(6.2)- MANAGEMENT INFORMATION SYSTEM

Unit I: Introduction 10 Hrs

Introduction, Concept, evolution and meaning of MIS; Information system for competitive advantage; Systems approach to problem solving; Challenges in the development of MIS, MIS function in an organization.

Unit II: Information and Managerial Effectiveness 14 Hrs

Information and Managerial Effectiveness, Information as a corporate resource, pervasiveness of information, types of information – operational, tactical and strategic; Levels of management and information needs of management; Process of generation of information; Quality of information; information systems for finance, marketing, manufacturing, research and development and human resource areas.

Unit III: Information Systems 14 Hrs

Information Systems - Information systems and their role in Business systems, changing role of information systems, users of information systems; Types of information systems – transaction processing systems, MIS decision support systems, executive support system; Enterprise Resource Planning (ERP) system, Business expert system.

Unit IV: Information System for Functional Areas and Issues 12 Hrs

Information System for Functional Areas - Information for Financial - Marketing Inventory Control - Production and HR Functions, Security Issues Relating to Information Systems, threats to information systems, Vulnerability, risk and control measures.

Unit V: New Trends in MIS 10 Hrs

Cloud computing, Big data, CRM technology for Business, Data ware housing and artificial intelligence, Near field Communication, Super Beam (Only concepts)

Unit I:

Introduction

To the managers, 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 three components of MIS provide a more complete and focused definition, where **System** suggests integration and holistic view, **Information** stands for processed data, and **Management** is the ultimate user, the decision makers.

CONCEPTS: The word 'MIS' comprises of three basic elements such as:

a) Management
b) Information
c) System

Management information system can thus be analyzed as follows:

Management: 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.

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.

System: Data is processed into information 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.

Meaning of MIS:

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.

MIS is the acronym for Management Information Systems. In a nutshell, MIS is a collection of systems, hardware, procedures and people that all work together to process, store, and produce information that is useful to the organization.

Definition:

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.

The MIS has been understood and described in a number of ways. It is also referred to as:

a) Information system
b) Information and decision system
c) Computer based information system

MIS can be defined in a number of ways:

1. The MIS is defined as a system which provides information support for decision making in the organisation.
2. MIS is an integrated system of men and machines for providing the information to support the operations, the management and decision making functions in the organisation.
3. MIS is defined as a system based on the database to the Organisation evolved for the purpose of providing information to the people in the Organisation.

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.

Following are the basic objectives of an MIS −

- **Capturing Data** − Capturing contextual data, or operational information that will contribute in decision making from various internal and external sources of organization.
- **Processing Data** − The captured data is processed into information needed for planning, organizing, coordinating, directing and controlling functionalities at strategic, tactical and operational level. Processing data means:
    - o making calculations with the data
    - o sorting data
    - o classifying data and
    - o summarizing data
- **Information Storage** − Information or processed data need to be stored for future use.
- **Information Retrieval** − The system should be able to retrieve this information from the storage as and when required by various users.
- **Information Propagation** − Information or the finished product of the MIS should be circulated to its users periodically using the organizational network.

Characteristics of MIS

Following are the characteristics of an MIS:

- It should be based on a long-term planning.
- It should provide a holistic view of the dynamics and the structure of the organization.
- It should work as a complete and comprehensive system covering all interconnecting sub-systems within the organization.
- 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.
- It should be based on need of strategic, operational and tactical information of managers of an organization.
- It should also take care of exceptional situations by reporting such situations.
- 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.
- 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.
- 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.
- 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.
- A central database is the backbone of a well-built MIS.

Characteristics of Computerized MIS

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

- It should be able to process data accurately and with high speed, using various techniques like operations research, simulation, heuristics, etc.
- 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.
- It should provide real time information on ongoing events without any delay.
- It should support various output formats and follow latest rules and regulations in practice.
- It should provide organized and relevant information for all levels of management: strategic, operational, and tactical.
- It should aim at extreme flexibility in data storage and retrieval.

Information system for competitive advantage:

Gaining competitive advantage is critical for organisations. Baltzan and Phillips (2010, p. 16) define competitive advantage as 'a product or service that an organization's customers value more highly than similar offerings from its competitors' (in other words, you have something useful (i.e. products, services, capabilities) that your competitors do not have). Competitive advantages are typically temporary as competitors often seek ways to duplicate the competitive advantage (Baltzan & Phillips 2010, p. 16). In order to stay ahead of competition, organisations have to continually develop new competitive advantages. This section discusses how an organisation can analyse, identify, and develop competitive advantages using tools such as Porter's Five Forces, three generic strategies, and value chains.

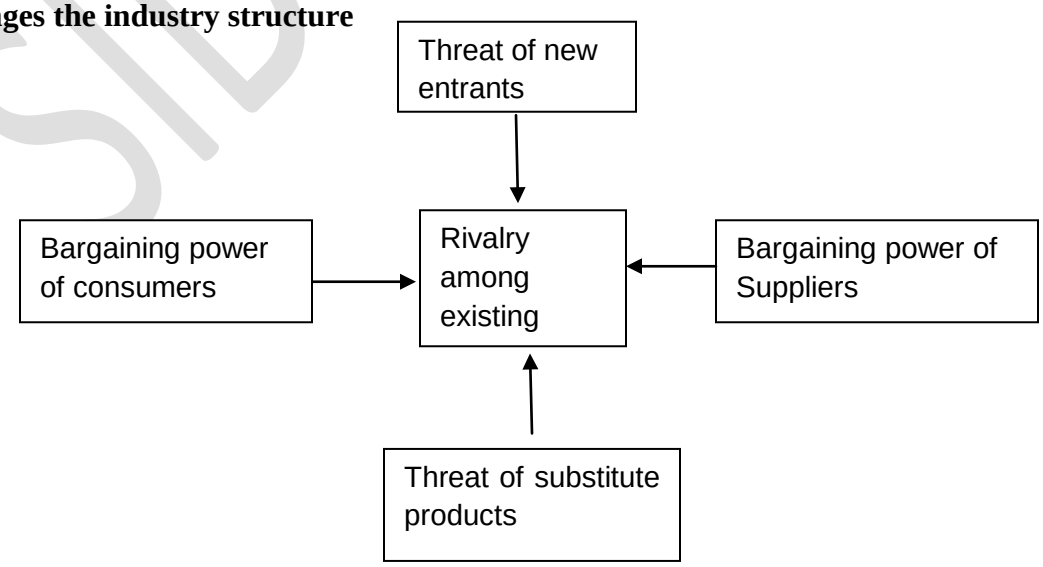
Michael Porter's Five Forces Model is a useful tool to assist in assessing the competition in an industry and determining the relative attractiveness of that industry. Porter states that in order to do an industry analysis a firm must analyse five competitive forces (Baltzan & Phillips 2010, p. 17):

- Rivalry of competitors within its industry
- Threat of new entrants into an industry and its markets
- Threat posed by substitute products which might capture market share
- Bargaining power of customers
- Bargaining power of suppliers.

Michael Porter & Victor Millar have said, IT is affecting competition in three vital ways:

1. It changes the industry structure & in so doing, affecting the rules of competitions.
2. It spawns the new business, often from within the company existing operations.
3. It creates competitive advantage by giving companies new ways to outperform their Rivals.

1. Changes the industry structure



2. Spanning of New Businesses

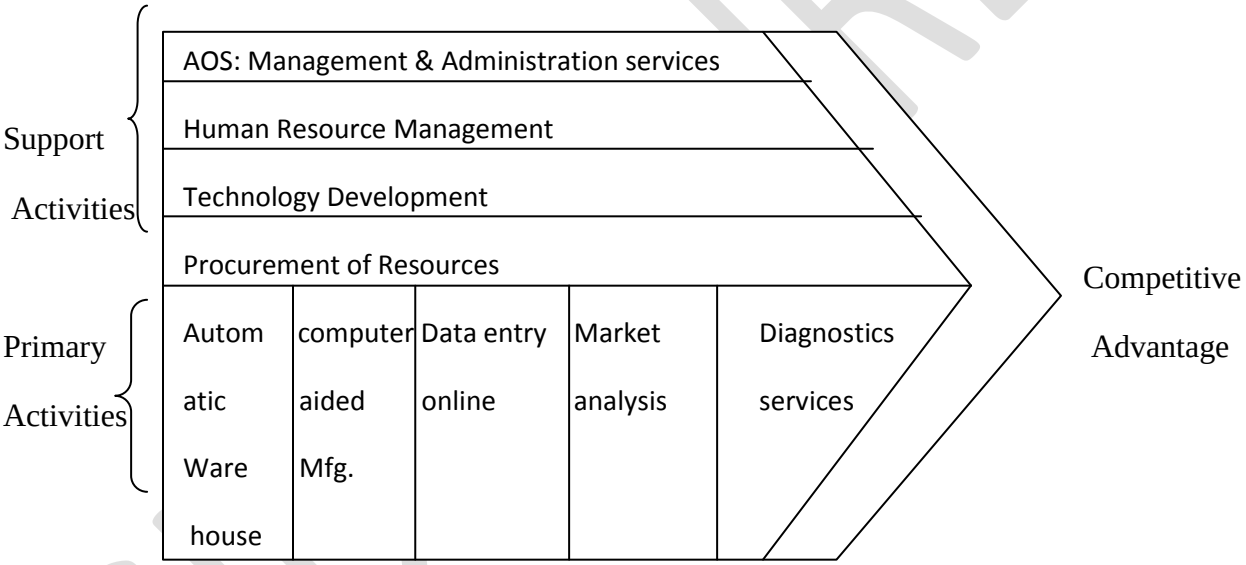
Information, information technology & information Revolution gives birth to new industries.

- Information Revolution makes new business technology feasible.
- Information & IT also spawn new business by creating derived demand for new products.
- Information & IT helps to create new business with old ones.

3. New ways to outperform their rivals

Information & IT, developments of new ways of doing things in a different way confers competitive advantage on a firm.

The Value chain model:



The **value chain is** an analytical frame work to disaggregate a firm in to the different interdependent activities that add value to its raw materials and bring the firms products or service to the customer.

The **key feature** of a value chain is to examine each step of production & determine how value is added at each step.

The second **objective** of value chain analysis is to examine the bigger picture in the industry.

The value chain is combination of **primary** and **support activities**.

Primary activities involve physical creation of the product, its marketing and delivery to buyers, its support and service after sale.

Support activities provide the input & infrastructure that allow the primary activities to take place.

Each **activity adds value**; there is a cost of adding a value in every level of the chain.

Value chain **enables a company** to analyses where & how it can add value to reduce cost.

If the **total cost of added values** is less then what the values is less than, what the customer pays, there is profit.

The concept of value chain is a **useful frame work** for identifying information technology opportunities.

The value chain concept can help managers decide where and how to apply the strategic capabilities of information system technology.

EVOLUTION OF MIS

The older version of MIS was Electronic Data Processing (EDP) systems. The main activity of EDP was record keeping under accounting department of an organisation. One example of EDP is the payroll software package used by any organisation.

The philosophical shift from data to information developed the concept of MIS. The main aim of EDP was to compile a chunk of data, whereas MIS took the responsibility to process those data and generate fine tuned information.

With the revolution in personal computing, the management could directly access the information base instead of depending on the EDP or MIS departments. This enhanced the decision making capabilities of management and gave birth to Decision Support Systems (DSS) pioneered by Keen. The direct use of information base created the 'What-if' analysis capability with the help of modern software packages like Spreadsheet, Word Processing and Database Management Systems (DBMS), etc.

The spectacular growth in Artificial Intelligence and Expert Systems generated Knowledge Based System (KBS). Combined with DSS, the expert systems could supply a superior class of MIS by providing software packages having self-learning capabilities.

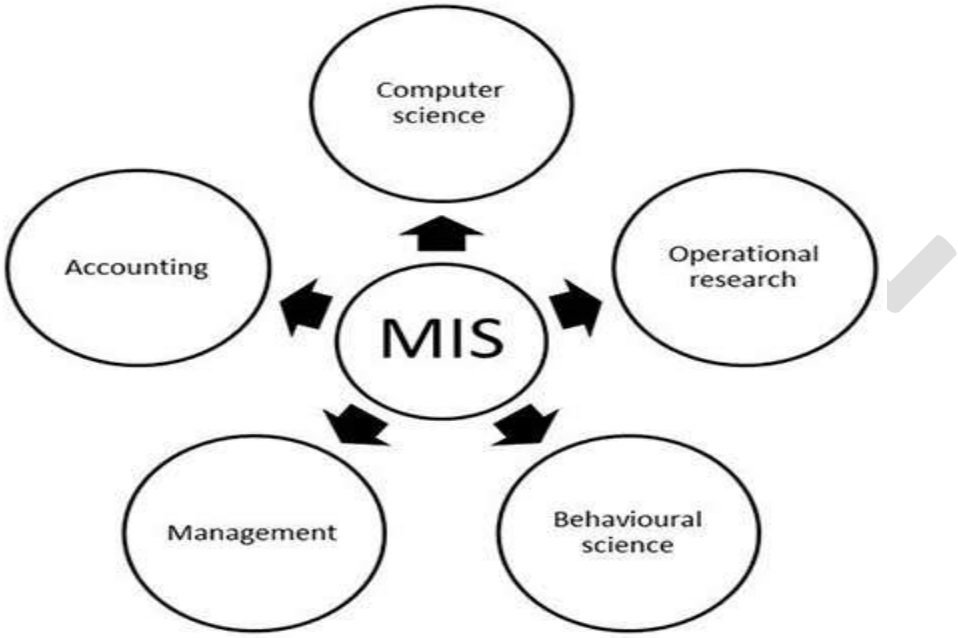
The philosophy of DSS, combined with the power of the Operation Research models together with Management Science transformed the 'What-if' capability to 'What-is-best'. This came to be known as Model Management Systems (MMS) help the management to take the optimal decision from several available alternatives.

The EDP targeted the lower level of management. The MIS/DSS/MMS targeted the middle level of management. The Executive Information System (EIS) or Executive Support System (ESS) serves the top level of management whose time value is extremely high. Here the user interface

must be superior such as, Natural Language Interface, Voice Processing and Response, Multi-Media (Graphics, Sound and Video), etc.

Nature and Scope of MIS

The following diagram shows the nature and scope of MIS:



The Systems Approach to Problem Solving

Characteristics of the systems approach:

1. A top-down approach. The well done systems analysis starts with an analysis of the strategy and goals of the project and then proceeds to the specific.
2. A rational, objective basis for analysis. Decisions are based on carefully gathered evidence and analyzed using a logical procedure.
3. Considers a generalized problem including the problem setting. A properly done systems analysis always includes consideration of the problem environment including all stakeholders.
4. Client orientation
5. Index of performance and goals/objectives
6. Importance of Alternatives **–"What do you mean you didn't consider any alternatives?"**
7. Problem decomposition
8. Normative

Analytic Sins (from Jones, Morgan D., The Thinker's Toolkit, Three Rivers Press, 1998)

- We often begin our analysis by formulating our conclusion. We start at the end!
- Our analysis focuses on the solution that we intuitively favor. We give inadequate attention to alternative solutions.
- We tend to focus on the substance (evidence, arguments, conclusion) and not the process of our analysis.
- Most people are functionally illiterate when it comes to structuring their analysis.
- We instinctively rely on and are susceptible to biases and assumptions.
- We tend to stick to untrue beliefs in the face of contradictory evidence.

Simon's Model for Decision Making- Decision-making consists of three major phases

1) Intelligence

a) Problem Identification and Definition

i. What's the problem?

ii. Why is it a problem?

iii. Whose problem is it?

2) Design

a. Problem Structuring

i. Generate alternatives

ii. Set criteria and objectives

iii. Develop models and scenarios to evaluate alternatives

iv. Solve models to evaluate alternatives

3) Choice

a. Solution

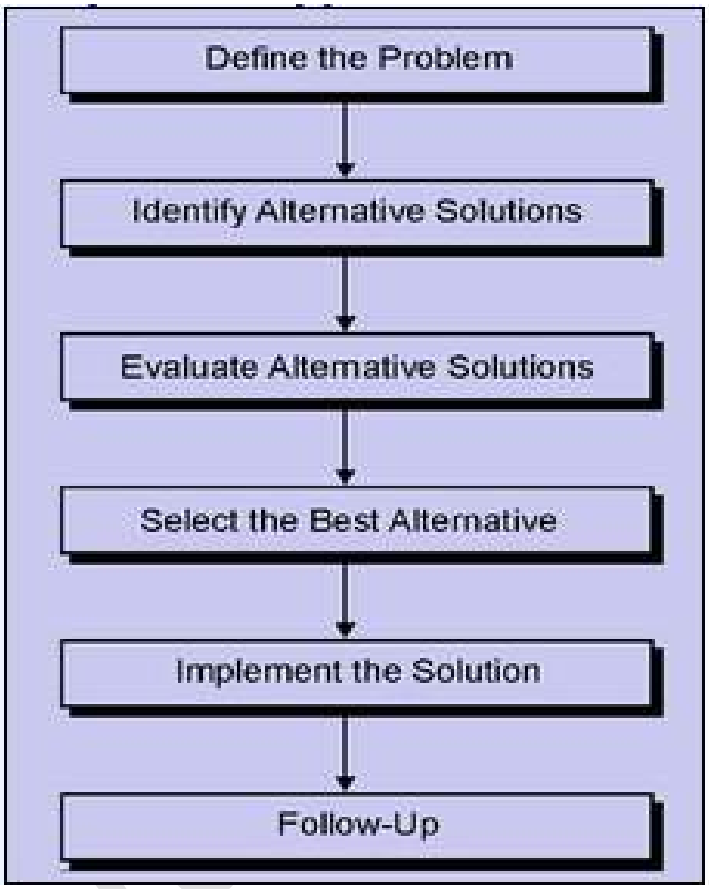
i. Determine the outcome of chosen alternatives

ii. **Select "best alternative"**

The system analysts and programmers, who designed and developed the MIS, were not, in the initial stages, familiar with the managerial set-up and the role of managers in the organization. So, they were not in a position to understand how managers solved problems in the organizations. In order to develop a standard and structured framework for problem solving, they introduced the systems approach to problem solving. Any manager can use the systems approach irrespective of the type of problem. It provides a universal methodology with an inherent logic to solve any kind of problem through a series of steps.

- Define the problem
- Identify alternative solutions
- Evaluate alternative solutions
- Select the best alternative
- Implement the solution
- Follow up

Another popular model was proposed by Herbert Simon which contains four steps: intelligence, design, choice, and review. Intelligence is the first step of this approach and refers to problem identification and definition. Design consists of developing and evaluating the alternative solutions. Choice is the process of selecting the best alternative and implementing it, while review is the follow-up process after implementing the solution. Let us now understand each of the steps involved in the systems approach.



Define the problem: The first step in this approach is to identify the problem. A problem is considered as a constraint or hindrance to the otherwise smooth flow of activities. It can be identified through its symptoms. A symptom is an indicator of a problem and need not be the cause. The system analysts are required to identify such possible indications. For example, a fall in sales is an indicator of a problem. As and when such an indication comes up, the management has to review the possible causes for the fall and identify the real problem(s). Once a problem has been identified, it has to be defined in clearer terms such that no ambiguity exists in communicating the problem across the hierarchy.

Identify alternative solutions: A problem can be solved in more than one ways. It is therefore not advisable to just think of a single solution and try to implement it. Such a decision would not allow the manager to think of other possible alternative solutions and the advantages associated with them. Therefore, it is recommended that multiple alternatives be developed for the problem and the best alternative selected. In this step, such alternatives are identified and developed. The

solutions that have worked in the past are a good source from which to search for new alternatives. Advice from colleagues (internal) and consultants (external) can provide fresh insights into the problem. Many organizations use expert systems to assist them in generating alternatives. Expert systems use the knowledge of various experts and develop solutions to problems in the same way as an expert does.

Evaluate alternative solutions: Once the alternative solutions have been developed, they have to be evaluated to choose the best solution. Evaluation is mainly done to see how well an alternative fits as the right solution to the problem. Every alternative is evaluated through different analyses like cost-benefit analysis, etc. Different criteria of each alternative are evaluated to understand their influence in arriving at a solution to the problem.

Select the best alternative: The next step is to choose the best alternative as the solution to the problem. To do this, different factors in each alternative are compared with other alternatives to eliminate the less feasible alternatives. After several comparisons, the best alternative is selected. Sometimes it so happens that none of the alternatives can serve as the solution to the problem. Then, fresh alternatives have to be developed. Sometimes, it may happen that 'no action' is the best solution to the problem.

Implement the solution: The selected solution has to be implemented to solve the problem. Sometimes, the solution has to be freshly designed in order to be implemented. For instance, if installation of new and custom-made equipment is considered as the chosen solution, then the equipment has to be designed accordingly and then installed. This is true for information systems also. Changes in MIS have to be designed and redesigned to suit the organizational requirements.

Follow-up: This is the final step in this approach. The best solution can fail to produce the expected results if put into practice in the real world. Hence, it is always recommended that the results produced by the solution be monitored and evaluated. This is called follow-up. Follow-up ensures that the post-implementation performance of the system is satisfactory.

Challenges in the development of MIS:

If all the existing barriers are divided into humanistic, organizational and environmental factors, the major drawbacks and the reasons of failure and using MIS in public organizations are as following:

Humanistic factors

- The lack of information of the managers and users as they don't know exactly what they want and what their information needs are.
- The lack of understanding of the needs of the users by designers (the lack of correct definition of the needs and their analysis)
- The lack of information of the managers and users about the collaboration method with the designer team.

