warehouses have assumed even greater importance in information systems with the emergence of "big data, " a term for the truly massive amounts of data that can be collected and analyzed.

5 **Network:**

The network is defined as a system in which more than the system is connected through a transmission media. It provides an interface to receive a piece of information or send an information. It is also one of the best resources in the information system.

**Information as a strategic resource**

One of the dilemmas facing today's manager is that on the one hand they seem to be suffering from information overload, yet on other hand, they often they complain about shortage of information needed to make vital decisions.

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Symptoms of overload are a growth of incoming information, including electronic mail, an explosion in the volume of information sources (there are over 10,000 business newsletter titles and a similar number of CD-ROM titles). Symptoms of scarcity are the lack of vital information for decision making, unexpected competitor moves and the inability to find the relevant 'needle in the haystack'

There is also the crucial problem of exploiting an organisation's proprietary information as a strategic asset. Underlying these problems is that of having "the right information, in the right place, in the right format, at the right time"

## Management of Information System

### 1. Understand the role of Information.

Information can add value to your products and services. Improved information flows can improve the quality of decision making and internal operations. Yet many managers do not fully understand the real impact of information - the cost of a lost opportunity, of a poor product, of a strategic mistake - all risks that can be reduced by using the appropriate information.

### 2. Assign Responsibility for Leading your IRM Initiative.

Developing value from information resources is often a responsibility that falls between the cracks of several departments - the user departments in different business units, and corporate planning, MIS units or librarians.

### 3. Develop Clear Policies on Information Resources

Policies for ascertaining information needs, acquiring and managing information throughout its life cycle. Pay particular attention to ownership, information integrity and sharing. Make the policies consistent with the organisational culture.

### 4. Conduct an Information Audit (Knowledge Inventory).

Identify current knowledge and information resources (or entities), their users, usage and importance. Identify sources, cost and value. Classify information

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and knowledge by its key attributes. Develop knowledge maps. As knowledge management gains prominence, this is sometimes called a knowledge inventory "knowing what you know".

### 5. Link to Management Processes.

Make sure that key decision and business process are supported with high leverage information. Assess each process for its information needs.

### 6. Systematic scanning.

Systematically scan the business environment. This includes the wider environment - legal and regulatory, political, social, economic and technological - as well as the inner environment of your industry, markets, customers and competitors. Provide selective and tailored dissemination of vital signs to key executives. This goes beyond the daily abstracting service provided by many suppliers.

### 7. Mix hard/soft, internal/external.

True patterns and insights emerge when internal and external data is juxtaposed, when hard data is evaluated against qualitative analysis

### 7. Optimize your information purchases.

Most organisations do not know how much they are really spending on external information. By treating consultancy, market research, library expenses, report and databases as separate categories, many organisations are confusing media with content.

### 8. Introduce mining and refining processes.

Good information management involves 'data mining', 'information refining' and 'knowledge editing'. Organisation can use technology such as intelligent agents, to help, but ultimately subject matter experts are needed to repackage relevant material in a user friendly format. One useful technique is content analysis, whose methods have been developed by Trend Monitor

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International in their Information Refinery, and are used in the analysis services. The classifying, synthesising and refining of information combines the crafts of the information scientist, librarian, business analyst and market researcher/analyst. Yet many organisations do not integrate these disciplines.

## 9. Develop Appropriate Technological Systems

Continual advances in technology increase the opportunities available for competitive advantage through effective information management. In particular, intranets, groupware and other collaborative technologies make it possible for more widespread sharing and collaborative use of information. Advances in text retrieval, document management and a host of other trends in knowledge management technologies have all created new opportunities for providers and users alike.

## 10. Exploit technology convergence.

Telecommunications, office systems, publishing, documentation are converging. Exploit this convergence through open networking, using facilities such as the World Wide Web, not just for external information dissemination but for sharing information internally.