- The lack of participation of the managers and users in system design.
- The lack of understanding of the managers of software and information systems.
- The lack of information of most of the analysts and programmers (designers) with new system work environment.
- The lack of acceptance of the system executers and resistance against the change.
- The lack of accuracy in the data collected Organizational factors
- The lack of good conditions for participation and collaboration of the managers, users and system directors
- The lack of consistency and complexity of the existing manual systems.
- The lack of existing systems and methods analysis before the system design
- The lack of evaluation of the existing power
- Bad condition of educating the specialized forces
- The lack of human resources with management and computer fields and other required specializations (the problems of absorbing human resources)
- Inadequate education of the users
- Inadequate and incomplete documentation
- Unsuitable implementation of the system

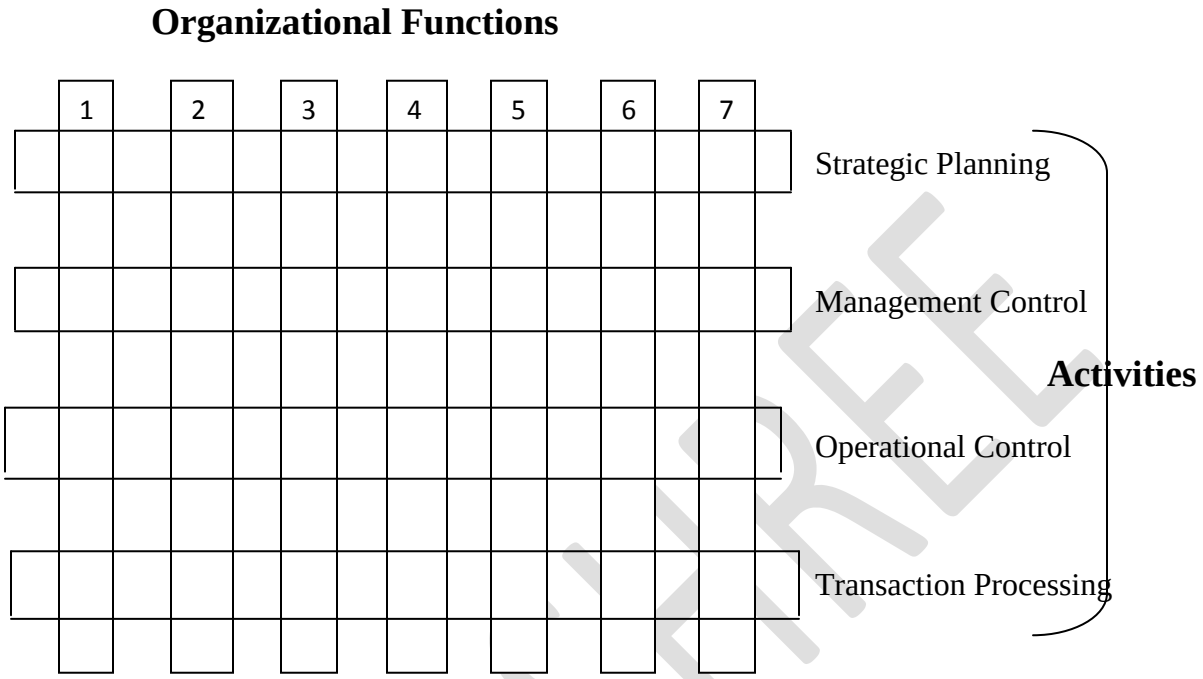
Environmental factors

- The lack of suitable consultants for designing the system and software
- The lack of procedures and methodology and stages of creating the system
- The lack of evaluation of environmental aspects in management information systems
- The lack of suitable use of mass media to develop the culture of using computer and information systems.
- The lack of holding suitable MA training courses in the universities and the lack of suitable education of human resources in this regard.
- The lack of ratification of the suitable rules in Islamic council parliament and government board and the considerable problem in this regard.
- The lack of serious consideration and adequate investment in this regard.

MIS function in an organization:

The structure of an information system can also be described in terms of the organizational functions which use information. There is no standard classification of functions, but a typical set of functions in a manufacturing organization includes Production, sales & marketing, finance and accounting, logistics, personnel, and information system. Top management is also consider as a separate management

The conceptual structure of MIS is defined as a federation of functional subsystems each of which is divide in to four major information processing components like Transaction processing, Operational control information system, Management control information and Strategic planning.



Organizational Functions:

1. Sales & Marketing
2. Production
3. Logistics
4. Personnel
5. Finance & Accounting
6. Information Processing
7. Top Management

1. **Sales and Marketing Subsystem:** the sales and Marketing includes al activities related to the promotion and sales of products or services.

   - **The Transactions** are sales order, promotion orders, etc.
   - **The Operational control** activities include the hiring and training of the sales force, the day-day scheduling of sales and promotion efforts etc.
   - **Management control** concerns comparisons of overall performance against a marketing plan. Information for management control may include data on customers, competitors, competitors products and sales force requirement.

- **Strategic Planning** for the marketing function involves consideration of new markets and new marketing strategies.

2. **Production Subsystem:** The production functions includes product engineering, planning of production facilities, scheduling and operation of production facilities, employment and training of production personnel and quality control and inspection.

   - **The typical transaction** to be processed is production orders, assembly order, finished parts tickets, scarp tickets and time keeping tickets.
   - **Operational control** requires detailed reports comparing actual performance to the production schedule and highlighting areas.
   - **Management control** requires summary reports comparing overall planned performance to actual performance
   - **Strategic planning** for manufacturing approaches and alternatives approach to automation.

3. **Logistics Subsystem:** The logistics function encompasses such activities as purchasing, receiving, inventory control and distribution.

   - **The transaction** to be processed includes purchase requisition, purchase order, manufacturing orders.
   - **The Operational control** function uses information contained in reports such as past due purchase, past due shipments to customers etc.
   - **Managerial control** information for logistics consists of overall comparisons between planned and actual inventory levels.
   - **Strategic control** involves the analysis of new distribution strategies, new policies with required to vendors.

4. **Personnel subsystem:** includes hiring, training, record keeping, payment and termination of personnel.

   - **The transaction result** in documents describing employment requisition, job descriptions, training, personal data.
   - **Operational control** for personnel requires decision procedures for action such as hiring, training, termination, changing pay rates, and issuing benefits.
   - **Management control** of the personnel function decision is supported by reports and analysis showing the variances between actual and planned performance.
   - **Strategic planning** fro personnel is involved with evaluating alternatives for recruiting, salary, training, benefits and building location to ensure that the organization obtained and retains personnel.

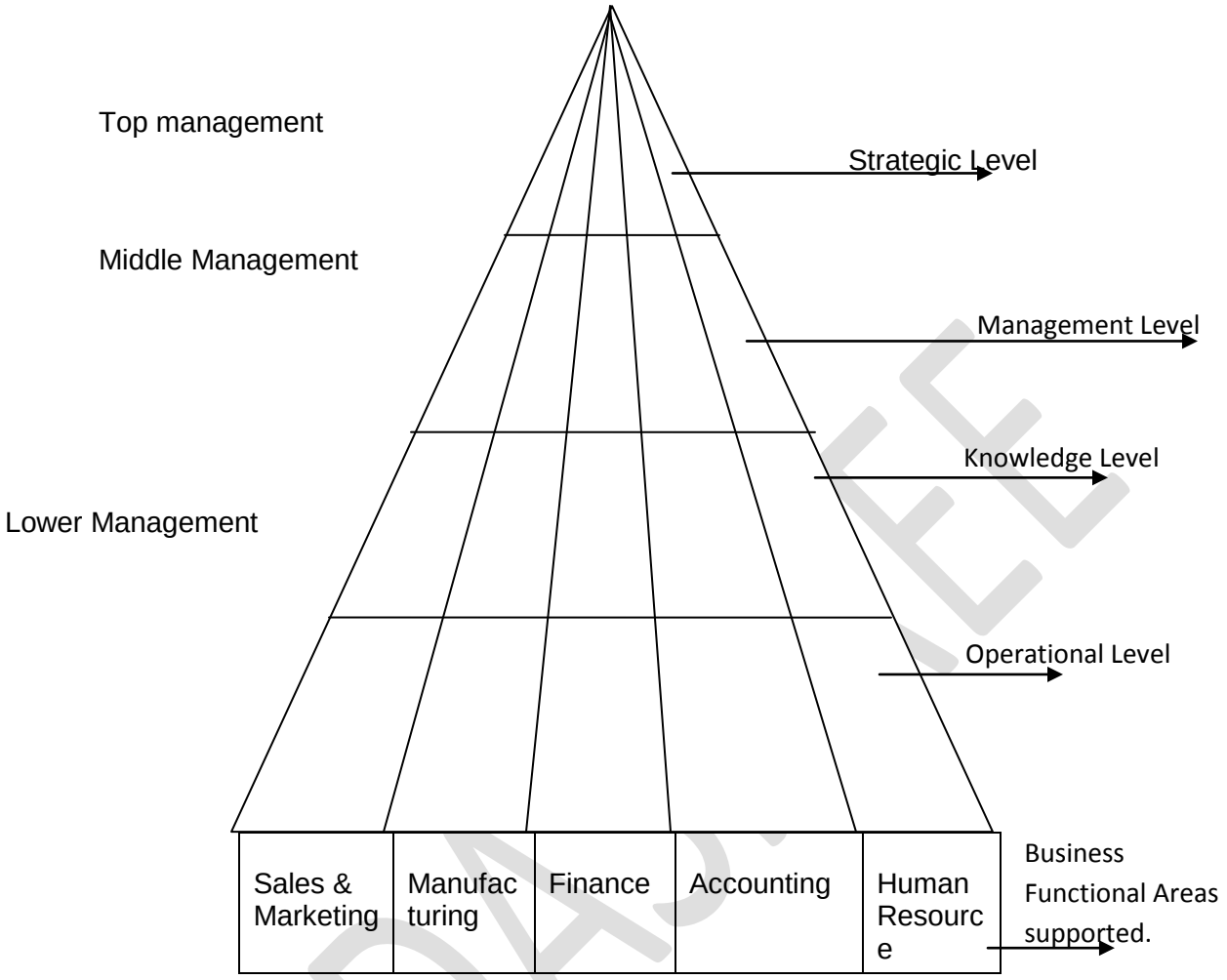
5. **Finance & Accounting subsystem:** Finance function covers granting of credit to customer, collection process, cash management and financing arrangements. Accounting covers the

classification of financial transaction and summarization in to the standard financial reports, preparation of budgets.

- **Transaction** associated with finance and accounting are credit applications, sales, billing, collection documents, payment vouchers etc.
- **Operational control** over the function itself require daily error and exception report, records of processing delays etc.
- **Managerial control** level for accounting and finance utilizes information on budgeted versus actual cost of financial resources and error rates.
- **Strategic planning** level for accounting finance involves a long run strategy to ensure adequate financing, a long range tax accounting policy to minimize the impact of taxes.

6. **Information processing subsystem:** The information processing function is responsible fro ensuring that the other functions are provided the necessary information processing services and resources.

- **Typical transaction** for information processing service and resources, requests fro corrections or changes in data and programs, reports of hardware and program performance and projects proposals.
- **Operational control** of information processing operations requires information on the daily schedule of jobs, error rates and equipment failures, for new projects development it requires daily or weekly schedules.
- **Managerial control** over information processing requires data on planned versus actual utilization, equipment cost, overall programmer performance and progress.
- **Strategic planning** for information system involves the organization of the function, the overall information system plan, selection of strategic uses of information and the general structure of the hardware and software environment.



Top Management: Strategic Planning

Middle Management: Tactical Planning or Management Control

Lower Management & Operational Management: Operational Control

UNIT II

INFORMATION AND MANAGERIAL EFFECTIVENESS

Information and Managerial Effectiveness:

DATA: Data is raw facts or Observation about physical phenomena or Business Transaction.

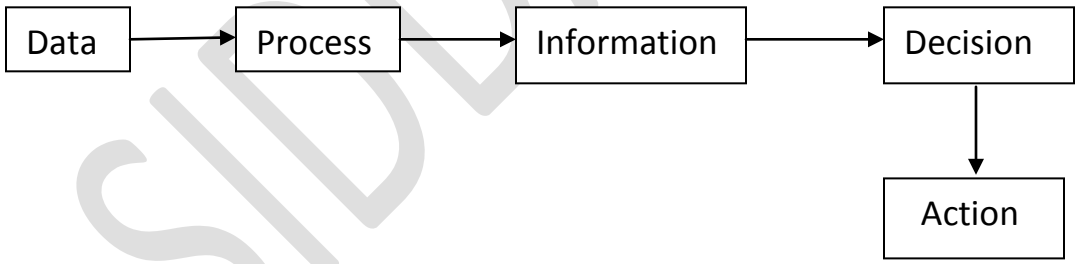
Data is also objective measurement of the attributes (characteristics) of entities such as People, place, things & events.

Data is Raw, un- summarized, unanalyzed facts.

Data is used in the form of raw material & must be subjected to data manipulation or processing to produce useful information.

INFORMATION: Information is data placed in a meaningful & useful context for end users.

The conversion of process of data/action is shown in the following.



Importance of information:

- Its form is aggregated, manipulated and organized.
- Its content is analyzed and evaluated.
- It is placed in proper context for a human user.

Information contains:

- An element of surprise.
- Reduces uncertainty.
- Triggers action.

- Information is one of the major resources of an Information system.
- Without information no action could take place.
- An information system generates information using data.

If the information system generate information useful for managers in planning & control the whole system is called "management information system".

Meaning of Managerial Effectiveness:

The term 'managerial effectiveness' could mean achievement of organisational goals, increase in productivity, profit, workers' satisfaction, growth, diversification etc. Managerial effectiveness aims at optimum allocation and utilisation of scarce organisational resources in order to achieve the goals at minimum cost. It aims at deriving maximum output out of minimum input.

Managerial effectiveness means performing managerial activities effectively. An effective manager performs activities effectively and efficiently. This means doing the right things and doing these things right. Many people believe that successful managers are intelligent, imaginative and knowledgeable. However, only effectiveness translates the intelligence, imagination, and knowledge into results and makes a manager successful.

Managerial effectiveness consists of the following elements:

1. **Manager:** Manager is the key pin of a successful organisation. Well-defined objectives and strategies are required to effectively transform inputs into outputs. Managerial effectiveness is governed by managerial skills, competence, intelligence, knowledge, sincerity and creativity. It is judged by not what the managers do but by how well they do. Effective managers enable the business to grow in the dynamic environment.
2. **Organisation:** Managerial effectiveness is also judged by the organisation itself. Highly innovative and creative managers may not perform well if the organisation structure does not permit them to do so. The structure, value system, design, culture, size and the work environment largely determine the way managers manage the organisation. A highly bureaucratic and formal organisation structure may not have committed and effective managers.
3. **Entrepreneurship:** Success cannot be ensured unless managers have the quality of entrepreneurship. Managerial effectiveness ensures that business in future is different from business today. It requires hard work, intelligence, creativity and innovativeness to keep the business successful in future.
4. **Environment:** Business operates in the dynamic and turbulent environment with ever changing factors (economic, political, legal, social etc.). Managers adapt the organisations according to demands of the environment. Successful and effective managers not only respond to environment; they also influence the environment and become market leaders in the industry.

Managerial effectiveness is not an end. It is a means to the end, that is, efficient attainment of organisational goals. In order to accomplish the tasks effectively, managerial effectiveness deals with managerial jobs, skills of managers and the organisation as a whole.

Information as a corporate resource:

Information is knowledge that one derives from facts placed in the right context with the purpose of reducing uncertainty from a manager's point of view, information serves the purpose of reducing uncertainty regarding the alternative courses of action, in the process of decision making.

Availability of information regarding the alternatives improves the odds in favour of making a correct decision. Information is recognised as one of the most important corporate resources. It is a source of competitive strength as it enables the management to outmaneuver its business rivals at critical stages.

A. Security as Part of the Total Organization

Information security is not simply software or hardware security, and it does not stand apart from the total organization. An organization's policies, plans and procedures may affect security needs, and security practices may affect those policies, plans or procedures. The important point is that a secure system is integral to the total organization.

B. Understanding the Organization

If a secure system is part of the total organization, then one must understand the organization, its goals, objectives, policies and procedures. If the objectives of an organization are unclear, then implementing new technology will not help. If procedures are not secure, then new technology will not make them secure. Understanding the organization is the first step in planning for a secure system.

C. Identifying Sensitive Data

After establishing a clear understanding of the organization's function and how it is to complete its objectives, the first step in planning for and developing a secure system is to identify sensitive data. Recognize specific levels of security and that each may not be equally valuable. Identifying sensitive data and determining their value before the fact is a most difficult task for any organization. Unfortunately for most Management Information Systems (MIS) directors, management will more easily recognize the true value of data after the data have been disclosed to unauthorized individuals and are compromised.

D. Controlled Sharing of Information and Resources

Sharing of information and resources is increasingly possible through increased networking, communications and connectivity. As this data sharing increases, the problem of information

security increases exponentially. The problem for management is one of encouraging increased productivity through technology while maintaining what will probably be an increasingly insecure system.

Information as a corporate resource has the following features:

1. Information is a value added resource. Just as value is added to a product as it moves from raw material stage to final product, the same is true of conversion of data into information.
2. Information has a specific cost associated with it just as if it were acquired from market. Therefore, it is as essential to acquire and utilise information efficiently as it would be for any other resource.
3. Information is meant to be shared by all associated with the attainment of company's common goals and they, in turn, contribute to the corporate stock of information.
4. Information is exposed to a variety of security risks. Therefore, it has to be protected by implementing appropriate security policies and procedures without hindering its seamless flow across its users.
5. Most of the information is organisation specific and its value depends upon its use by the decision maker.
6. It has a high rate of obsolescence and thus, it must reach the user as early as possible. Redundant part of this resource must be weeded out of the total stock of information.

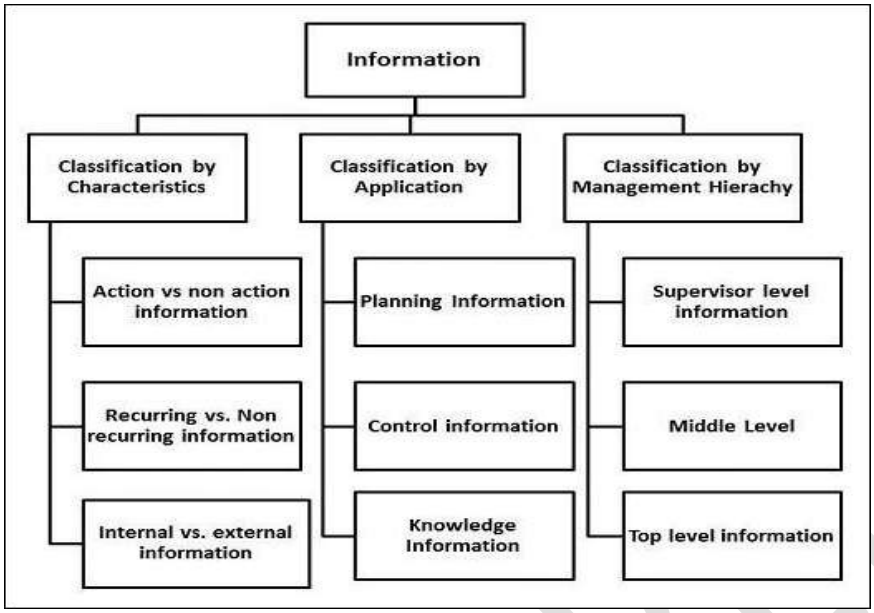
Types of information:

Jarvelin and Repo16 (1983) proposes three categories of information, namely:

- **Problem information:** information, which describes the structure, properties, and requirements of the problem at hand.
- **Domain information:** which consists of known facts, concepts, laws, and theories in the domain of the problem.
- **Problem-solving information:** this type of information describes:
  1. How problem should be seen and formulated
  2. What problem and domain information should be used
  3. How it should be used, in order to solve the current problem.

These three information categories represent three different dimensions and have different roles in addressing a problem.

Information can be classified in a number of ways and in this chapter, you will learn two of the most important ways to classify information.



Classification by Characteristic

Based on Anthony's classification of Management, information used in business for decision-making is generally categorized into three types:

- **Strategic Information** − Strategic information is concerned with long term policy decisions that defines the objectives of a business and checks how well these objectives are met. For example, acquiring a new plant, a new product, diversification of business etc, comes under strategic information.
- **Tactical Information** − Tactical information is concerned with the information needed for exercising control over business resources, like budgeting, quality control, service level, inventory level, productivity level etc.
- **Operational Information** − Operational information is concerned with plant/business level information and is used to ensure proper conduction of specific operational tasks as planned/intended. Various operator specific, machine specific and shift specific jobs for quality control checks comes under this category.

Classification by Application

In terms of applications, information can be categorized as:

- **Planning Information** − These are the information needed for establishing standard norms and specifications in an organization. This information is used in strategic, tactical, and operation planning of any activity. Examples of such information are time standards, design standards.

- **Control Information** − This information is needed for establishing control over all business activities through feedback mechanism. This information is used for controlling attainment, nature and utilization of important processes in a system. When such information reflects a deviation from the established standards, the system should induce a decision or an action leading to control.

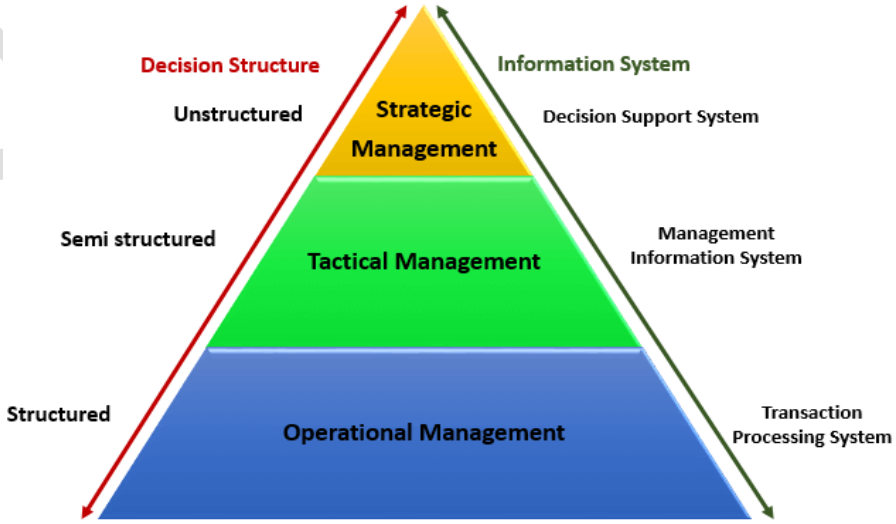
- **Knowledge Information** − Knowledge is defined as "information about information". Knowledge information is acquired through experience and learning, and collected from archival data and research studies.

- **Organizational Information** − Organizational information deals with an organization's environment, culture in the light of its objectives. Karl Weick's Organizational Information Theory emphasizes that an organization reduces its equivocality or uncertainty by collecting, managing and using these information prudently. This information is used by everybody in the organization; examples of such information are employee and payroll information.

- **Functional/Operational Information** − This is operation specific information. For example, daily schedules in a manufacturing plant that refers to the detailed assignment of jobs to machines or machines to operators. In a service oriented business, it would be the duty roster of various personnel. This information is mostly internal to the organization.

- **Database Information** − Database information construes large quantities of information that has multiple usage and application. Such information is stored, retrieved and managed to create databases. For example, material specification or supplier information is stored for multiple users.

Levels of management and information needs of management:



The term "**Levels of Management**' refers to a line of demarcation between various managerial positions in an organization. The number of levels in management increases when the size of the business and work force increases and vice versa. The level of management determines a chain of command, the amount of authority & status enjoyed by any managerial position. The levels of management can be classified in three broad categories:

1. **Top level / Administrative level**
2. **Middle level / Executory**
3. **Low level / Supervisory / Operative / First-line managers**

Managers at all these levels perform different functions. The role of managers at all the three levels is discussed by the following diagram illustrates the various levels of a typical organization.

LEVELS OF MANAGEMENT

1. **Top Level of Management:** It consists of board of directors, chief executive or managing director. The top management is the ultimate source of authority and it manages goals and policies for an enterprise. It devotes more time on planning and coordinating functions.

   The role of the top management can be summarized as follows -

   a. Top management lays down the objectives and broad policies of the enterprise.
   b. It issues necessary instructions for preparation of department budgets, procedures, schedules etc.
   c. It prepares strategic plans & policies for the enterprise.
   d. It appoints the executive for middle level i.e. departmental managers.
   e. It controls & coordinates the activities of all the departments.
   f. It is also responsible for maintaining a contact with the outside world.
   g. It provides guidance and direction.

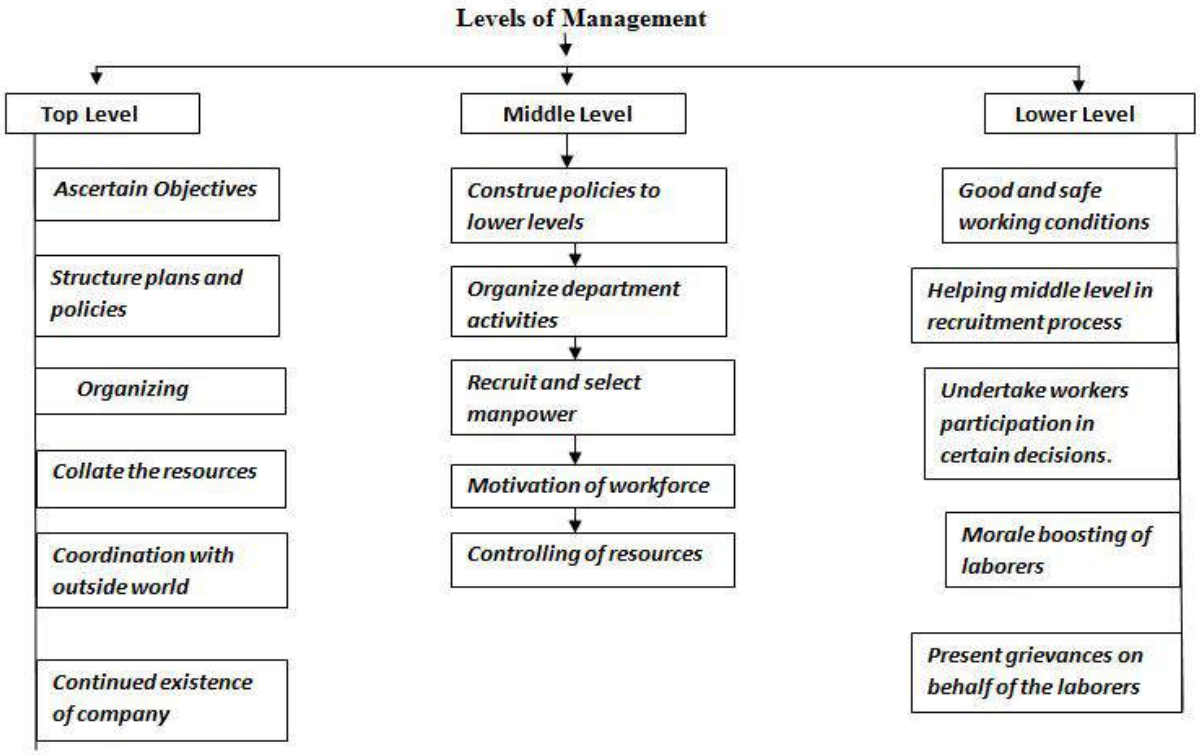
h. The top management is also responsible towards the shareholders for the performance of the enterprise.

2. **Middle Level of Management:** The branch managers and departmental managers constitute middle level. They are responsible to the top management for the functioning of their department. They devote more time to organizational and directional functions. In small organization, there is only one layer of middle level of management but in big enterprises, there may be senior and junior middle level management. Their role can be emphasized as -

   a) They execute the plans of the organization in accordance with the policies and directives of the top management.
   b) They make plans for the sub-units of the organization.
   c) They participate in employment & training of lower level management.
   d) They interpret and explain policies from top level management to lower level.
   e) They are responsible for coordinating the activities within the division or department.
   f) It also sends important reports and other important data to top level management.
   g) They evaluate performance of junior managers.
   h) They are also responsible for inspiring lower level managers towards better performance.

3. **Lower Level of Management:** Lower level is also known as supervisory / operative level of management. It consists of supervisors, foreman, section officers, superintendent etc. According to *R.C. Davis,* "Supervisory management refers to those executives whose work has to be largely with personal oversight and direction of operative employees". In other words, they are concerned with direction and controlling function of management. Their activities include -

   a) Assigning of jobs and tasks to various workers.
   b) They guide and instruct workers for day to day activities.
   c) They are responsible for the quality as well as quantity of production.
   d) They are also entrusted with the responsibility of maintaining good relation in the organization.
   e) They communicate workers problems, suggestions, and recommendatory appeals etc to the higher level and higher level goals and objectives to the workers.
   f) They help to solve the grievances of the workers.
   g) They supervise & guide the sub-ordinates.
   h) They are responsible for providing training to the workers.
   i) They arrange necessary materials, machines, tools etc for getting the things done.
   j) They prepare periodical reports about the performance of the workers.
   k) They ensure discipline in the enterprise.
   l) They motivate workers.
   m) They are the image builders of the enterprise because they are in direct contact with the workers.



Information needs of management:

Information processing beyond doubt is the dominant industry of the present century. Following factors states few common factors that reflect on the needs and objectives of the information processing:

- Increasing impact of information processing for organizational decision making.
- Dependency of services sector including banking, financial organization, health care, entertainment, tourism and travel, education and numerous others on information.
- Changing employment scene world over, shifting base from manual agricultural to machine-based manufacturing and other industry related jobs.
- Information revolution and the overall development scenario.
- Growth of IT industry and its strategic importance.
- Strong growth of information services fuelled by increasing competition and reduced product life cycle.
- Need for sustainable development and quality life.
- Improvement in communication and transportation brought in by use of information processing.
- Use of information processing in reduction of energy consumption, reduction in pollution and a better ecological balance in future.

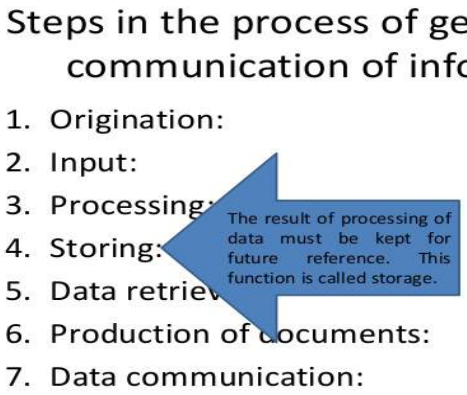
- Use of information processing in land record managements, legal delivery system, educational institutions, natural resource planning, customer relation management and so on.

In a nutshell:

- Information is needed to survive in the modern competitive world.
- Information is needed to create strong information systems and keep these systems up to date.

Process of generation of information:

Data processing can be defined as the processing of data to make it more usable and meaningful and thus converting into information. It covers all activities required for generating information from data.



Step1: Origination: The main source of records used in data processing is sales orders, purchase orders or employee time cards stored in magnetic tapes, disks and terminals.

Step 2: Input: The input of data stored on these source documents into the data processing system. The data records stored in secondary devices is now fed into the computer for processing.

Step3: Processing: Computer and other electronic devices are used for processing data. Data should be sorted and verified before processing. Processing involves calculation, comparison, filtering and modification of data according to user's requirements.

Step4: Storing: The result of processing of data must be kept for future reference. This function is called storage.

Step5: Data Retrieving: With the introduction of information technology users will be able to search and retrieve files records on-line with direct access devices.

Step6: Production of documents: Copies of documents and reports are prepared as an output of the information system.

Step7: Data Communication: On-line transmission of information is possible in electronic data processing system.

Quality of information:

Information is a vital resource for the success of any organization. Future of an organization lies in using and disseminating information wisely. Good quality information placed in right context in right time tells us about opportunities and problems well in advance.

Good quality information − Quality is a value that would vary according to the users and uses of the information.

According to Wang and Strong, following are the dimensions or elements of Information Quality:

- **Intrinsic** − Accuracy, Objectivity, Believability, Reputation
- **Contextual** − Relevancy, Value-Added, Timeliness, Completeness, Amount of information
- **Representational** − Interpretability, Format, Coherence, Compatibility
- **Accessibility** − Accessibility, Access security

Various authors propose various lists of metrics for assessing the quality of information. Let us generate a list of the most essential characteristic features for information quality:

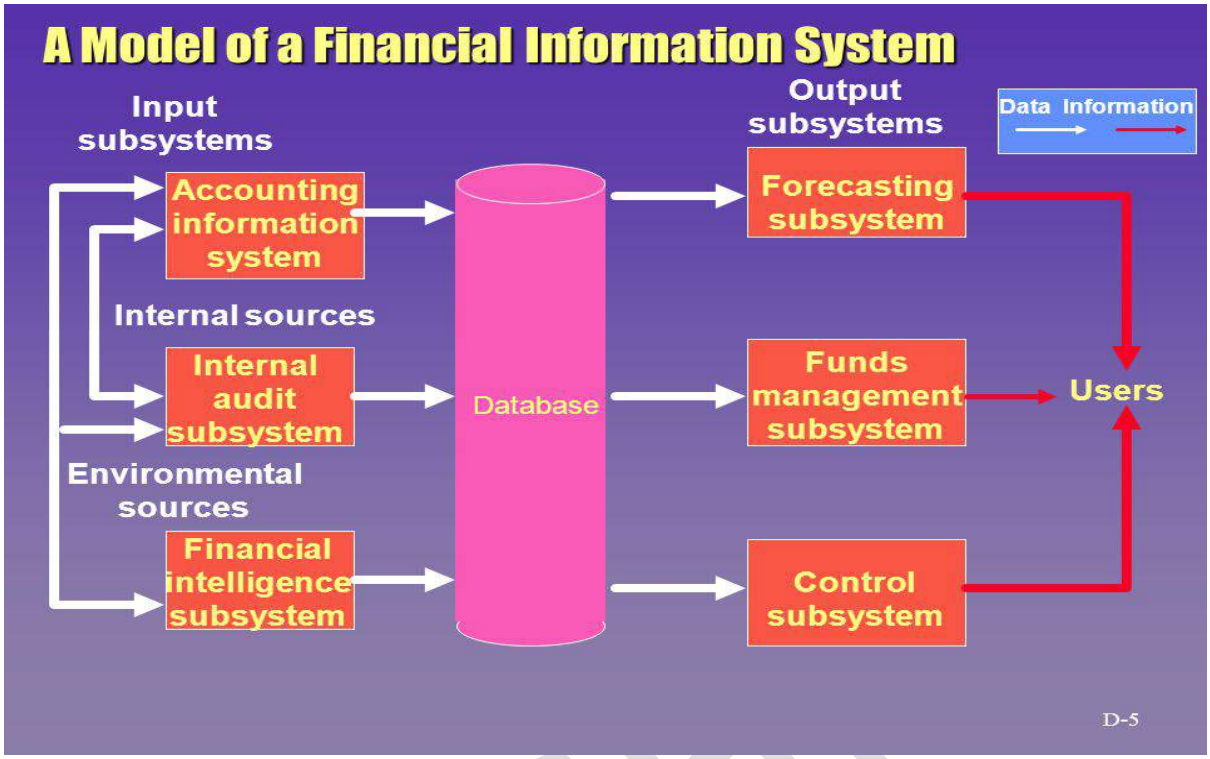
- **Reliability** − It should be verifiable and dependable.
- **Timely** − It must be current and it must reach the users well in time, so that important decisions can be made in time.
- **Relevant** − It should be current and valid information and it should reduce uncertainties.
- **Accurate** − It should be free of errors and mistakes, true, and not deceptive.
- **Sufficient** − It should be adequate in quantity, so that decisions can be made on its basis.
- **Unambiguous** − It should be expressed in clear terms. In other words, in should be comprehensive.
- **Complete** − It should meet all the needs in the current context.
- **Unbiased** − It should be impartial, free from any bias. In other words, it should have integrity.
- **Explicit** − It should not need any further explanation.
- **Comparable** − It should be of uniform collection, analysis, content, and format.
- **Reproducible** − It could be used by documented methods on the same data set to achieve a consistent result.

A System: A system is defined as a collection of related components that interact to perform a task in order to accomplish a goal. It can also be defined as set of detailed methods, procedures, and routines established or formulated to carry out a specific activity, perform a duty, or solve a problem. It is an organized, purposeful structure regarded as a whole and consisting of interrelated and interdependent elements (components, entities, factors, members, parts etc.). These elements continually influence one another (directly or indirectly) to maintain their activity and the existence of the system, in order to achieve the goal of the system. A system takes input, performs processing to give some desired outputs. A control element may sometimes be employed for the process to give some desired level of output and avoid or reduce the effect of interaction between the system and its environment.

An Information system: An information system is defined as any combination of information technology and people's activities using that technology to gather, process, store and disseminate information. In a broader sense, the term is frequently used to refer to the interaction between people, algorithmic processes, data and technology. In this sense, the term is used to refer not only to the information and communication technology (ICT) an organization uses, but also to the way in which people interact with this technology in support of business processes.

Financial Information System Is a system that accumulates and analyzes financial data in order to make good financial management decisions in running the business. Financial information systems are the software programs that help businesses manage their money. Systems can be set up to keep track of your banking, accounts payable and accounts receivable; to generate standard financial reports such as a profit-and-loss statement; and to report the information in various formats. It's important to choose a system that suits your business needs. The basic objective of the financial information system is to meet the firm's financial obligations as they come due, using the minimal amount of financial resources consistent with an established margin of safety. Outputs generated by the system include accounting reports, operating and capital budgets, working capital reports, cash flow forecast, and various what - if analysis reports. The evaluation of financial data may be performed through ratio analysis, trend evaluation, and financial planning modeling. Financial planning and forecasting are facilitated if used in conjunction with a DECISION SUPPORT SYSTEM (DSS)

Elements of a financial information system: The elements of a financial information system are: Input: these are the devices and the process of feeding the system with the necessary data to be recorded and or processed by the system.



Accounting Information Systems: The financial function of the enterprise consists in taking stock of the flows of money and other assets into and out of an organization, ensuring that its available resources are properly used and that the organization is financially fit. The components of the accounting system include:

1. Accounts receivable records
2. Accounts payable records
3. Payroll records
4. Inventory control records
5. General ledgers

Internal Auditing: The ***audit*** function provides an independent appraisal of an organization's accounting, financial, and operational procedures and information. All large firms have ***internal auditors***, answerable only to the audit committee of the board of directors. The staff of the chief financial officer of the company performs financial and operational audits. During a ***financial audit***, an appraisal is made of the reliability and integrity of the company's financial information and of the means used to process it. An ***operational audit*** is an appraisal of how well management utilizes company resources and how well corporate plans are being carried out.

Finance intelligence: It is a combination of art as well as science. Finance intelligence talks about empowering employees with basic finance knowledge so that they can make a sound business decision. **Finance intelligence is a skill set which every senior executive needs to have**. Finance intelligence help employees' right question for a business decision.

Financial information systems rely on external sources, such as on-line databases and custom produced reports, particularly in the areas of financial forecasting and funds management. The essential functions that financial information systems perform include:

1. Financial forecasting and planning
2. Financial control
3. Funds management

Financial Forecasting: Financial forecasting is the process of predicting the inflows of funds into the company and the outflows of funds from it for a long term into the future. Outflows of funds must be balanced over the long term with the inflows. With the globalization of business, the function of financial forecasting has become more complex, since the activities in multiple national markets have to be consolidated, taking into consideration the vagaries of multiple national currencies. Scenario analysis is frequently employed in order to prepare the firm for various contingencies.

Financial forecasts are based on computerized models known as cash-flow models. They range from rather simple spreadsheet templates to sophisticated models developed for the given industry and customized for the firm or, in the case of large corporations to specify modeling of their financial operations. Financial forecasting serves to identify the need for funds and their sources.

Financial Control: The primary tools of financial control are budgets. A ***budget*** specifies the resources committed to a plan for a given project or time period. Fixed budgets are independent of the level of activity of the unit for which the budget is drawn up. Flexible budgets commit resources depending on the level of activity.

Spreadsheet programs are the main budgeting tools. Spreadsheets are the personal productivity tools in use today in budget preparation.

In the systems-theoretic view, budgets serve as the standard against which managers can compare the actual results by using information systems. Performance reports are used to monitor budgets of various managerial levels. A performance report states the actual financial results achieved by the unit and compares them with the planned results.

Along with budgets and performance reports, financial control employs a number of financial ratios indicating the performance of the business unit. A widely employed financial ratio is ***return on investment*** (ROI). ROS shows how well a business unit uses its resources. Its value is obtained by dividing the earnings of the business unit by its total assets.

Funds Management: Financial information systems help to manage the organization's liquid assets, such as cash or securities, for high yields with the lowest degree of loss risk. Some firms deploy computerized systems to manage their securities portfolios and automatically generate buy or sell orders.