## 11. Encourage a Sharing Culture

Information acquires value when turned into intelligence. Market Intelligence Systems (MIS) are human expert-centred. Raw information needs interpretation, discussing and analysing teams of experts, offering different perspectives.

**Benefits of Functional Information System**

- Identifies gaps and duplication of information

- Clarifies roles and responsibilities of owners and users of information

- Provide costs saving in the procurement and handling of information

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- Identifies cost/benefits of different information resources

- Actively supports management decision processes with quality information

**Some of the issues that it addresses are**:

**Strategic -** the information needs to support the implementation of business strategies; also the way that information itself can be a key lever of strategy (in terms of new product and service opportunities)

**Organizational -** ownership, evaluation, fragmentation, isolation from processes, the politics of information

**Structural-** Integrating external and internal information, its categorisation, refining it from data into classified actionable 'chunks'.

**Systems-** User accessibility, interface to sources, multiple databases, retrieval, usability

**Human-** Processing capability, overload, incentives to share.

**Information Security**

**Information Security** is not only about securing information from unauthorized access. Information Security is basically the practice of preventing unauthorized access, use, disclosure, disruption, modification, inspection, recording or destruction of information. Information can be physical or electronic one. Information can be anything like Your details or we can say your profile on social media, your data in mobile phone, your biometrics etc. Thus, Information Security spans so many research areas like Cryptography, Mobile Computing, Cyber Forensics, online social media etc.

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During First World War, Multi-tier Classification System was developed keeping in mind sensitivity of information. With the beginning of Second World War formal alignment of Classification System was done. Alan Turing was the one who successfully decrypted Enigma Machine which was used by Germans to encrypt warfare data.

Information Security programs are built around 3 objectives, commonly known as CIA – Confidentiality, Integrity and Availability.

1. **Confidentiality –** means information is not disclosed to unauthorized individuals, entities and process. For example, if we say I have a password for my Gmail account but someone saw while I was doing a login into Gmail account. In that case my password has been compromised and Confidentiality has been breached.

2. **Integrity –** means maintaining accuracy and completeness of data. This means data cannot be edited in an unauthorized way. For example, if an employee leaves an organisation, then in that case data for that employee in all departments like accounts, should be updated to reflect status to JOB LEFT so that data is complete and accurate and in addition to this only authorized person should be allowed to edit employee data.

3. **Availability –** means information must be available when needed. For example if one needs to access information of a particular employee to check whether employee has outstand the number of leaves, in that case it requires collaboration from different organizational teams like network operations, development operations, incident response and policy/change management.
   Denial of service attack is one of the factor that can hamper the availability of information.

Principles that governs information security programs.

**Non repudiation –** means one party cannot deny receiving a message or a transaction nor can the other party deny sending a message or a

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transaction. For example in cryptography it is sufficient to show that message matches the digital signature signed with sender's private key and that sender could have a sent a message and nobody else could have altered it in transit. Data Integrity and Authenticity are pre-requisites for Non repudiation.

- **Authenticity –** means verifying that users are who they say they are and that each input arriving at destination is from a trusted source. This principle if followed guarantees the valid and genuine message received from a trusted source through a valid transmission. For example if take above example sender sends the message along with digital signature which was generated using the hash value of message and private key. Now at the receiver side this digital signature is decrypted using the public key generating a hash value and message is again hashed to generate the hash value. If the 2 value matches then it is known as valid transmission with the authentic or we say genuine message received at the recipient side.

- **Accountability –** means that it should be possible to trace actions of an entity uniquely to that entity. For example Not every employee should be allowed to do changes in other employees data. For this there is a separate department in an organization that is responsible for making such changes and when they receive request for a change then that letter must be signed by higher authority for example Director of college and person who is allotted that change will be able to do change after verifying his bio metrics, thus timestamp with the user (doing changes) details get recorded. Thus, if a change goes like this then it will be possible to trace the actions uniquely to an entity.