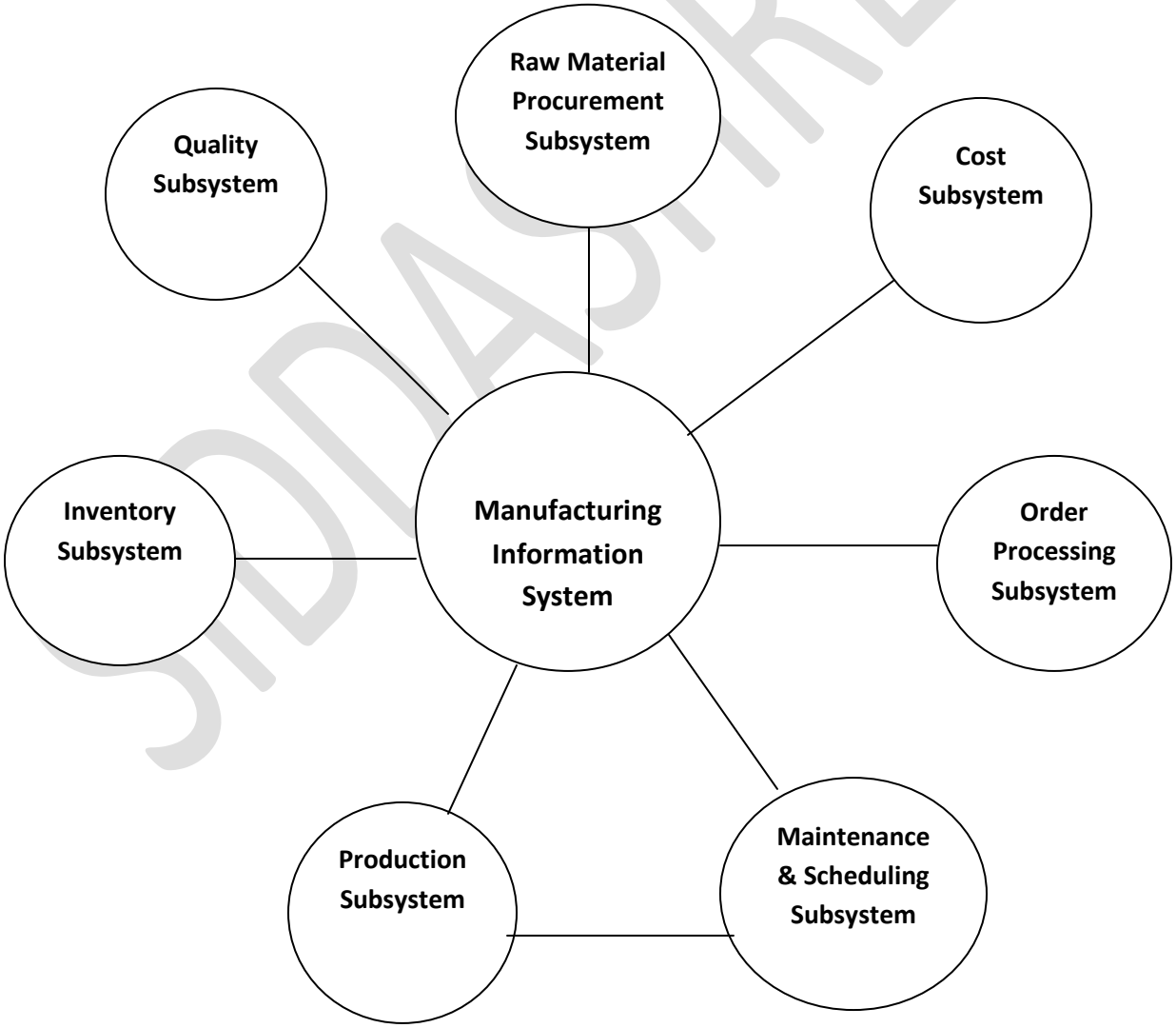
Manufacturing Information System

The information needs were and are always there. Information systems used to exist when comput erized environments were not available. Automation has enhanced the availability of information.

Every industry has its own departmental structure which gives rise to a different set of sub-systems as part of the information system. Here we would consider the sub-systems of a manufacturing system only.

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. The term manufacturing information system actually applies to both manufacturing and service environments.

Following are the sub-systems of an information system:



Raw Material Procurement Sub-System:

This is the commencement of the manufacturing process. Some might think of procurement as a simple purchasing process like any other commodity but the spirit of having an all-embracing raw material procurement sub-system is simply more than that.

Parameters of Raw-material Procurement:

Like with every system, there has to be a list of minimum specifications which every system or subsystem has to cover. Purchasing logistics of an entity critically affect time to market and other quality related issues. Issues like selection of suppliers, choice between local purchase and import and delivery time taken by the supplier.

All these concerns are met and dealt with in the purchase subsystem. The complexity of the purchase subsystem should depend on types of raw materials required, number of suppliers to deal with and complexity of the terms of purchase agreements for long term. With higher customer expectations, every organization wants to efficiently manage its suppliers and other internal processes. Supply chain management spans all movement and storage of raw materials, work-in process inventory, and finished goods from point-of-origin to point-of-consumption. A procurement system should help in improving the supply chain of the organization.

Inventory Sub System:

Inventory subsystem focuses on maintaining records and movements on inventory levels and usage. This control of inventory is critical to the organization since money lock-in of raw materials purchase represents substantial investment. Timely production of finished goods require availability of right quantity of material, maintenance of right stock levels, determination of lead times and flex times and exchange of information with supplier at the right time.

An inventory subsystem helps us to address these issues. Inventory subsystems are critical where the organization is following Just in Time approach a philosophy which encourages zero tolerance for stock levels and placing orders exactly when they are needed for manufacturing. Proper logistic management is important for the timely and quality production.

Various factors which can play critical role are:

- Who to purchase from supplier selection
- When to purchase time of delivery or raw materials
- How much to purchase Ideal stock levels
- An efficient inventory subsystem helps us to deal with these issues in a time saving manner

Production Sub System:

It can be seen as the most critical part of the entire manufacturing sub system. Basically it tracks the flow of the job through the entire production process.

It also records change in form of goods or transfer of goods from one place to the other.

Maintenance & Scheduling Sub System:

For efficient production, the machines should be timely available. Many a times, the machine is under repair and is not available to be used for production. Without this subsystem, there is a possibility of customer's orders not being met on time. Certain issues that can be very important are

- Deciding delivery time in accordance with availability of machines.
- Any foreseen machine-down-time.
- Any major overhauling /tuning /replacement expected may result in unavailability of machine.
- An over hauling schedule shouldbe kept so that the production of finished goods is not halted.
- Avoiding duplication of jobs for the same machine

Quality Sub system:

This subsystem ensures the production made and end product being delivered to the customer is conforming the quality standards set by the company. Quality covers aspects for the organization like better quality raw materials and what is being purchased is according to organization's standards and improved finished goods in accordance with the customer specification

The question now arises is why do we need a quality sub-system?

It is defined and demanded by customer, it has to be achieved by management, it is a firm wide responsibility and these subsystems provide the firm's managers with information that reveals the extent to which the firm's products are achieving the quality goals.

Marketing Information System

Definition: 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.

Marketing Information System (MIS) has been defined as:

Philip Kotler: "A marketing information system is a continuing and interacting system of people, equipment's, and procedures to gather, sort, analyze, evaluate, and distribute the pertinent, timely, and accurate information for use by marketing decision-makers to improve their marketing planning, implementation, and control." Philip Kotler gives alternative definition, such as: "A marketing information system (MIS) consists of people, equipment's, and procedures to gather,

sort, analyze, evaluate, and distribute the needed, timely, and accurate information to marketing decision makers."

We can say: Marketing Information System (MIS) is a permanent arrangement (system or setup) for provision of regular availability of relevant, reliable, adequate, and timely information for making marketing decisions.

Finally, let us define the term more comprehensively: MIS concerns with setting and maintaining of a permanent system (network) to avail necessary information on regular basis. The system consists of people, equipment's, facilities, and procedures directed to gather, analyze, evaluate, update, distribute, and preserve the information to assist marketing decision-making, i.e., analyzing, planning, implementing, and controlling of marketing activities.

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:

1. **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 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.

2. **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.

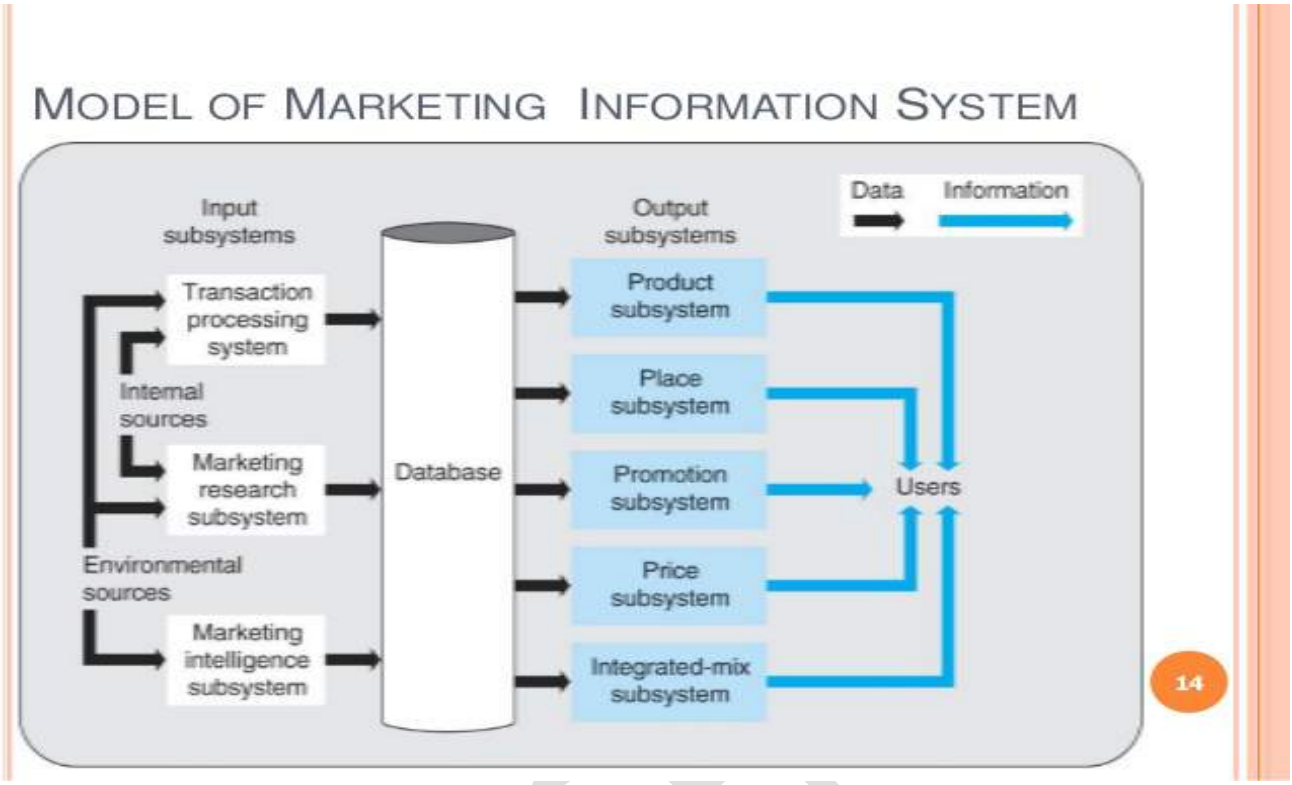
3. **Marketing Research**: The Marketing Research is the systematic collection, organization, analysis and interpretation of the primary or the secondary data to find out the solutions to the marketing problems.Several Companies conduct marketing research to analyze the marketing environment comprising 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.

4. **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.



Marketing activities are directed toward planning, promoting, and selling goods and services to satisfy the needs of customers and the objectives of the organization.

Marketing information systems support decision making regarding the marketing mix. These include:

1. Product
2. Price
3. Place
4. Promotion

Figure illustrates the structure of the entire marketing information system. In order to support decision making on the marketing mix, a marketing information system draws on several sources of data and information.

Sources of Data and Information for Marketing: Boundary-Spanning and Transaction Processing Subsystems

A marketing information system relies on external information to a far greater degree than other organizational information systems. It includes two subsystems designed for boundary spanning - bringing into the firm data and information about the marketplace.

The objective of **marketing research** is to collect data on the actual customers and the potential customers, known as prospects. The identification of the needs of the customer is a fundamental starting point for total quality management (TQM). Electronic commerce on the WEB makes it easy to compile statistics on actual buyer behaviour.

Marketing research software supports statistical analysis of data. It enables the firm to correlate buyer behaviour with very detailed geographic variables, demographic variables, and psychographic variables.

Marketing (competitive) intelligence is responsible for the gathering and interpretation of data regarding the firm's competitors, and for the dissemination of the competitive information to the appropriate users. Most of the competitor information comes from corporate annual reports, media-tracking services, and from reports purchased from external providers, including on-line database services. The Internet has become a major source of competitive intelligence.

Marketing Mix Subsystems

The marketing mix subsystems support decision making regarding product introduction, pricing, promotion (advertising and personal selling), and distribution. These decisions are integrated into the sales forecast and marketing plans against which the ongoing sales results are compared.

Marketing mix subsystems include:

1. Product subsystem
2. Place subsystem
3. Promotion subsystem
4. Price subsystem
5. Sales forecasting

Product Subsystem

The product subsystem helps to plan the introduction of new products. Continually bringing new products to market is vital in today's competitive environment of rapid change. The product subsystem should support balancing the degree of risk in the overall new-product portfolio, with more aggressive competitors assuming higher degrees of risk for a potentially higher payoff.

Although decisions regarding the introduction of new products are unstructured, information systems support this process in several ways:

1. Professional support systems assist designers in their knowledge work
2. DSSs are used to evaluate proposed new products
3. With a DSS, a marketing manager can score the desirability of a new product.
4. Electronic meeting systems help bring the expertise of people dispersed in space and time to bear on the problem

5. Information derived from marketing intelligence and research is vital in evaluating new product ideas.

Place Subsystem

The place subsystem assists the decision makers in making the product available to the customer at the right place at the right time. The place subsystem helps plan the distribution channels for the product and track their performance.

The use of information technology has dramatically increased the availability of information on product movement in the distribution channel. Examples include:

1. Bar-coded Universal Product Code (UPC)
2. Point-of-sale (POS) scanning
3. Electronic data interchange (EDI)
4. Supports just-in-time product delivery and customized delivery

Promotion Subsystem

The promotion subsystem is often the most elaborate in the marketing information system, since it supports both personal selling and advertising. Media selection packages assist in selecting a mix of avenues to persuade the potential purchaser, including direct mail, television, print media, and the electronic media such as the Internet and the WEB in particular. The effectiveness of the selected media mix is monitored and its composition is continually adjusted.

Database marketing relies on the accumulation and use of extensive databases to segment potential customers and reach them with personalized promotional information.

The role of ***telemarketing***, marketing over the telephone, has increased. Telemarketing calls are well supported by information technology.

Sales management is thoroughly supported with information technology. Customer profitability analysis helps identify high-profit and high-growth customers and target marketing efforts in order to retain and develop these accounts.

Sales force automation involves equipping salespeople with portable computers tied into the corporate information systems. This gives the salespeople instantaneous access to information and frees them from the reporting paperwork. This increases selling time and the level of performance. Access to corporate databases is sometimes accompanied by access to corporate expertise; either by being able to contact the experts or by using expert systems that help specifies the product meeting customer requirements.

Price Subsystem

Pricing decisions find a degree of support from DSSs and access to databases that contain industry prices. These highly unstructured decisions are made in pursuit of the companies pricing

objectives. General strategies range from profit maximization to forgoing a part of the profit in order to increase a market share.

Information systems provide an opportunity to finely segment customer groups, and charge different prices depending on the combination of products and services provided, as well as the circumstances of the sale transaction.

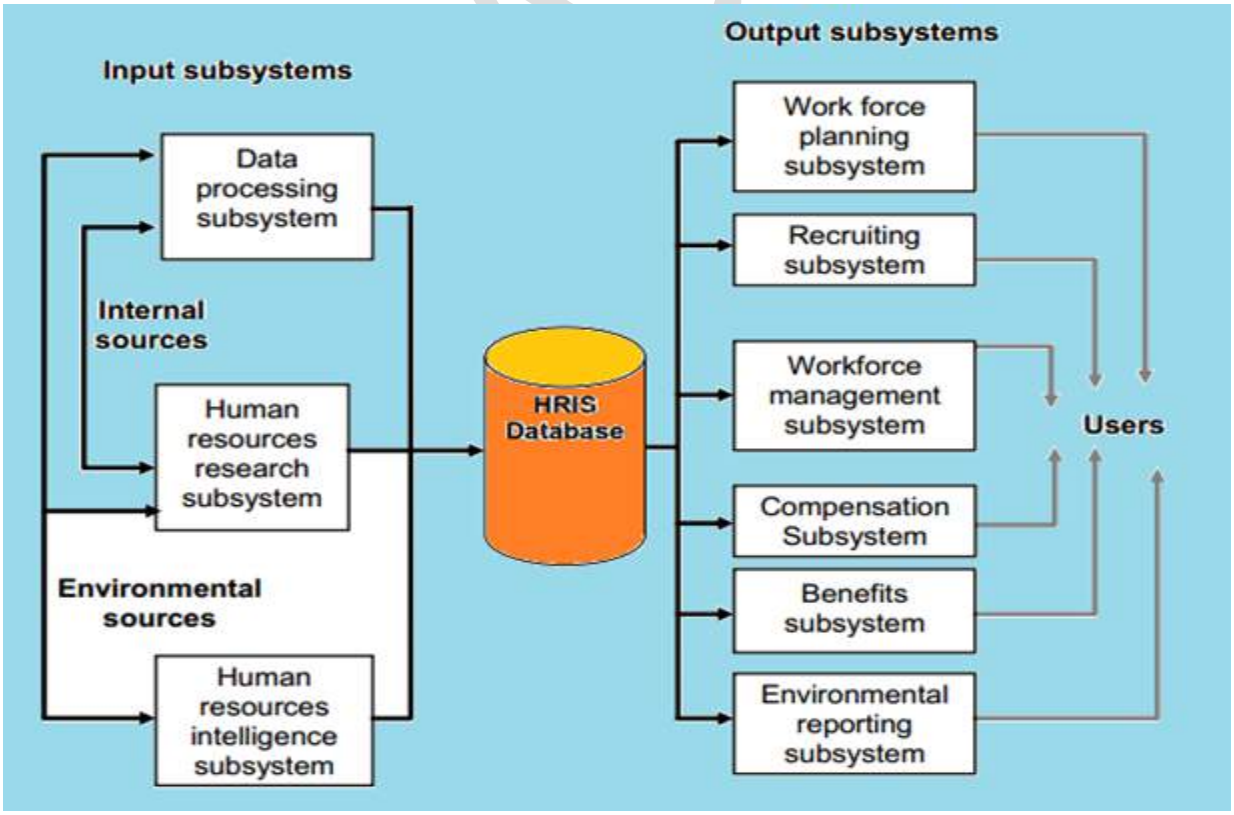
Sales Forecasting

Based on the planned marketing mix and outstanding orders, sales are forecast and a full marketing plan is developed. ***Sale forecasting***is an area where any quantitative methods employed must be tempered with human insight and experience. The actual sales will depend to a large degree on the dynamics of the environment.

Qualitative techniques are generally used for ***environmental forecasting*** - an attempt to predict the social, economic, legal, and technological environment in which the company will try to realize its plans. Sales forecasting uses numerous techniques, which include:

1. Group decision making techniques are used to elicit broad expert opinion
2. Scenario analysis in which each scenario in this process is a plausible future environment
3. Extrapolation of trends and cycles through a time-series analysis.

Human Resource Information Systems:



A human resource information system (HRIS) supports the human resources function of an organization with information. The name of this function reflects the recognition that people who work in a firm are frequently its most valuable resources. The complexity of human resource management has grown immensely over recent years, primary due to the need to conform with new laws and regulations.

A HRIS has to ensure the appropriate degree of access to a great variety of internal stakeholders, including:

1. The employees of the Human Resources department in performance of their duties
2. All the employees of the firm wishing ti inspect their own records
3. All the employees of the firm seeking information regarding open positions or available benefit plans
4. Employees availing themselves of the computer-assisted training and evaluation opportunities
5. Managers throughout the firm in the process of evaluating their subordinates and making personnel decisions
6. Corporate executives involved in tactical and strategic planning and control

Transaction Processing Subsystems and Databases of Human Resource Information Systems

At the heart of HRIS are its databases, which are in some cases integrated into a single human resource database. The record of each employee in a sophisticated employee database may contain 150 to 200 data items, including the personal data, educational history and skills, occupational background, and the history of occupied positions, salary, and performance in the firm. Richer multimedia databases are not assembled by some firms in order to facilitate fast formation of compatible teams of people with complementary skills.

Other HRIS databases include:

1. Applicant databases
2. Position inventory
3. Skills inventory
4. Benefit databases
5. External databases

Information Subsystems for Human Resource Management

The information subsystems of HRIS reflect the flow of human resources through the firm, from planning and recruitment to termination. A sophisticated HRIS includes the following subsystems:

1. Human resource planning
2. Recruiting and workforce management

3. Compensation and benefits
4. Government reporting and labour relations support

Human Resource Planning

To identify the human resources necessary to accomplish the long-term objectives of a firm, we need to project the skills, knowledge, and experience of the future employees.

Recruiting and Workforce Management

Based on the long-term resource plan, a recruitment plan is developed. The plan lists the currently unfilled positions and those expected to become vacant due to turnover.

The life-cycle transitions of the firm's workforce - hiring, promotion and transfer, and termination - have to be supported with the appropriate information system components.

Compensation and Benefits

Two principal external stakeholders have an abiding interest in the human resource policies of organizations. These are:

1. Various levels of government
2. Labor unions

Unit III

Information Systems

Defining Information Systems

Almost all programs in business require students to take a course in something called *information systems*. But what exactly does that term mean? Let's take a look at some of the more popular definitions, first from Wikipedia and then from a couple of textbooks:

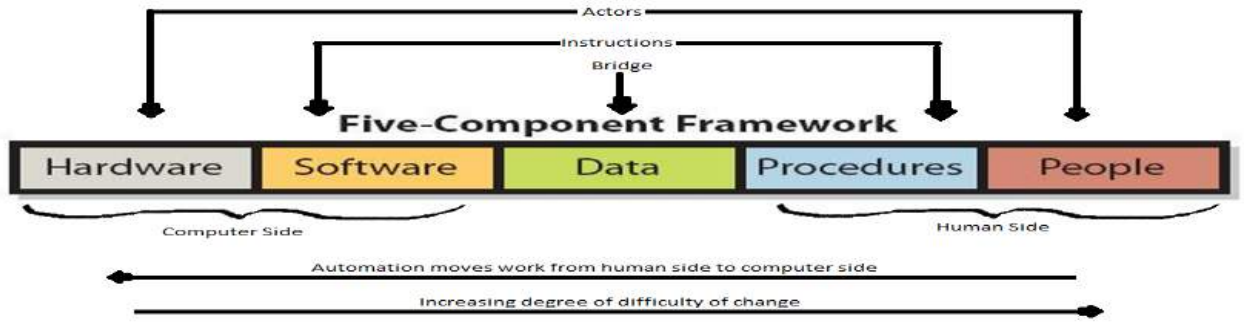
- "Information systems (IS) is the study of complementary networks of hardware and software that people and organizations use to collect, filter, process, create, and distribute data."
- "Information systems are combinations of hardware, software, and telecommunications networks that people build and use to collect, create, and distribute useful data, typically in organizational settings."
- "Information systems are interrelated components working together to collect, process, store, and disseminate information to support decision making, coordination, control, analysis, and viualization in an organization."

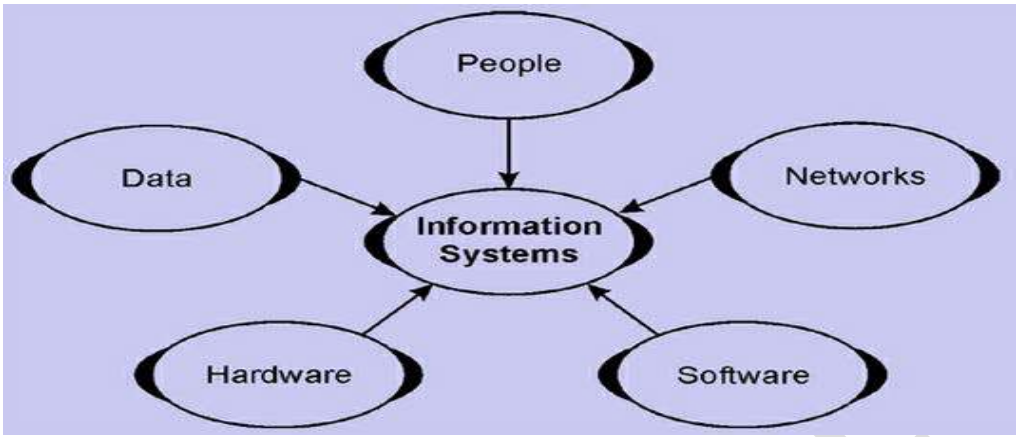
As you can see, these definitions focus on two different ways of describing information systems: the components that make up an information system and the role that those components play in an organization. Let's take a look at each of these.

THE COMPONENTS OF INFORMATION SYSTEMS:

A system is a set of components (subsystems) that operate together to achieve certain objectives. The objectives of a system are realized in its outputs. An information system is a system that accepts data resources as input and processes them into information products as output.

An information system depends on the resources of people (end users and IS specialists), hardware (machines and media), software (programs and procedures), data (data and knowledge basis), and networks (communications media and network support) to perform input, processing, output, storage, and control activities that convert data resources into information products.





This information system model highlights the relationships among the components and activities of information systems. It provides a framework that emphasizes four major concepts that can be applied to all types of information systems:

- People, hardware, software, data, and networks are the five basic resources of information systems.
- People resources include end users and IS specialists, hardware resources consist of machines and media, software resources include both programs and procedures, data resources can include data and knowledge bases, and network resources include communications media and networks.
- Data resources are transformed by information processing activities into a variety of information products for end users.
- Information processing consists of input, processing, output, storage, and control activities.

Information System Resources

1. **People Resources**: People are required for the operation of all information systems. These people resources include end users and ARE specialists.
   - **End users** (also called users or clients) are people who use an information system or the information it produces. They can be accountants, salespersons, engineers, clerks, customers, or managers. Most of us are information system end users.
   - **IS Specialists** are people who develop and operate information systems. They include systems analysts, programmers, computer operators, and other managerial technical, and clerical IS personnel. Briefly, systems analysts design information systems based on the information requirements of end uses, programmers prepare computer programs based on the specifications of systems analysts, and computer operators operate large computer systems.

2. **Hardware Resources:** The concept of Hardware resources includes all physical devices and materials used in information processing. Specially, it includes not only machines, such as computers and other equipment, but also all data media, that is, all tangible objects on which

data is recorded, from sheets of paper to magnetic disks. Example of hardware in computer-based information systems are:

- **Computer systems,** which consist of central processing units containing microprocessors, and variety of interconnected peripheral devices. Examples are microcomputer systems, midrange computer systems, and large mainframe computer systems.
- **Computer peripherals,** which are devices such as a keyboard or electronic mouse for input of data and commands, a video screen or printer for output of information, and magnetic or optical disks for storage of data resources.

3. **Software Resources:** The concept of Software Resources includes all sets of information processing instructions. This generic concept of software includes not only the sets of operating instructions called programs, which direct and control computer hardware, but also the sets of information processing instructions needed by people, called procedures.

   It is important to understand that even information systems that don't use computers have a software resource component. This is true even for the information systems of ancient times, or the manual and machine-supported information systems still used in the world today. They all require software resources in the form of information processing instructions and procedures in order to properly capture, process, and disseminate information to their users.

   The following are the examples of software resources:

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

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

   Data can take many forms, including traditional alphanumeric data, composed of numbers and alphabetical and other characters that describe business transactions and other events and entities. Text data, consisting of sentences and paragraphs used in written communications; image data, such as graphic shapes and figures; and audio data, the human voice and other sounds, are also important forms of data.
   The data resources of information systems are typically organized into:

   - Database that hold processed and organized data.

- Knowledge bases that hold knowledge in variety of forms such as facts, rules, and case examples about successful business practices.

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

5. **Network Resources:** Telecommunications networks like the Internet, intranets, and extranets have become essential to the successful operations of all types of organizations and their computer-based information systems. Telecommunications networks consist of computers, communications processors, and other devices interconnected by communications media and controlled by communications software. The concept of Network resources emphasizes that communications networks are a fundamental resource component of all information systems. Network resources include:
   - **Communication media,** Examples include twisted pair wire, coaxial cable, fiber-optic cable, microwave systems, and communication satellite systems.
   - **Network Support,** This generic category includes all of the people, hardware, software, and data resources that directly support the operation and use of a communications network. Examples include communications control software such as network operating systems and Internet packages.

   In summary, these five components together make up the five component framework, which are the five fundamental **components of an information system**. First you will need the hardware in order to start off your system. Then you must use the software in order to run you hardware. After you have set up your hardware and loaded up the software to run it, you will need data to input into your hardware. Once you have your data ready you will need procedures set in play to properly store your data within the system, and last you will need people in order to put in the data and keep the system up and running properly at all times. As you can see, you will need every component in order to ensure that you have a functional running information system.

Information System role in Business systems:

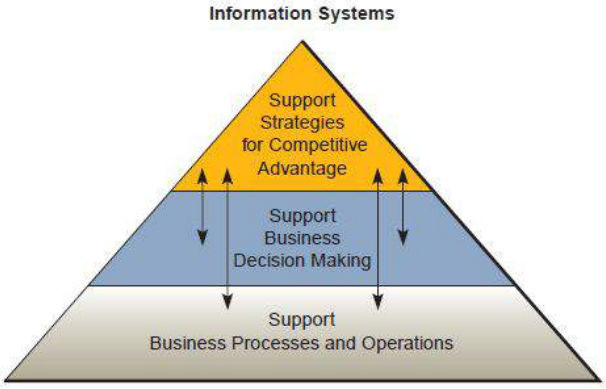
Information systems play a vital role in an organizations' overall performance. They provide man y advantages to their users which range fromsimple transaction processing at the operational level to difficult tasks such as making important and competitive decisions at the strategic level of the organization.

Several roles played by information systems in an organisation can be identified but O'Brien and Marakas (2008) have identified three fundamental roles played by information systems in businesses. These are;

- Information systems support business processes and operations.

- Secondly, they support decision making of employees and managers and
- Lastly, they support strategies for competitive advantage. These three fundamental roles encompass any other roles played by information systems in an organisation.

The Fundamental Roles of IS in Business



- Support of business processes and operations: most retail stores now use it.
- computer-based information systems to help their employees record customer purchases, keep track of inventory, pay employees, buy new merchandise, and evaluate sales trends.
- Support of decision making by employees and managers: Information systems also help store managers and other business professionals make better decisions.
- Support of strategies for competitive advantage: gaining a strategic advantage over competitors requires the innovative application of information technologies(e-commerce Web site).

CHANGING THE ROLE OF INFORMATION SYSTEMS:

Now that we have explored the different components of information systems, we need to turn our attention to the role that information systems play in an organization. So far we have looked at what the components of an information system are, but what do these components actually do for an organization? From our definitions above, we see that these components collect, store, organize, and distribute data throughout the organization. In fact, we might say that one of the roles of information systems is to take data and turn it into information, and then transform that into organizational knowledge. As technology has developed, this role has evolved into the backbone of the organization. To get a full appreciation of the role information systems play, we will review how they have changed over the years.

IBM 704 Mainframe (Copyright: Lawrence Livermore National Laboratory)

The Mainframe Era: From the late 1950s through the 1960s, computers were seen as a way to more efficiently do calculations. These first business computers were room-sized monsters, with several refrigerator-sized machines linked together. The primary work of these devices was to organize and store large volumes of information that were tedious to manage by hand. Only large businesses, universities, and government agencies could afford them, and they took a crew of specialized personnel and specialized facilities to maintain. These devices served dozens to hundreds of users at a time through a process called time-sharing. Typical functions included scientific calculations and accounting, under the broader umbrella of "data processing."

Registered trademark of International Business Machines

In the late 1960s, the Manufacturing Resources Planning (MRP) systems were introduced. This software, running on a mainframe computer, gave companies the ability to manage the manufacturing process, making it more efficient. From tracking inventory to creating bills of materials to scheduling production, the MRP systems (and later the MRP II systems) gave more businesses a reason to want to integrate computing into their processes. IBM became the dominant mainframe company. Nicknamed "Big Blue," the company became synonymous with business computing. Continued improvement in software and the availability of cheaper hardware eventually brought mainframe computers (and their little sibling, the minicomputer) into most large businesses.

The PC Revolution: In 1975, the first microcomputer was announced on the cover of *Popular Mechanics*: the Altair 8800. Its immediate popularity sparked the imagination of entrepreneurs everywhere, and there were quickly dozens of companies making these "personal computers." Though at first just a niche product for computer hobbyists, improvements in usability and the availability of practical software led to growing sales. The most prominent of these early personal

computer makers was a little company known as Apple Computer, headed by Steve Jobs and Steve Wozniak, with the hugely successful "Apple II." Not wanting to be left out of the revolution, in 1981 IBM (teaming with a little company called Microsoft for their operating-system software) hurriedly released their own version of the personal computer, simply called the "PC." Businesses, who had used IBM mainframes for years to run their businesses, finally had the permission they needed to bring personal computers into their companies, and the IBM PC took off. The IBM PC was named *Time* magazine's "Man of the Year" for 1982.

Because of the IBM PC's open architecture, it was easy for other companies to copy, or "clone" it. During the 1980s, many new computer companies sprang up, offering less expensive versions of the PC. This drove prices down and spurred innovation. Microsoft developed its Windows operating system and made the PC even easier to use. Common uses for the PC during this period included word processing, spreadsheets, and databases. These early PCs were not connected to any sort of network; for the most part they stood alone as islands of innovation within the larger organization.

Client-Server: In the mid-1980s, businesses began to see the need to connect their computers together as a way to collaborate and share resources. This networking architecture was referred to as "client-server" because users would log in to the local area network (LAN) from their PC (the "client") by connecting to a powerful computer called a "server," which would then grant them rights to different resources on the network (such as shared file areas and a printer). Software companies began developing applications that allowed multiple users to access the same data at the same time. This evolved into software applications for communicating, with the first real popular use of electronic mail appearing at this time.

Registered trademark of SAP

This networking and data sharing all stayed within the confines of each business, for the most part. While there was sharing of electronic data between companies, this was a very specialized function. Computers were now seen as tools to collaborate internally, within an organization. In fact, these networks of computers were becoming so powerful that they were replacing many of the functions previously performed by the larger mainframe computers at a fraction of the cost. It was during this era that the first Enterprise Resource Planning (ERP) systems were developed and run on the client-server architecture. An ERP system is a software application with a centralized database that can be used to run a company's entire business. With separate modules for accounting, finance, inventory, human resources, and many, many more, ERP systems, with Germany's SAP leading the way, represented the state of the art in information systems integration. We will discuss ERP systems as part of the chapter on process (chapter 9).

The World Wide Web and E-Commerce: First invented in 1969, the Internet was confined to use by universities, government agencies, and researchers for many years. Its rather arcane commands and user applications made it unsuitable for mainstream use in business. One exception to this was the ability to expand electronic mail outside the confines of a single organization. While the first e-mail messages on the Internet were sent in the early 1970s, companies who wanted to expand their LAN-based e-mail started hooking up to the Internet in the 1980s. Companies began connecting their internal networks to the Internet in order to allow communication between their employees and employees at other companies. It was with these early Internet connections that the computer truly began to evolve from a computational device to a communications device.

In 1989, Tim Berners-Lee developed a simpler way for researchers to share information over the network at CERN laboratories, a concept he called the World Wide Web.[4] This invention became the launching point of the growth of the Internet as a way for businesses to share information about themselves. As web browsers and Internet connections became the norm, companies rushed to grab domain names and create websites.

Registered trademark of Amazon Technologies, Inc.

In 1991, the National Science Foundation, which governed how the Internet was used, lifted restrictions on its commercial use. The year 1994 saw the establishment of both eBay and Amazon.com, two true pioneers in the use of the new digital marketplace. A mad rush of investment in Internet-based businesses led to the dot-com boom through the late 1990s, and then the dot-com bust in 2000. While much can be learned from the speculation and crazy economic theories espoused during that bubble, one important outcome for businesses was that thousands of miles of Internet connections were laid around the world during that time. The world became truly "wired" heading into the new millenium, ushering in the era of globalization.

As it became more expected for companies to be connected to the Internet, the digital world also became a more dangerous place. Computer viruses and worms, once slowly propagated through the sharing of computer disks, could now grow with tremendous speed via the Internet. Software written for a disconnected world found it very difficult to defend against these sorts of threats. A whole new industry of computer and Internet security arose. We will study information security in chapter 6.

Web 2.0: As the world recovered from the dot-com bust, the use of technology in business continued to evolve at a frantic pace. Websites became interactive; instead of just visiting a site to find out about a business and purchase its products, customers wanted to be able to customize their experience and interact with the business. This new type of interactive website, where you did not have to know how to create a web page or do any programming in order to put information online, became known as web 2.0. Web 2.0 is exemplified by blogging, social

networking, and interactive comments being available on many websites. This new web-2.0 world, in which online interaction became expected, had a big impact on many businesses and even whole industries. Some industries, such as bookstores, found themselves relegated to a niche status. Others, such as video rental chains and travel agencies, simply began going out of business as they were replaced by online technologies. This process of technology replacing a middleman in a transaction is called disintermediation.

As the world became more connected, new questions arose. Should access to the Internet be considered a right? Can I copy a song that I downloaded from the Internet? How can I keep information that I have put on a website private? What information is acceptable to collect from children? Technology moved so fast that policymakers did not have enough time to enact appropriate laws, making for a Wild West–type atmosphere. Ethical issues surrounding information systems will be covered in chapter 12.

The Post-PC World: After thirty years as the primary computing device used in most businesses, sales of the PC are now beginning to decline as sales of tablets and smartphones are taking off. Just as the mainframe before it, the PC will continue to play a key role in business, but will no longer be the primary way that people interact and do business. The limited storage and processing power of these devices is being offset by a move to "cloud" computing, which allows for storage, sharing, and backup of information on a massive scale. This will require new rounds of thinking and innovation on the part of businesses as technology continues to advance.

The Eras of Business Computing

Era	Hardware	Operating System	Applications
Mainframe (1970s)	Terminals connected to mainframe computer.	Time-sharing (TSO) on MVS	Custom-written MRP software
PC (mid-1980s)	IBM PC or compatible. Sometimes connected to mainframe computer via expansion card.	MS-DOS	WordPerfect, Lotus 1-2-3
Client-Server (late 80s to early 90s)	IBM PC "clone" on a Novell Network.	Windows for Workgroups	Microsoft Word, Microsoft Excel

World Wide Web (mid-90s to early 2000s)	IBM PC "clone" connected to company intranet.	Windows XP	Microsoft Office, Internet Explorer
Web 2.0 (mid-2000s to present)	Laptop connected to company Wi-Fi.	Windows 7	Microsoft Office, Firefox
Post-PC (today and beyond)	Apple iPad	iOS	Mobile-friendly websites, mobile apps

Can Information Systems Bring Competitive Advantage?

It has always been the assumption that the implementation of information systems will, in and of itself, bring a business competitive advantage. After all, if installing one computer to manage inventory can make a company more efficient, won't installing several computers to handle even more of the business continue to improve it?

In 2003, Nicholas Carr wrote an article in the *Harvard Business Review* that questioned this assumption. The article, entitled "IT Doesn't Matter," raised the idea that information technology has become just a commodity. Instead of viewing technology as an investment that will make a company stand out, it should be seen as something like electricity: It should be managed to reduce costs, ensure that it is always running, and be as risk-free as possible.

As you might imagine, this article was both hailed and scorned. Can IT bring a competitive advantage? It sure did for Walmart (see sidebar). We will discuss this topic further in chapter 7.

Sidebar: Walmart Uses Information Systems to Become the World's Leading Retailer

Registered trademark of Wal-Mart Stores, Inc.

Walmart is the world's largest retailer, earning $15.2 billion on sales of $443.9 billion in the fiscal year that ended on January 31, 2012. Walmart currently serves over 200 million customers every

week, worldwide.[5] Walmart's rise to prominence is due in no small part to their use of information systems.

One of the keys to this success was the implementation of Retail Link, a supply-chain management system. This system, unique when initially implemented in the mid-1980s, allowed Walmart's suppliers to directly access the inventory levels and sales information of their products at any of Walmart's more than ten thousand stores. Using Retail Link, suppliers can analyze how well their products are selling at one or more Walmart stores, with a range of reporting options. Further, Walmart requires the suppliers to use Retail Link to manage their own inventory levels. If a supplier feels that their products are selling out too quickly, they can use Retail Link to petition Walmart to raise the levels of inventory for their products. This has essentially allowed Walmart to "hire" thousands of product managers, all of whom have a vested interest in the products they are managing. This revolutionary approach to managing inventory has allowed Walmart to continue to drive prices down and respond to market forces quickly.

Today, Walmart continues to innovate with information technology. Using its tremendous market presence, any technology that Walmart requires its suppliers to implement immediately becomes a business standard.

Users of information systems:

We will be discussing the last component of an information system: people. People are involved in information systems in just about every way you can think of: people imagine information systems, people develop information systems, people support information systems, and, perhaps most importantly, people *use* information systems.

The Creators of Information Systems

The first group of people we are going to look at play a role in designing, developing, and building information systems. These people are generally very technical and have a background in programming and mathematics. Just about everyone who works in the creation of information systems has a minimum of a bachelor's degree in computer science or information systems, though that is not necessarily a requirement.

Systems Analyst: The role of the systems analyst is to straddle the divide between identifying business needs and imagining a new or redesigned computer-based system to fulfill those needs. This individual will work with a person, team, or department with business requirements and identify the specific details of a system that needs to be built. Generally, this will require the analyst to have a good understanding of the business itself , the business processes involved, and the ability to document them well. The analyst will identify the different stakeholders in the system and work to involve the appropriate individuals in the process.

Programmer: Programmers spend their time writing computer code in a programming language. In the case of systems development, programmers generally attempt to fulfill the design

specifications given to them by a systems analyst. Many different styles of programming exist: a programmer may work alone for long stretches of time or may work in a team with other programmers. A programmer needs to be able to understand complex processes and also the intricacies of one or more programming languages. Generally, a programmer is very proficient in mathematics, as mathematical concepts underlie most programming code.

Computer Engineer: Computer engineers design the computing devices that we use every day. There are many types of computer engineers, who work on a variety of different types of devices and systems. Some of the more prominent engineering jobs are as follows:

- **Hardware engineer:** A hardware engineer designs hardware components, such as microprocessors. Many times, a hardware engineer is at the cutting edge of computing technology, creating something brand new. Other times, the hardware engineer's job is to engineer an existing component to work faster or use less power. Many times, a hardware engineer's job is to write code to create a program that will be implemented directly on a computer chip.

- **Software engineer:** Software engineers do not actually design devices; instead, they create new programming languages and operating systems, working at the lowest levels of the hardware to develop new kinds of software to run on the hardware.

- **Systems engineer:** A systems engineer takes the components designed by other engineers and makes them all work together. For example, to build a computer, the mother board, processor, memory, and hard disk all have to work together. A systems engineer has experience with many different types of hardware and software and knows how to integrate them to create new functionality.

- **Network engineer:** A network engineer's job is to understand the networking requirements of an organization and then design a communications system to meet those needs, using the networking hardware and software available.

There are many different types of computer engineers, and often the job descriptions overlap. While many may call themselves engineers based on a company job title, there is also a professional designation of "professional engineer," which has specific requirements behind it. In the US, each state has its own set of requirements for the use of this title, as do different countries around the world. Most often, it involves a professional licensing exam.