At the core of Information Security is Information Assurance, which means the act of maintaining CIA of information, ensuring that information is

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not compromised in any way when critical issues arise. These issues are not limited to natural disasters, computer/server malfunctions etc.

Thus, the field of information security has grown and evolved significantly in recent years. It offers many areas for specialization, including securing networks and allied infrastructure, securing applications and databases, security testing, information systems auditing, business continuity planning                                                                                        etc.

## INFORMATION SYSTEMS AUDITING AND CONTROL

The information systems auditing and control (ISAC) specialization blends accounting with management information systems and computer science to provide graduates with the knowledge and skills required to assess the control and audit requirements of complex computer-based information systems

Audit of Information System

The effectiveness of an information system's controls is evaluated through an information systems audit. An audit aims to establish whether information systems are safeguarding corporate assets, maintaining the integrity of stored and communicated data, supporting corporate objectives effectively, and operating efficiently. It is a part of a more general financial audit that verifies an organization's accounting records and financial statements. Information systems are designed so that every financial transaction can be traced. In other words, an audit trail must exist that can establish where each transaction originated and how it was processed. Aside from financial audits, operational audits are used to evaluate the effectiveness and efficiency of information systems operations, and technological audits verify that information technologies are appropriately chosen, configured, and implemented.

### Information Systems Control Techniques

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The information system auditor will be most familiar with:

**Accounting controls**:  Those controls which are intended to safeguard the client's assets and ensure the reliability of the financial records; The other types of control likely to be encountered are

**Operational controls:** These deal with the day-to-day operations, functions and activities to ensure that the operational activities are contributing to business objectives

**Administrative controls:** These are concerned with ensuring efficiency and compliance with    management policies, including the operational controls. Auditor's categorization of controls We categories the controls into following four groups:

**Preventive Controls:** Preventive controls are those inputs, which are designed to prevent an error, omission or malicious act occurring.

**Detective Control**: These controls are designed to detect errors, omissions or malicious acts that occur and report the occurrence.

**Corrective Controls:** Corrective controls are designed to reduce the impact or correct an error once it has been detected. A business continuity plan is considered to be a significant corrective control.

**Compensatory Controls**: Controls are basically designed to reduce the probability of threats, which can exploit the vulnerabilities of an asset and cause a loss to that asset.

**Audit Trails :**

Audit trails are logs that can be designed to record activity at the system, application, and user level

**Audit trail objectives:**

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Audit trails can be used to support security objectives in three ways:

Detecting unauthorized access to the system

Facilitating the reconstruction of events, and

Promoting personal accountability.

Thus an information technology audit, or information systems audit, is an examination of the management controls within an Information technology (IT) infrastructure and business applications.

**Role of ISA**

To evaluate the achievement of stated objectives.

To ensure the reliability of computer based financial and other information. To ensure all records included while processing.

To ensure protection from frauds.

Information Systems have become an integral part of our day-to-day life. From Morning till evening, all humans interact with systems, in one form or another. The increased usage of technology has its pitfalls. Organizations need to rely more on technology for their day to day jobs. As the usage of technology and information system is increasing, associated risk with technology is also imposing several threats to the information systems. More and more use of technology and the increased instances has made it imperative for organizations to place proper controls. As a part of compliance, an auditor evaluates the existence effectiveness and continued effectiveness of internal controls.

` **Need for Control and Audit of Information Systems:**

A control is a system that prevents, detects or corrects unlawful events.

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Factors influencing an organization toward control and audit of computers and the impact of the information systems audit function on organizations are depicted below: Organizational cost of data loss:

Data is a critical resource of an organization for its present and future process and its ability to adapt and survive in a changing environment.

Incorrect decision making:

Management and operational controls taken by managers involve direction, investigations and correction of out-of-control processes.

Cost of computer abuse:

Unauthorized access to computer systems can lead to destruction of assets (hardware, software, documentation etc.) Value of computer hardware, software & personnel: These are critical resources of an organization which has a credible impact on its infrastructure and business competitiveness.