Information-Systems Operations and Administration

Another group of information-systems professionals are involved in the day-to-day operations and administration of IT. These people must keep the systems running and up-to-date so that the rest of the organization can make the most effective use of these resources.

Computer Operator: A computer operator is the person who keeps the large computers running. This person's job is to oversee the mainframe computers and data centers in organizations. Some

of their duties include keeping the operating systems up to date, ensuring available memory and disk storage, and overseeing the physical environment of the computer. Since mainframe computers increasingly have been replaced with servers, storage management systems, and other platforms, computer operators' jobs have grown broader and include working with these specialized systems.

Database Administrator: A database administrator (DBA) is the person who manages the databases for an organization. This person creates and maintains databases that are used as part of applications or the data warehouse. The DBA also consults with systems analysts and programmers on projects that require access to or the creation of databases.

Help-Desk/Support Analyst: Most mid-size to large organizations have their own information-technology help desk. The help desk is the first line of support for computer users in the company. Computer users who are having problems or need information can contact the help desk for assistance. Many times, a help-desk worker is a junior-level employee who does not necessarily know how to answer all of the questions that come his or her way. In these cases, help-desk analysts work with senior-level support analysts or have a computer knowledgebase at their disposal to help them investigate the problem at hand. The help desk is a great place to break into working in IT because it exposes you to all of the different technologies within the company. A successful help-desk analyst should have good people and communications skills, as well as at least junior-level IT skills.

Trainer: A computer trainer conducts classes to teach people specific computer skills. For example, if a new ERP system is being installed in an organization, one part of the implementation process is to teach all of the users how to use the new system. A trainer may work for a software company and be contracted to come in to conduct classes when needed; a trainer may work for a company that offers regular training sessions; or a trainer may be employed full time for an organization to handle all of their computer instruction needs. To be successful as a trainer, you need to be able to communicate technical concepts well and also have a lot of patience!

Managing Information Systems

The management of information-systems functions is critical to the success of information systems within the organization. Here are some of the jobs associated with the management of information systems.

CIO: The CIO, or chief information officer, is the head of the information-systems function. This person aligns the plans and operations of the information systems with the strategic goals of the organization. This includes tasks such as budgeting, strategic planning, and personnel decisions for the information-systems function. The CIO must also be the face of the IT department within the organization. This involves working with senior leaders in all parts of the organization to ensure good communication and planning.

Functional Manager: As an information-systems organization becomes larger, many of the different functions are grouped together and led by a manager. These functional managers report to the CIO and manage the employees specific to their function. For example, in a large organization, there is a group of systems analysts who report to a manager of the systems-analysis function. For more insight into how this might look, see the discussion later in the chapter of how information systems are organized.

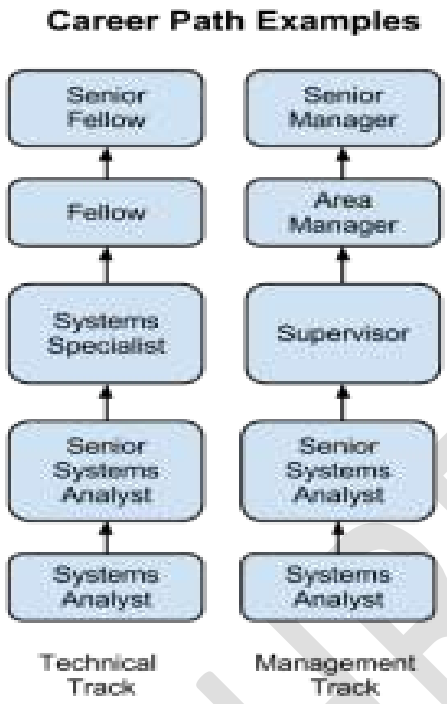
ERP Management: Organizations using an ERP require one or more individuals to manage these systems. These people make sure that the ERP system is completely up to date, work to implement any changes to the ERP that are needed, and consult with various user departments on needed reports or data extracts.

Project Managers: Information-systems projects are notorious for going over budget and being delivered late. In many cases, a failed IT project can spell doom for a company. A project manager is responsible for keeping projects on time and on budget. This person works with the stakeholders of the project to keep the team organized and communicates the status of the project to management. A project manager does not have authority over the project team; instead, the project manager coordinates schedules and resources in order to maximize the project outcomes. A project manager must be a good communicator and an extremely organized person. A project manager should also have good people skills. Many organizations require each of their project managers to become certified as a project management professional (PMP).

Information-Security Officer: An information-security officer is in charge of setting information-security policies for an organization, and then overseeing the implementation of those policies. This person may have one or more people reporting to them as part of the information-security team. As information has become a critical asset, this position has become highly valued. The information-security officer must ensure that the organization's information remains secure from both internal and external threats.

Emerging Roles: As technology evolves, many new roles are becoming more common as other roles fade. For example, as we enter the age of "big data," we are seeing the need for more data analysts and business-intelligence specialists. Many companies are now hiring social-media experts and mobile-technology specialists. The increased use of cloud computing and virtual-machine technologies also is breeding demand for expertise in those areas.

Career Paths in Information Systems



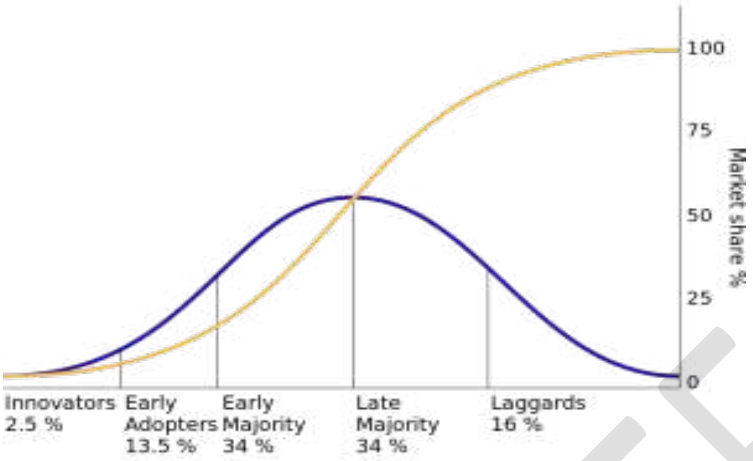
These job descriptions do not represent all possible jobs within an information-systems organization. Larger organizations will have more specialized roles; smaller organizations may combine some of these roles. Many of these roles may exist outside of a traditional information-systems organization, as we will discuss below.

Working with information systems can be a rewarding career choice. Whether you want to be involved in very technical jobs (programmer, database administrator), or you want to be involved in working with people (systems analyst, trainer), there are many different career paths available.

Many times, those in technical jobs who want career advancement find themselves in a dilemma: do they want to continue doing technical work, where sometimes their advancement options are limited, or do they want to become a manager of other employees and put themselves on a management career track? In many cases, those proficient in technical skills are not gifted with managerial skills. Some organizations, especially those that highly value their technically skilled employees, will create a technical track that exists in parallel to the management track so that they can retain employees who are contributing to the organization with their technical skills.

Information-Systems Users – Types of Users

Besides the people who work to create, administer, and manage information systems, there is one more extremely important group of people: the users of information systems. This group represents a very large percentage of the people involved. If the user is not able to successfully learn and use an information system, the system is doomed to failure.



Technology adoption user types

One tool that can be used to understand how users will adopt a new technology comes from a 1962 study by Everett Rogers. In his book, *Diffusion of Innovation*, Rogers studied how farmers adopted new technologies, and he noticed that the adoption rate started slowly and then dramatically increased once adoption hit a certain point. He identified five specific types of technology adopters:

- **Innovators:** Innovators are the first individuals to adopt a new technology. Innovators are willing to take risks, are the youngest in age, have the highest social class, have great financial liquidity, are very social, and have the closest contact with scientific sources and interaction with other innovators. Risk tolerance has them adopting technologies that may ultimately fail. Financial resources help absorb these failures (Rogers 1962 5th ed, p. 282).

- **Early adopters:** The early adopters are those who adopt innovation after a technology has been introduced and proven. These individuals have the highest degree of opinion leadership among the other adopter categories, which means that they can influence the opinions of the largest majority. They are typically younger in age, have higher social status, more financial liquidity, more advanced education, and are more socially aware than later adopters. These people are more discrete in adoption choices than innovators, and realize judicious choice of adoption will help them maintain a central communication position (Rogers 1962 5th ed, p. 283).

- **Early majority:** Individuals in this category adopt an innovation after a varying degree of time. This time of adoption is significantly longer than the innovators and early adopters. This group tends to be slower in the adoption process, has above average social status, has contact with early adopters, and seldom holds positions of opinion leadership in a system (Rogers 1962 5th ed, p. 283).

- **Late majority:** The late majority will adopt an innovation after the average member of the society. These individuals approach an innovation with a high degree of skepticism, have

below average social status, very little financial liquidity, are in contact with others in the late majority and the early majority, and show very little opinion leadership.

- **Laggards:** Individuals in this category are the last to adopt an innovation. Unlike those in the previous categories, individuals in this category show no opinion leadership. These individuals typically have an aversion to change-agents and tend to be advanced in age. Laggards typically tend to be focused on "traditions," are likely to have the lowest social status and the lowest financial liquidity, be oldest of all other adopters, and be in contact with only family and close friends.

These five types of users can be translated into information-technology adopters as well, and provide additional insight into how to implement new information systems within an organization. For example, when rolling out a new system, IT may want to identify the innovators and early adopters within the organization and work with them first, then leverage their adoption to drive the rest of the implementation.

Types of information systems:

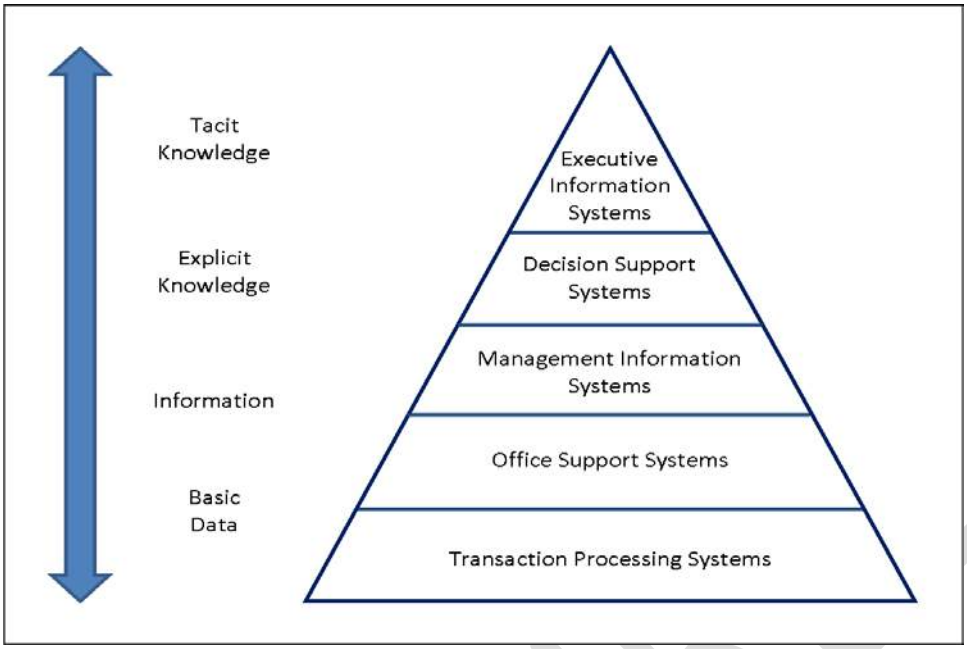
A typical organization is divided into operational, middle, and upper level. The information requirements for users at each level differ. Towards that end, there are number of information systems that support each level in an organization.

Businesses tend to have several "information systems" operating at the same time. This study note highlights the main categories of information system and provides some examples to help you distinguish between them.

For most businesses, there are a variety of requirements for information:

- Senior managers need information to help with their business planning
- Middle management need more detailed information to help them monitor and control business activities
- Employees with operational roles need information to help them carry out their duties

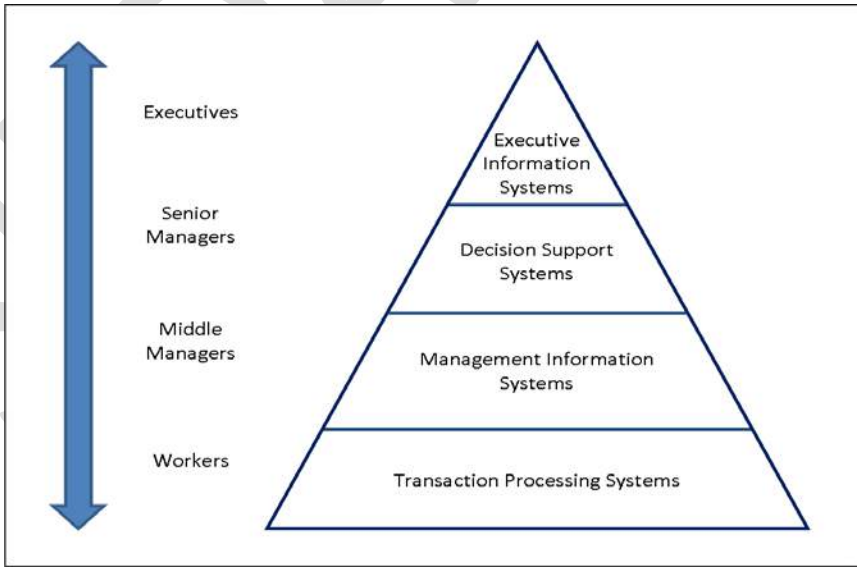
The different types of date / information / knowledge that are processed at different levels in the organization, we can create a five level model.



Five level pyramid model based on the processing requirement of different levels in the organization

What are the most common types of information system in an organization?

While there are several different versions of the pyramid model, the most common is probably a four level model based on the people who use the systems. Basing the classification on the people who use the information system means that many of the other characteristics such as the nature of the task and informational requirements are taken into account more or less automatically.



Four level pyramid model based on the different levels of hierarchy in the organization

Transaction processing system (TPS):

Information systems that process data generated from business transactions are known as transaction processing systems. In other words, the main job of a transaction processing system is to collect data generated from the transactions, store it, and, at times, control the decisions that are taken arising out of the transactions. Such transactions can be in the form of purchases, sales, deposits, withdrawals, etc. For instance, booking an airline ticket, withdrawing money from an ATM, depositing cash in the bank, etc are all example of transactions.

Generally, these transactions occur on a day-to-day-basis. A sale or purchase of an item triggers many other transactions like credit checks, billing, and changes in the inventory. Thus, transactions generate additional data.

Definition: A Transaction Processing System is a set of information which processes the data transaction in database system that monitors transaction programs. The system is useful when something is sold over the internet. It allows for a time delay between when an item is being sold to when it is actually sold. An example is that of a sporting event ticket. While the customer is filling out their information to purchase the seat ticket; the transaction processing system is holding the ticket so that another customer cannot also buy it. It allows for a ticket not to be sold to two different customers.

- An Information system that processes data arising from the occurrence of business transactions. Transaction processing systems (TPS) are aimed at improving the routine business activities on which all organizations depend.
- A transaction is any event or activity that affects the organization which occur as part of doing business, such as sales, purchases, deposit, withdrawals, refunds and payments.
- Common transactions include placing orders, billing customers, hiring employees, and depositing cheques.
- The types of transactions that occur vary from organization to organization.
- Transaction processing, the set of procedures for handling the transactions, often includes the activities like calculation, storage and retrieval, classification, summarization, sorting.
- Transaction processing procedures are often called standard operating procedures.

Example: The routines associated with general banking transactions typify the use of standard operating procedures for the handling of deposits and withdraws, cashing of cheques, and other processes.

Types of TPS:

1. **Batch processing:** Processes several transactions at the same time, with a time delay.
2. **Real-time processing:** Deals with one transaction at a time and does not have a time delay.

Features

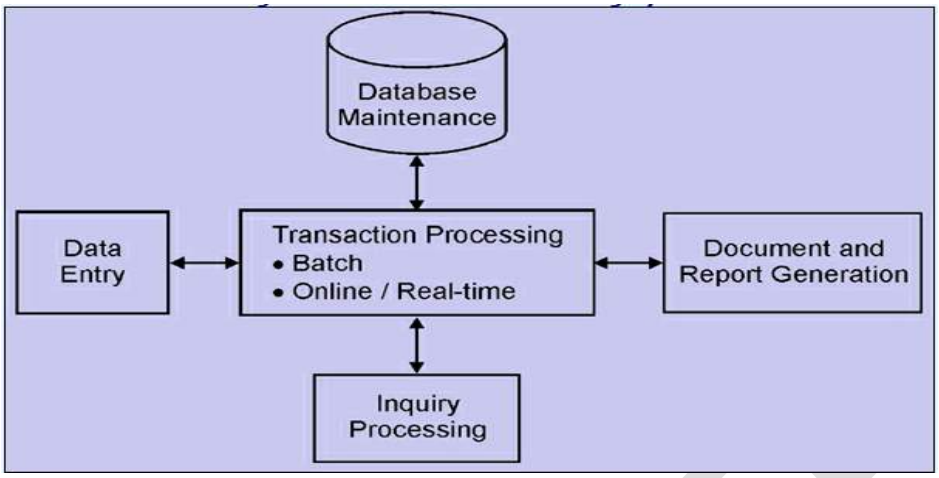
1. **Rapid Response:** The response time of a transaction processing system (TPS) is important because a business cannot afford to have their customers waiting for long periods of time before making a transaction.
2. **Reliability:** A good TPS must be very reliable because if it were to break down businesses could lose a huge portion of revenue because customers would not be able to purchase their products.
3. **Inflexibility:** The TPS must work the same way for every transaction as long as the TPS is being used. The formality and structure should never change.
4. **Controlled processing:** The TPS must be able to allow authorized employees to be able to access it at any time.

Storing and Retrieving Data: A TPS must be able to easily be accessed by authorized employees so that information in the TPS can be retrieved. The information that goes through a TPS must never be deleted so that there will not be any confusion of what orders have gone through it. It is a good idea to have a back up hard drive so that older information can still be stored, but will not slow down the server which houses the TPS.

Following are the objectives of a transaction processing system:

- Carrying out the day-to-day transactions of the organization on a regular basis.
- Collecting, processing, editing, updating, storing the data, and generating the required reports or documents.
- Supplying the necessary information to the organization, this would enable proper functioning of the business.
- Providing reports and documents which would help in making timely decisions.
- Supplying data to other information systems.

Essentially, transaction processing systems should capture data and process it with great speed and accuracy. After capturing and processing the data, the transaction processing system updates organizational databases and produces a variety of information products for internal as well as external use. Diagram illustrates a cycle in which the basic transaction processing activities take place.



Components of TPS:

- **Inputs**: Source documents such as Customer orders, invoices, purchase orders, etc. serves as Inputs to the TPS system.
- **Processing:** Once the inputs are provided, they are further processed to get an output.
- **Storage**: Ledgers serves as a source of storage.
- **Output:** Any document generated is termed as output.

These were the fundamentals behind the Transaction Processing System. It is a very helpful, reliable & secured system of processing transactions at an ease.

Transaction Processing cycle:

Transaction processing systems capture and process data describing business transactions. Then they update organizational files and databases and produce a variety of information products for internal and external use. Transaction processing systems generally go through a five-stage cycle of

1) Data entry activities
2) Transaction processing activities
3) File and database processing
4) Document and report generation
5) Inquiry processing activities.

Data Entry: The input activity in transaction processing systems involves a data entry process. In this process, data is captured, or collected by recording, coding, and editing activities. Then the data may be converted to a form that can be entered into a computer system. Data entry activities have always been a bottleneck in the use of computers for transaction processing.

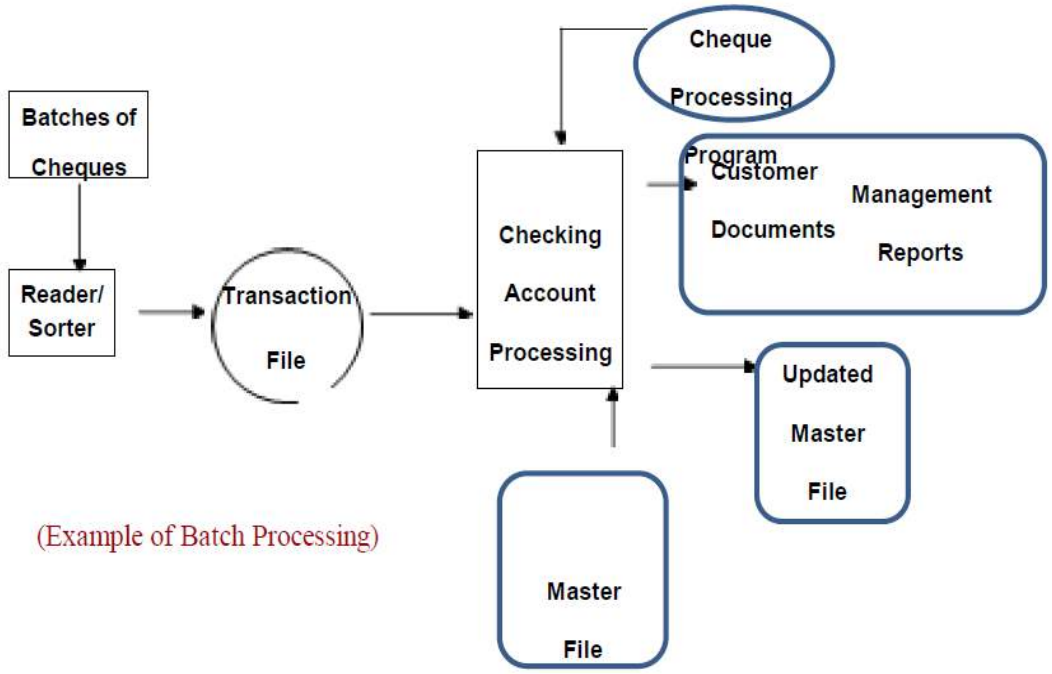
Transaction Processing: Transaction processing systems process data in two ways.

a) Batch processing

b) Real-time processing

a) Batch Processing:

In a batch processing system, transaction data is accumulated over a period of time and processed periodically.

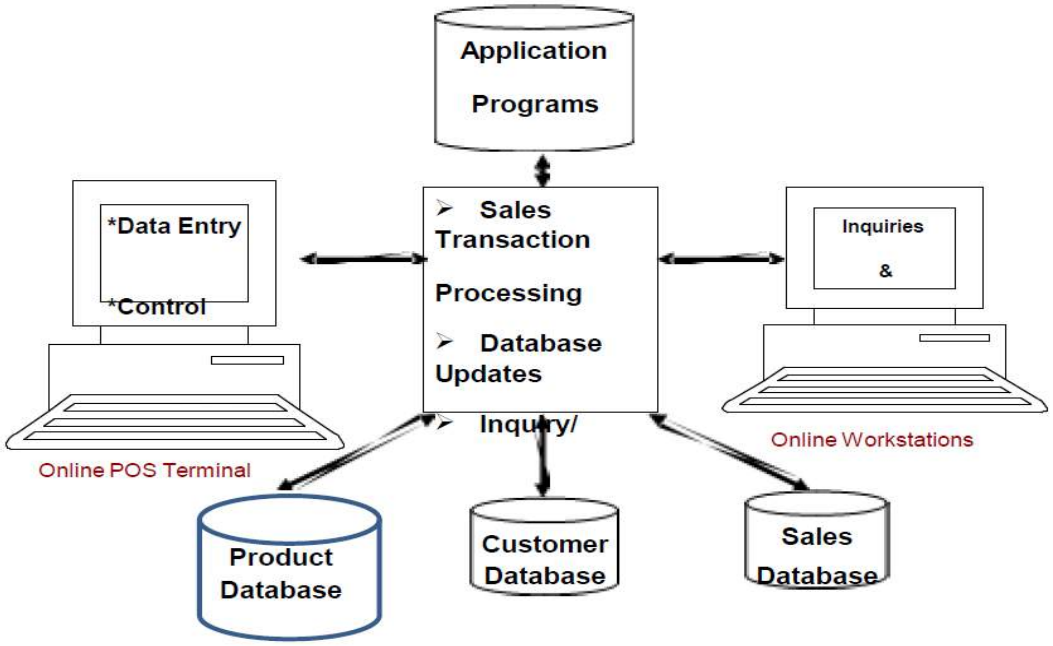


(Example of Batch Processing)

It usually involves the following activities.

- Gathering source documents originated by business transactions, such as sales orders and invoices, into group called batches.
- Recording transaction data on an input medium , such as magnetic disks or magnetic tapes.
- Sorting the transactions in a transaction file in the same sequence as records in *a sequential master file.*
- Processing transaction data and creating an updated master file and a variety of documents (such as customer invoices or paycheques) and reports
- Capturing and storing batches of transactions data at remote sites, and then transmitting it periodically to central computers for processing. This is called remote job entry or RJE.

b) Real-time Processing:



Real-time Processing involves the following:

- Real-time processing systems process transaction data immediately after they are generated and can provide immediate output to end users.
- In full-fledged real-time processing systems, data is processed as soon as it is originated or recorded, without waiting to accumulate batches of data.
- Data is fed directly into the computer system from online terminals, without being sorted, and it is always stored online in direct access files.
- Files and databases are always up to data since they are updated as and whenever data is originated, regardless of its frequency.
- Responses to end users' inquiries are immediate, since information stored on direct access devices can be retrieved almost instantaneously.
- Real-time processing depends on telecommunication networks of online terminals and computers.

3. File and Database Processing:

File and database processing are the basic activities of transaction processing systems. These are also known as file and database maintenance.

This term emphasizes that an organization's files and databases must be maintained by its transaction processing systems so that they are always correct and up to date.

Transaction processing systems update and make changes to corporate databases, which are then used to

a) Provide data needed to produce proper information products, and

b) Provide data needed for further processing by management information systems.

4. Document & Report generation:

The final stage in the transaction processing cycle is the generation of information products such as documents and reports.

Documents produced by transaction processing systems are called transaction documents. There are various types of documents such as

- Action documents that initiate actions or transactions on the part of their recipient. For e.g., a paycheque authorizes a bank to pay the customer.
- Information documents relate, confirm or prove to their recipients that transactions have occurred. For e.g., sales receipts, customer statements etc.
- Turnaround documents say that some types of transaction documents are designed to be read by magnetic or optical scanning equipment. Forms produced in this manner designed to be returned to the sender. For e.g., many computer-printed invoices consist of a turnaround portion, which is returned to the customer along with his/her payment.

Transaction processing systems also produce several types of reports and are used by managers. Such reports provide an audit trail for transaction control purposes. For example,

- Control listings, are detailed reports that describe each transaction occurring during a period. They are also called logs. For example, a payroll register lists every paycheque printed on a specified payday by a payroll system.
- Edit reports, describe errors detecting during processing. For e.g., invalid Account Number, missing data etc would be presented in edit reports.
- Accounting statements are such reports that legally document the financial performance or status of a business. For e.g., statements of cash flow, income statements etc.

5. Inquiry Processing:

Many transaction processing allows us to use Internet and Web browsers or database management query languages to make inquiries and receive responses concerning the results of transaction processing activity. Typically responses are displayed in a variety of pre specified formats or screens. For e.g., checking balance in A/C and receive immediate response on PC.

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.
- 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.
- 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).
- **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. Hoi Apple and Whinstone classifies DSS 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. The most popular tool is Excel and Lotus 1-2-3.
- **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.

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.

Users of Decision Support System:

The ultimate user of a decision support system is the decision maker; however, he may not actually run the system. Based on his research on 56 Decision Support Systems, Alter identified following four distinct usage patterns.

1. Terminal mode
2. Clerk mode
3. Subscription mode
4. Intermediary mode.

1. **Terminal mode:** The decision maker is the direct user of the system through on line access.
2. **Clerk mode:** The decision maker uses the system directly but offline, preparing input on a coding form. The primary difference between this mode and the terminal mode is in the technology employed (batch versus online).
3. **Subscription mode:** The decision maker receives reports that are generated automatically on a regular basis. This is the typical mode of usage for management reporting systems.

Although some data analysis systems or accounting models might be used in this way, it is not typical for decision support systems.

4. **Intermediary mode:** The decision maker uses the system through intermediaries, who perform the analysis and interpret and report the results. The decision maker does not need to know the intermediary used the system to arrive at the requested information.

Role of Decision Support System in MIS:

Decision support system is a special class of system which facilitate decision making. As in an organisation, at each and every point and time, decisions are to be taken irrespective of their nature. Some decisions may be routine and programmed decisions while other may be strategic, and non-programmed decisions.

But one thing is certain that decision making is done at all level of management. Decision support system involves the packages which help the managers to take right and timely decisions.

Decision support systems use data from the general management information system and they are used by a manager or a decision maker for decision support. The basic characteristic of the decision support system is that it is based on some tool, technique or model. These systems are used sometimes for testing new alternatives, training and learning. They are also used for sensiting the various parameters of the model.

The MIS designer has to look for all such situations and design the decision support system for integration in the system. The management information system would become more useful if the decision making is made person independent and executed with well designed decision support system.

All such embedded systems cover the normal variety of decision situations. If anything outside the considered variety crops up, decision support system will bring to the notice of the decision makers that action is called for in the situation.

The decision support system plays a dominant role in the management information system as a support to decision making.

Executive Support System:

Executive support systems are intended to be used by the senior managers directly to provide support to non-programmed decisions in strategic management.

These information are often external, unstructured and even uncertain. Exact scope and context of such information is often not known beforehand.

This information is intelligence based:

- Market intelligence
- Investment intelligence

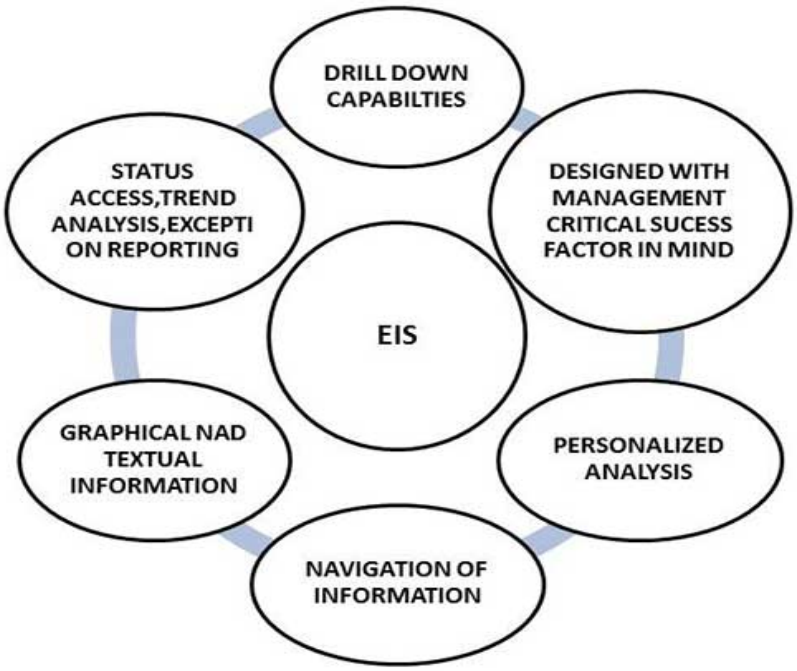
- Technology intelligence

Examples of Intelligent Information

Following are some examples of intelligent information, which is often the source of an ESS:

- External databases
- Technology reports like patent records etc.
- Technical reports from consultants
- Market reports
- Confidential information about competitors
- Speculative information like market conditions
- Government policies
- Financial reports and information

Features of Executive Information System



Advantages of ESS

- Easy for upper level executive to use
- Ability to analyze trends
- Augmentation of managers' leadership capabilities
- Enhance personal thinking and decision-making
- Contribution to strategic control flexibility
- Enhance organizational competitiveness in the market place
- Instruments of change

- Increased executive time horizons.
- Better reporting system
- Improved mental model of business executive
- Help improve consensus building and communication
- Improve office automation
- Reduce time for finding information
- Early identification of company performance
- Detail examination of critical success factor
- Better understanding
- Time management
- Increased communication capacity and quality

Disadvantage of ESS

- Functions are limited
- Hard to quantify benefits
- Executive may encounter information overload
- System may become slow
- Difficult to keep current data
- May lead to less reliable and insecure data
- Excessive cost for small company

Enterprise Resource Planning (ERP) system:

ERP is an integrated, real-time, cross-functional enterprise application, an enterprise-wide transaction framework that supports all the internal business processes of a company.

It supports all core business processes such as sales order processing, inventory management and control, production and distribution planning, and finance.

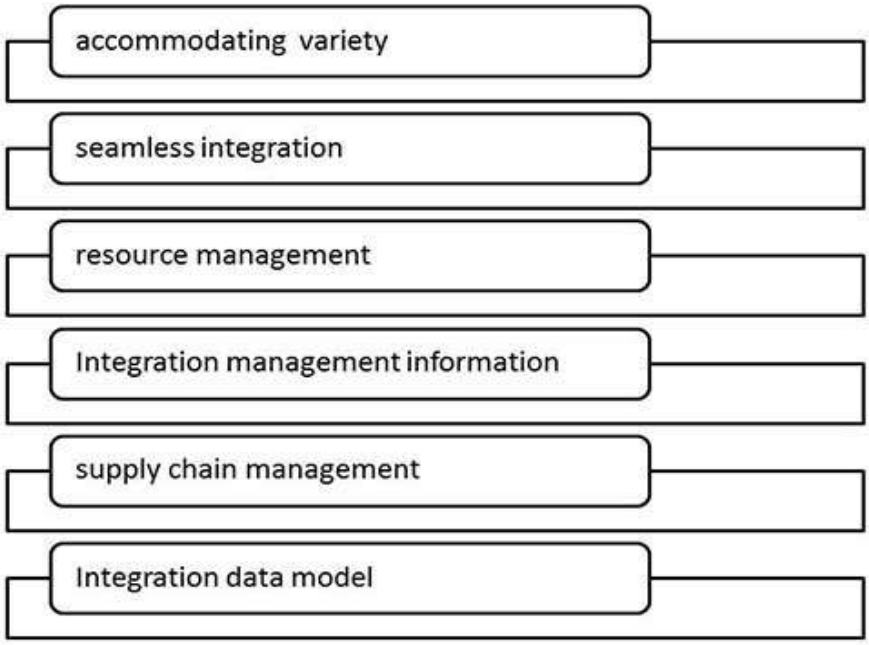
Why of ERP?

ERP is very helpful in the following areas:

- Business integration and automated data update
- Linkage between all core business processes and easy flow of integration
- Flexibility in business operations and more agility to the company
- Better analysis and planning capabilities
- Critical decision-making
- Competitive advantage
- Use of latest technologies

Features of ERP

The following diagram illustrates the features of ERP:



Scope of ERP

- **Finance** − Financial accounting, Managerial accounting, treasury management, asset management, budget control, costing, and enterprise control.
- **Logistics** − Production planning, material management, plant maintenance, project management, events management, etc.
- **Human resource** − Personnel management, training and development, etc.
- **Supply Chain** − Inventory control, purchase and order control, supplier scheduling, planning, etc.
- **Work flow** − Integrate the entire organization with the flexible assignment of tasks and responsibility to locations, position, jobs, etc.

Advantages of ERP

- Reduction of lead time
- Reduction of cycle time
- Better customer satisfaction
- Increased flexibility, quality, and efficiency
- Improved information accuracy and decision making capability
- Onetime shipment
- Improved resource utilization
- Improve supplier performance
- Reduced quality costs
- Quick decision-making
- Forecasting and optimization

- Better transparency

Disadvantage of ERP

- Expense and time in implementation
- Difficulty in integration with other system
- Risk of implementation failure
- Difficulty in implementation change
- Risk in using one vendor

Business expert system:

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

What are Expert Systems?

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
- Justifying the conclusion
- Suggesting alternative options to a problem

They are incapable of:

- Substituting human decision makers

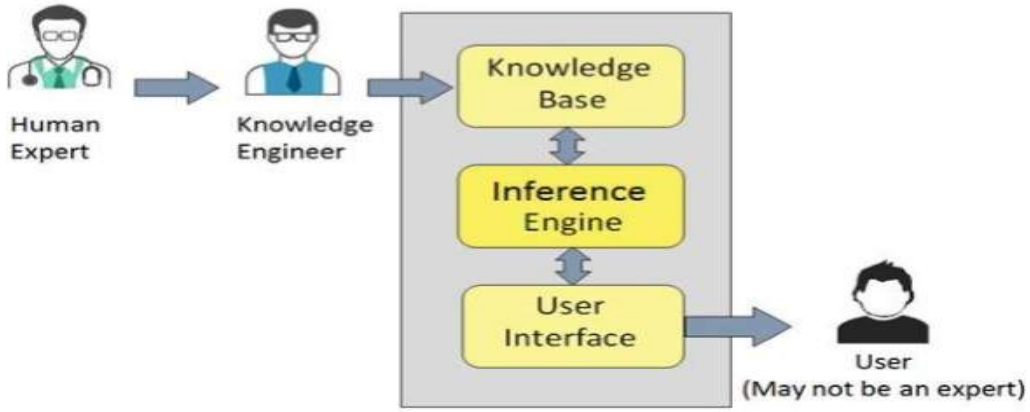
- Possessing human capabilities
- Producing accurate output for inadequate knowledge base
- Refining their own knowledge

Components of Expert Systems

The components of ES include:

- Knowledge Base
- Inference Engine
- User Interface

Let us see them one by one briefly:



Knowledge Base

It contains domain-specific and high-quality knowledge.

Knowledge is required to exhibit intelligence. The success of any ES majorly depends upon the collection of highly accurate and precise knowledge.

What is Knowledge?

The data is collection of facts. The information is organized as data and facts about the task domain. Data, information, and past experience combined together are termed as knowledge.

Components of Knowledge Base:

The knowledge base of an ES is a store of both, factual and heuristic knowledge.

- **Factual Knowledge:** It is the information widely accepted by the Knowledge Engineers and scholars in the task domain.
- **Heuristic Knowledge:** It is about practice, accurate judgment, one's ability of evaluation, and guessing.

Knowledge representation: It is the method used to organize and formalize the knowledge in the knowledge base. It is in the form of IF-THEN-ELSE rules.

Knowledge Acquisition: The success of any expert system majorly depends on the quality, completeness, and accuracy of the information stored in the knowledge base.

The knowledge base is formed by readings from various experts, scholars, and the Knowledge Engineers. The knowledge engineer is a person with the qualities of empathy, quick learning, and case analyzing skills.

He acquires information from subject expert by recording, interviewing, and observing him at work, etc. He then categorizes and organizes the information in a meaningful way, in the form of IF-THEN-ELSE rules, to be used by interference machine. The knowledge engineer also monitors the development of the ES.

Inference Engine: Use of efficient procedures and rules by the Inference Engine is essential in deducting a correct, flawless solution.

In case of knowledge-based ES, the Inference Engine acquires and manipulates the knowledge from the knowledge base to arrive at a particular solution.

In case of rule based ES, it:

- Applies rules repeatedly to the facts, which are obtained from earlier rule application.
- Adds new knowledge into the knowledge base if required.
- Resolves rules conflict when multiple rules are applicable to a particular case.

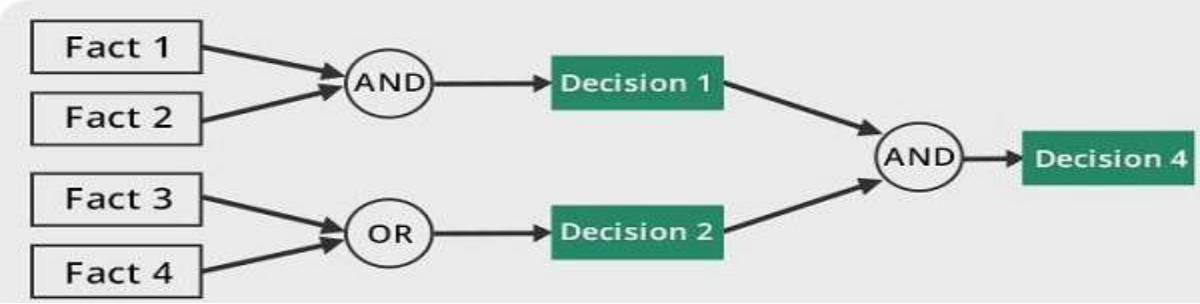
To recommend a solution, the Inference Engine uses the following strategies:

- Forward Chaining
- Backward Chaining

Forward Chaining: It is a strategy of an expert system to answer the question, “What can happen next?”

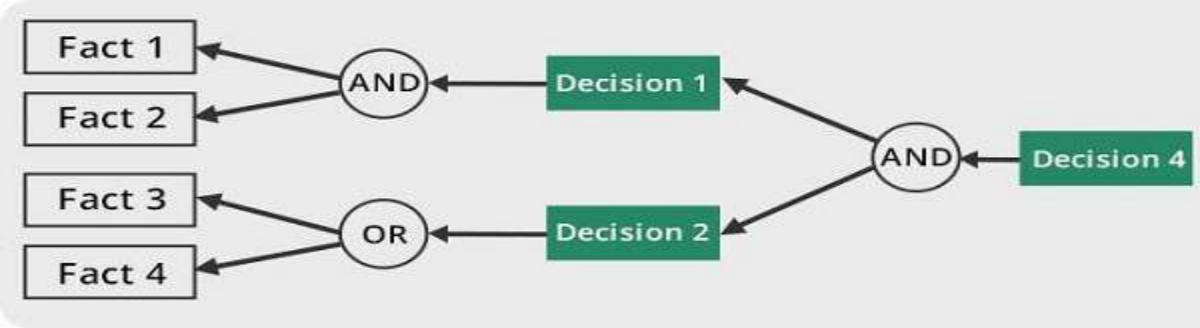
Here, the Inference Engine follows the chain of conditions and derivations and finally deduces the outcome. It considers all the facts and rules, and sorts them before concluding to a solution.

This strategy is followed for working on conclusion, result, or effect. For example, prediction of share market status as an effect of changes in interest rates.



Backward Chaining: With this strategy, an expert system finds out the answer to the question, "Why this happened?"

On the basis of what has already happened, the Inference Engine tries to find out which conditions could have happened in the past for this result. This strategy is followed for finding out cause or reason. For example, diagnosis of blood cancer in humans.



User Interface

User interface provides interaction between user of the ES and the ES itself. It is generally Natural Language Processing so as to be used by the user who is well-versed in the task domain. The user of the ES need not be necessarily an expert in Artificial Intelligence.

It explains how the ES has arrived at a particular recommendation. The explanation may appear in the following forms:

- Natural language displayed on screen.
- Verbal narrations in natural language.
- Listing of rule numbers displayed on the screen.