High costs of computer error:

In a computerized enterprise environment where many critical business processes are performed a data error in the entry or process would cause great damage.

Maintenance of privacy:

The data were also collected before computers but now there is a fear that privacy has eroded beyond acceptable limits.

Controlled evolution of computer use:

Technology use and reliability of complex computer systems cannot be guaranteed and consequences can be destructive.

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**Effects of computer system on Audit:**

To cope up with the new technology usage in an enterprise, the auditor should be competent to provide independent evaluation as to whether the business process activities are recorded and reported according to established standards or criteria.

Two basic functions carried out to examine these changes are:

1. Changes to evidence collection:

    Data retention and storage: Client's storage capacity may restrict the amount of historical data retained online & readily accessible to the auditor.

    Absence of input documents: Most of the online & system generated transactions happen without the use of any input resulting change in audit trail.

    Non-availability of audit trail: In computer system audit trail may not exist or exists for short time.

    Lack of availability of output: The transactions processed may not produce printed hardcopy output.

    Audit evidence: Certain transactions which are generated automatically may not have audit evidences.

    Legal issues: With increase in trading over internet, creates problems with contract like legal jurisdiction of contract, parties to contract etc.

2. Changes to evidence evaluation:

    System generated transactions: They do not provide any vision to users when they are processed. They may lead to new sources of error.

    Automatic transaction processing: It may cause problem for auditor, e.g. in case of JIT, if stock level falls below certain units, system automatically generates purchase order & send it to supplier without authorization from manager.

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Systemic error: It means if computer program is wrong, it will continuously give wrong output till it is connected.

The Information System Audit:

It is the process of assessment of internal controls within IS environment and attesting following objectives:

Asset safeguarding:

The information system assets must be safeguarded to provide confidentiality, integrity and availability.

Data integrity:

It is a fundamental attribute of IS auditing.  The importance to maintain integrity of data of an organization depends on the value of information.

System effectiveness:

Effectiveness of a system is evaluated by auditing the characteristics and objective of the system to meet substantial requirements.

System efficiency:

To optimize the use of various information system resources along with the impact on its computing environment.

**The set of skills expected from an Information System auditor include:**

Sound knowledge of business operations, practices and compliance requirements,

Requisite professional/technical qualification and certifications,

Good understanding of information risk & controls,

Knowledge of IT strategies, policy and procedure controls,

Ability to understand technical and manual controls,

Good knowledge of professional standards and best practices.

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### Functions of Information System auditor:

IS auditor often is the assessor of business risk, as it relates to the use of IT, to management.

IT auditors review relating to IT systems and processes, some of them are:

Inadequate information security e.g. no or outdated antivirus, no or weak password etc.

Inefficient use of corporate resources e.g. huge spending on high power servers which were not required.

Ineffective IT strategies, policies & practices e.g. lack of internet usage policy & security policies.

 IT-related frauds e.g. phishing, hacking etc.


### Categories of Information System audits:

 Information System audits have been categorized into five parts: System and applications:

Systems & applications are appropriate and adequately controlled to ensure valid, reliable, timely & secure input, process & output.

Information processing facilities:

Facility must be controlled to ensure timely, accurate & efficient processing under normal and disruptive conditions.

System development:

To ensure that system under development meets organization's objective & is developed according to generally accepted standards.

Management of IT and enterprise architecture:

IT management has organization structure & procedure to ensure controlled & efficient environment for information processing.

Telecommunications, intranets and extranets:

To ensure controls are in place on client, server & networking connecting client & server.

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**Steps in Information System audit:**

Information System audit can be categorized into six stages:

Scoping and pre-audit survey:

Auditor determines main area of focus & out of focus based on risk based assessment.

Planning and preparation:

It involves generation of audit work plan & risk control matrix.

Fieldwork:

Gathering evidencing by interviewing staff & managers, reviewing documents and observing processes.

Analysis:

It involves reviewing & trying to make sense of all evidences gathered.

Reporting:

Reporting to the management after analysis of data.

Closure:

It involves preparing notes for future audits.

**Audit Standards and Best Practices**:

Information System auditors need guidance and a yardstick to measure the 3E's (Economy, Efficiency and Effectiveness) of a system.

Several well-known organizations have given practical and useful information on Information System audit, which are given as follows:

Information System Audit and Control Association (ISACA):

It is a global leader in governance, security audit & control. To assist IT auditors, it has issued 16 auditing standards, 39 guidelines to apply standards, 11 IS auditing procedures and COBIT for best business practices relating to IT.

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ISO 27001:

International best practice, certification standards & foundation for ISMS. It defines how to organize information security in any organization.

Internal Audit Standards:

IIA is a professional association. It provides dynamic leadership for internal auditing. IIA issued Global Technology Audit Guide.

Standards on Internal Audit issued by ICAI:

It has issued various standards which highlights process to be adopted by internal auditor in specific situation.

Information Technology Infrastructure Library:

It is a set of practice for ITSM. It focuses on aligning IT with the needs of business. It describes procedures, task & checklist which are not organization specific for establishing minimum level of competency.

Concurrent or Continuous Audit:

Today, organizations produce information on a real-time, online basis. Real-time recordings needs real-time auditing to provide continuous assurance about the quality of the data, thus, continuous auditing. Continuous auditing enables auditors to significantly reduce and perhaps eliminate the time between occurrence of the client's events and the auditor's assurance services thereon.

**Types of Audit tools**:

Snapshots:

It examines the way the transactions are processed. Selected transactions are marked with special code that triggers snapshot process. Audit module records the transactions before & after processing.

Integrated Test Facility (ITF):

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It involves creation of dummy entity in the application system & to audit the processing of test data entered in dummy entity.

System Control Audit Review File (SCARF):

It involves embedding audit software module within host application to provide continuous monitoring of transactions. SCARF is like snapshot with data collection capability.

Continuous and Intermittent Simulation (CIS):

It examines the transactions that updates the database. It independently process the data, records the result & compare them with those obtained by DBMS.

Audit Hooks:

It is used to flag the suspicious transactions. Auditor is informed of questionable transactions as they occur via real time notification

**Advantages of CAT**

Timely, comprehensive and detailed auditing

Surprise test capability

Information to system staff on meeting of objectives

Training for new users

**Audit Trails:**

Audit trails are used as detective controls which help to accomplish security policy. Audit trails are log that can be designed to record the user activities on system and application.

Objectives of Audit Trails:

Detecting unauthorized access to system

Reconstruction of events

Personal accountability

**COSO Framework:**

Control environment:

For each business process, an organization needs to develop a control environment including criticality & materiality of each business process.

Risk assessment:

Each business process comes with various risks. A control environment must include an assessment of risks associated with each business process.

Control activities:

Control activities must be developed to manage, mitigate & reduce the risk associated with each business process as it is unrealistic to expect to eliminate risk.

Information and communication:

Control activities are associated with information & communication systems as these systems enable an organization to capture & exchange the information to conduct, manage & control its business operations.

Monitoring:

Internal control process must be continuously monitored with modifications made as warranted by changing conditions.

**Layers of security policy and audit:**

Strategic Layer: At this layer, the top management takes action, in form of drawing up security policy, security training, security guidelines.

Tactical Layer: At the tactical layer, security administration is put in place.

Operational Layer: The operational layer audit issues include: User accounts and access rights Password controls Segregation of duties

**Conclusion:**

By seeing around the world, it can be clearly understood that information is blood of a business. To run business for unforeseen

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future, protection of information and data is very critical. And that's why organizations are expending major chunk of their budget to ensure security of information and data. It is also necessary to gain the trust of stakeholders. In short, information lost means business gone, so, information must be protected with due and reasonable care