The user interface makes it easy to trace the credibility of the deductions.

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 has their limitations which include −

- Limitations of the technology
- Difficult knowledge acquisition
- ES are difficult to maintain
- High development costs

Applications of Expert System

The following table shows where ES can be applied.

Application	Description
Design Domain	Camera lens design, automobile design.
Medical Domain	Diagnosis Systems to deduce cause of disease from observed data, conduction medical operations on humans.
Monitoring Systems	Comparing data continuously with observed system or with prescribed behavior such as leakage monitoring in long petroleum pipeline.
Process Control Systems	Controlling a physical process based on monitoring.
Knowledge Domain	Finding out faults in vehicles, computers.
Finance/Commerce	Detection of possible fraud, suspicious transactions, stock market trading, Airline scheduling, cargo scheduling.

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:

- Workstations, minicomputers, mainframes.
- High level Symbolic Programming Languages such as LISt Programming (LISP) and PROgrammation en LOGique (PROLOG).
- Large databases.

- **Tools:** They reduce the effort and cost involved in developing an expert system to large extent.
  - Powerful editors and debugging tools with multi-windows.
  - They provide rapid prototyping
  - 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 −
  - Java Expert System Shell (JESS) that provides fully developed Java API for creating an expert system.
  - *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.

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.
- 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.
- **Steady response:** They work steadily without getting motional, tensed or fatigued.

Unit IV

Information System for Functional Areas and Issues

Information System for Functional Areas:

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:

- Financial Information System
- Marketing Information System
- Production/Marketing Information System
- Human Resource Information System

Security Issues Relating to Information Systems:

Information Systems security is one of the biggest challenges facing society's technological age. Information Systems have become an integral part of everyday life in the home, businesses, government, and organizations. Information Systems have changed the way that people live their lives, conduct business, even run the government. Information Systems have become such an important part of everyday life because there are many uses of Information Systems that make it much easier and faster to perform certain tasks, or even to perform certain tasks simultaneously.

Information Systems have become so developed and detailed in their short history. Society has developed along with the Information Systems, becoming a more technologically-reliable generation, also known as the digital firm era. Along with an increasing reliability for Information Systems, the digital firm era has also brought about an increasing profitability, competitiveness, and efficiency for any business of any size that uses an Information Systems.

Since the current technological generation has become so dependent upon Information Systems, the problems threatening Information Systems also threaten the order of everyday activities that many take for granted. The intricate role that Information Systems plays in daily activities has been developed near to perfection, but there are many current problems such as spamming, hacking, jamming, malicious software, sniffing, spoofing, and identity theft. These current problems are threatening the reliability and security of Information Systems.

With these current problems threatening Information Systems, users of Information Systems have been in the search for new techniques and new technology that will help fix the devastating consequences. Along with new techniques and new technology fixing these problems, users of Information Systems must also protect themselves. There are certain ways that users of

Information Systems can protect themselves against all of the current problems. The future of Information Systems is somewhat unknown since it lies in the hands of the users. This unexpectedness also means with many unexpected problems that the users will have to solve.

Information system security refers to the way the system is defended against unauthorized access, use, disclosure, disruption, modification, perusal, inspection, recording or destruction.

There are two major aspects of information system security:

- **Security of the information technology used:** securing the system from malicious cyber-attacks that tend to break into the system and to access critical private information or gain control of the internal systems.
- **Security of data:** ensuring the integrity of data when critical issues, arise such as natural disasters, computer/server malfunction, physical theft etc. Generally an off-site backup of data is kept for such problems.

Guaranteeing effective information security has the following key aspects:

- Preventing the unauthorized individuals or systems from accessing the information.
- Maintaining and assuring the accuracy and consistency of data over its entire life-cycle.
- Ensuring that the computing systems, the security controls used to protect it and the communication channels used to access it, functioning correctly all the time, thus making information available in all situations.
- Ensuring that the data, transactions, communications or documents are genuine.
- Ensuring the integrity of a transaction by validating that both parties involved are genuine, by incorporating authentication features such as "digital signatures".
- Ensuring that once a transaction takes place, none of the parties can deny it, either having received a transaction, or having sent a transaction. This is called 'non-repudiation'.
- Safeguarding data and communications stored and shared in network systems.

The Issues:

The problems which are facing information systems have either occurred through computer crime or computer abuse. Computer crime and computer abuse is widely becoming a widespread problem since technology can help accomplish almost any illegal or unethical task. There is a difference between computer crime and computer abuse, though; computer crime is when a person uses a computer to commit an illegal act, while computer abuse is when a person uses a computer to commit an unethical but not always illegal act.

Computer crime and computer abuse has become a widespread problem since the evolution of Information Systems. Before Information Systems were invented, data was protected more because most information was stored only in paper files, and only in certain departments of a business where many users would not have access to the data. With the evolution of Information Systems, large amounts of data can be stored in electric form rather than

in paper files, so the data can be viewed by a larger number of users. Since more users can access the data electronically rather than manually, the data in turn, is more susceptible to the threat of computer crime and computer abuse.

Many businesses and individuals often feel serious effects from the following computer crime and computer abuse problems. Often at times, the users of Information Systems depend so heavily on the systems that a small setback will often cause huge setbacks for the business and individual. From a few minutes to a few days, the side effects of computer crime and computer abuse can be damaging to a business or individual who relies heavily on Information Systems to accomplish certain everyday tasks.

The current computer crime and computer abuse problems have threatened Information Systems due to the increased reliability of businesses and individuals on Information Systems, but also because of an increased risk of threat due to insecure telecommunication networks. Many of the ordinary threats to Information Systems such as hardware failure, fire, software failure, electrical problems, personnel actions, user errors, and telecommunication problems also can lead to easier access to large volumes of data. When the telecommunication network itself is threatened, Information Systems of an individual or business becomes even more threatened.

One of the current computer crime and abuse problems threatening the future of Information Systems is spamming. According to Laundon, spamming can be defined as "the practice of sending unsolicited e-mail and other electronic communication." Spamming has become such a threatening problem with information systems because it is one of the cheapest and easiest methods to abuse a computer system. The spammers who send out all of these e-mails are only charged a few cents to send out the unsolicited e-mails to users who have not requested the information. There are laws prohibiting the use of spamming to abuse a computer system, but spammers rarely get punished since the laws are hardly enforced.

The next problem facing information systems is hacking. Hacking is when an illegal user tries to access private information that they are not entitled to access. This illegal access is done either by using Trojan horses, logic bombs, and many other types of software that can very easily be hidden. Sometimes the hackers will even go as far crashing an entire network. According to Laundon, "hackers flood a network server or Web server with many thousands of false communications or requests in order to crash the network." The repercussions from the attack of hackers can do serious harm to a business.

Jamming is also another computer crime and abuse problem that is threatening to information systems. It is not one of the most common, but it is one of the easiest to accomplish. The illegal purpose behind jamming is to find a way to tie up the lines to a computer is the central brain behind a website. Once the lines are tied up, then legitimate visitors can access the site, therefore, the lines are "jammed" with illegal users.

Malicious software is the most common form of computer crime against Information Systems. This computer crime occurs when computer viruses are sent through a means, usually

the Internet, and these computer viruses "infect" the computer, often disabling programs or maybe even causing the computer to "crash," become inoperable. Once the computer virus is implanted into a computer's hard drive, it can be spread very easily, causing even more widespread damage. Some of the effects of computer viruses or malicious software are destroying programs, data, "crashing" a computer's operating system, clogging memory, etc. Again, if a business or individual receives a computer virus on their computer, the damage can be small to devastating.

Malicious software has become the most common form of computer crime because there are so many new computer viruses being spread. According to Laundon, "many thousands of viruses are known to exist, with two hundred or more new viruses each month." Some examples of damaging computer viruses are "Monkey", "Chernobyl", and "Code Red". The computer virus known as "Monkey" does not let the Windows operating system run, thus causing the hard drive disk to look like it is not working properly. "Chernobyl" is the nickname for a computer virus that infects a computer's files, and this computer virus ruins a computer's hard drive and ROM BIOS, which is the basic input/output system of a computer. "Code Red" is another computer virus that slows down the Internet and other computer processes. This computer virus is often spread as a "worm" as an attachment to an email, and then it hooks itself onto other computers once the email is sent, thus creating a very damaging chain-reaction.

Two more computer crime and computer abuse problems that pose a threat to Information Systems security are "sniffing" and "spoofing." "Sniffing" is a computer abuse problem which can let unauthorized users access private information about an individual because a piece of software can be used to cross the lines between an Internet user and a web site so the "sniffer" can intercept sensitive data. "Spoofing" is somewhat like "sniffing," but "spoofing" involves the "spoofer" making a false web site geared to collect personal information from an Internet user to use it in criminal or unethical acts. The side effects of "sniffing" and "spoofing" are an increased risk of unsuspecting Internet users losing personal information. Once the personal information is collected, such as credit card numbers, social security numbers, birthdates, etc., the unsuspecting user is faced with a serious threat of misuse of that information, often resulting in horrible consequences.

Identity theft, a common computer crime, is the most common side effect of "sniffing" and "spoofing" and often times, the most horrible of all the computer crime and computer abuse problems. With an insecure Information System, identity theft often arises as a serious computer crime. Identity theft occurs, according to the Federal Trade Commission, "when someone possesses or uses [a person's] name, address, Social Security number, bank or credit card account number, or other identifying information without [a person's] knowledge with the intent to commit fraud or other crimes."

Identity theft can occur through a variety of low-technological and highly technological methods. Identity theft occurs through most businesses and organizations when illegal users gain access to stolen electronical records stolen from an employer. Identity theft vandals can also gain unauthorized access to records through bribery of an employer or someone in the business which

has legal access to the records. Conning is also another way that illegal users can find information in a business or organization. The most common form of unauthorized access to computer is through hacking into an Information System of a business or organization. Once the information is illegally accessed, the results can be very harmful for the victim.

Threats to information systems:

In Information Security threats can be many like Software attacks, theft of intellectual property, identity theft, theft of equipment or information, sabotage, and information extortion.

Threat can be anything that can take advantage of a vulnerability to breach security and negatively alter, erase, harm object or objects of interest.

Software attacks mean attack by Viruses, Worms, and Trojan Horses etc. Many users believe that malware, virus, worms, bots are all same things. But they are not same, only similarity is that they all are malicious software that behaves differently.

Malware is a combination of 2 terms: Malicious and Software. So Malware basically means malicious software that can be an intrusive program code or a anything that is designed to perform malicious operations on system.

Malware can be divided in 2 categories:

1. Infection Methods
2. Malware Actions

Malware on the basis of Infection Method are following:

1. **Virus:** They have the ability to replicate themselves by hooking them to the program on the host computer like songs, videos etc and then they travel all over the Internet. Ther Creeper Virus was first detected on ARPANET. Examples include File Virus, Macro Virus, Boot Sector Virus, Stealth Virus etc.

2. **Worms:** Worms are also self replicating in nature but they don't hook themselves to the program on host computer. Biggest difference between virus and worms is that worms are network aware. They can easily travel from one computer to another if network is available and on the target machine they will not do much harm, they will for example consume hard disk space thus slowing down the computer.

3. **Trojan:** The Concept of Trojan is completely different from the viruses and worms. The name Trojan derived from the 'Trojan Horse' tale in Greek mythology, which explains how the Greeks were able to enter the fortified city of Troy by hiding their soldiers in a big wooden horse given to the Trojans as a gift. The Trojans were very fond of horses and trusted the gift blindly. In the night, the soldiers emerged and attacked the city from the inside.

Their purpose is to conceal themselves inside the software that seem legitimate and when that software is executed they will do their task of either stealing information or any other purpose for which they are designed.

They often provide backdoor gateway for malicious programs or malevolent users to enter your system and steal your valuable data without your knowledge and permission. Examples include FTP Trojans, Proxy Trojans, Remote Access Trojans etc.

4. **Bots:** can be seen as advanced form of worms. They are automated processes that are designed to interact over the internet without the need of human interaction. They can be good or bad. Malicious bot can infect one host and after infecting will create connection to the central server which will provide commands to all infected hosts attached to that network called Botnet.

Malware on the basis of Actions:

1. **Adware:** Adware is not exactly malicious but they do breach privacy of the users. They display ads on computer's desktop or inside individual programs. They come attached with free to use software, thus main source of revenue for such developers. They monitor your interests and display relevant ads. An attacker can embed malicious code inside the software and adware can monitor your system activities and can even compromise your machine.

2. **Spyware:** It is a program or we can say a software that monitors your activities on computer and reveal collected information to interested party. Spyware are generally dropped by Trojans, viruses or worms. Once dropped they installs themselves and sits silently to avoid detection. One of the most common example of spyware is KEYLOGGER. The basic job of keylogger is to record user keystrokes with timestamp. Thus capturing interesting information like username, passwords, credit card details etc.

3. **Ransomware:** It is type of malware that will either encrypt your files or will lock your computer making it inaccessible either partially or wholly. Then a screen will be displayed asking for money i.e. ransom in exchange.

4. **Scareware:** It masquerades as a tool to help fix your system but when the software is executed it will infect your system or completely destroy it. The software will display a message to frighten you and force to take some action like pay them to fix your system.

5. **Rootkits:** are designed to gain root access or we can say administrative privileges in the user system. Once gained the root access, the exploiter can do anything from stealing private files to private data.

6. **Zombies:** They work similar to Spyware. Infection mechanism is same but they don't spy and steal information rather they wait for the command from hackers.

- Theft of intellectual property means violation of intellectual property rights like copyrights, patents etc.
- Identity theft means to act someone else to obtain person's personal information or to access vital information they have like accessing the computer or social media account of a person by login into the account by using their login credentials.
- Theft of equipment and information is increasing these days due to the mobile nature of devices and increasing information capacity.
- Sabotage means destroying company's website to cause loss of confidence on part of its customer.
- Information extortion means theft of company's property or information to receive payment in exchange. For example ransomware may lock victims file making them inaccessible thus forcing victim to make payment in exchange. Only after payment victim's files will be unlocked.

These are the old generation attacks that continue these days also with advancement every year. Apart from these there are many other threats. Below is the brief description of these new generation threats.

- **Technology with weak security:** With the advancement in technology, with every passing day a new gadget is being released in the market. But very few are fully secured and follows Information Security principles. Since the market is very competitive Security factor is compromised to make device more up to date. This leads to theft of data/ information from the devices

- **Social media attacks:** In this cyber criminals identify and infect a cluster of websites that persons of a particular organisation visit, to steal information.

- **Mobile Malware:** There is a saying when there is a connectivity to Internet there will be danger to Security. Same goes to Mobile phones where gaming applications are designed to lure customer to download the game and unintentionally they will install malware or virus in the device.

- **Outdated Security Software:** With new threats emerging everyday, updation in security software is a pre requisite to have a fully secured environment.

- **Corporate data on personal devices:** These days every organization follows a rule BYOD. BYOD means Bring your own device like Laptops, Tablets to the workplace. Clearly BYOD pose a serious threat to security of data but due to productivity issues organizations are arguing to adopt this.

- **Social Engineering:** is the art of manipulating people so that they give up their confidential information like bank account details, password etc. These criminals can trick you into giving your private and confidential information or they will gain your trust to get access to your computer to install a malicious software- that will give them control of your

computer. For example email or message from your friend, that was probably not sent by your friend. Criminal can access your friends device and then by accessing the contact list he can send infected email and message to all contacts. Since the message/ email is from a known person recipient will definitely check the link or attachment in the message, thus unintentionally infecting the computer.

Vulnerability:

Vulnerability is a cyber-security term that refers to a flaw in a system that can leave it open to attack. Vulnerability may also refer to any type of weakness in a computer system itself, in a set of procedures, or in anything that leaves information security exposed to a threat.

A computer vulnerability is a cybersecurity term that refers to a defect in a system that can leave it open to attack. This vulnerability could also refer to any type of weakness present in a computer itself, in a set of procedures, or in anything that allows information security to be exposed to a threat.

It is possible for network personnel and computer users to protect computers from vulnerabilities by regularly updating software security patches. These patches are capable of solving flaws or security holes found in the initial release. Network personnel and computer users should also stay informed about current vulnerabilities in the software they use and look out for ways to protect against them.

Common Computer Security Vulnerabilities

The most common computer vulnerabilities include:

- Bugs
- Weak passwords
- Software that is already infected with virus
- Missing data encryption
- OS command injection
- SQL injection
- Buffer overflow
- Missing authorization
- Use of broken algorithms
- URL redirection to untrusted sites
- Path traversal
- Missing authentication for critical function
- Unrestricted upload of dangerous file types
- Dependence on untrusted inputs in a security decision
- Cross-site scripting and forgery
- Download of codes without integrity checks

Causes and Harms of Computer Security Vulnerabilities

Computer system vulnerabilities exist because programmers fail to fully understand the inner programs. While designing and programming, programmers don't really take into account all aspects of computer systems and this, in turn, causes computer system vulnerability. Some programmers program in an unsafe and incorrect way, which worsen computer system vulnerability.

The harm of computer system vulnerability can be presented in several aspects, for example, the disclosure of confidential data, and widespread of Internet virus and hacker intrusion, which can cause great harm to enterprises and individual users by bringing about major economic loss. With the steady improvement of the degree of information, very severe computer system vulnerabilities can become a threat to national security in the aspects of economy, politics, and military.

Computer security vulnerability can harm five kinds of system securities that include: Reliability, confidentiality, entirety, usability, and undeniableness.

- **Reliability:** This refers to reducing incorrect false alarm in the operation of a computer system and enhancing the efficiency of a computer system.
- **Confidentiality:** This refers to protecting users' information from disclosure and getting by unauthorized third party.
- **Entirety:** This system security requires that information or programs should not be forged, tampered, deleted or inserted deliberately in the process of storing, operation and communication. In other words, information or programs cannot be lost or destroyed.
- **Usability:** This ensures that users can enjoy the services offered by computers and information networks.
- **Undeniableness:** This security refers to guaranteeing information actors to be responsible for their behavior.

Use Endpoint Security to Protect all Endpoints

Endpoint Security also known as Endpoint Protection is a centralized approach that focuses on protecting all endpoints – desktops, laptops, servers, smart phones, and several other IT devices – connected to the corporate IT network from cyber threats. This methodology enables effective, efficient, and easier security management. Some vendors offer Endpoint Security systems that include firewall, antivirus, and other high defined security software.

- **Antivirus:** Features multiple technology-based automatic detection, cleansing and quarantining of suspicious files to remove viruses and malware.
- **Comodo Firewall:** Offers high-level security against outbound and inbound threats, manages network connections, and blocks personal data transmission by malicious software.
- **Web URL Filtering:** Advanced interface to create rules as needed – user-specific, sweeping, or as granular as desired.

- **Host Intrusion Protection System (HIPS):** Monitors vital operating system activities to guarantee protection against malware intrusion.
- **Containment with auto-sandboxing:** All unrecognized applications and processes are auto-sandboxed to run in a restricted environment.
- **File Lookup Services (FLS):** Cloud-based instant analysis of strange files that checks file reputation against Comodo's master whitelist and blacklists.
- **Viruscope (Behavior Analysis):** Behavior of all processes are monitored for potential harmful action.

Most Common Website Security Vulnerabilities

1. **SQL INJECTIONS:** SQL injection is a type of web application security vulnerability in which an attacker attempts to use application code to access or corrupt database content. If successful, this allows the attacker to create, read, update, alter, or delete data stored in the back-end database. SQL injection is one of the most prevalent types of web application security vulnerabilities.
2. **CROSS SITE SCRIPTING (XSS):** Cross-site scripting (XSS) targets an application's users by injecting code, usually a client-side script such as JavaScript, into a web application's output. The concept of XSS is to manipulate client-side scripts of a web application to execute in the manner desired by the attacker. XSS allows attackers to execute scripts in the victim's browser which can hijack user sessions, deface websites or redirect the user to malicious sites.
3. **BROKEN AUTHENTICATION & SESSION MANAGEMENT:** Broken authentication and session management encompass several security issues, all of them having to do with maintaining the identity of a user. If authentication credentials and session identifiers are not protected at all times an attacker can hijack an active session and assume the identity of a user.
4. **INSECURE DIRECT OBJECT REFERENCES:** Insecure direct object reference is when a web application exposes a reference to an internal implementation object. Internal implementation objects include files, database records, directories and database keys. When an application exposes a reference to one of these objects in a URL hacker can manipulate it to gain access to a user's personal data.
5. **SECURITY MISCONFIGURATION:** Security misconfiguration encompasses several types of vulnerabilities all centered on a lack of maintenance or a lack of attention to the web application configuration. A secure configuration must be defined and deployed for the application, frameworks, application server, web server, database server and platform. Security misconfiguration gives hackers access to private data or features and can result in a complete system compromise.
6. **CROSS-SITE REQUEST FORGERY (CSRF):** Cross-Site Request Forgery (CSRF) is a malicious attack where a user is tricked into performing an action he or she didn't intend to do. A third-party website will send a request to a web application that a user is already authenticated against (e.g. their bank). The attacker can then access functionality via the

victim's already authenticated browser. Targets include web applications like social media, in browser email clients, online banking, and web interfaces for network devices.

The other most common software security vulnerabilities include:

- Missing data encryption
- OS command injection
- Buffer overflow
- Missing authentication for critical function
- Missing authorization
- Unrestricted upload of dangerous file types
- Reliance on untrusted inputs in a security decision
- Download of codes without integrity checks
- Use of broken algorithms
- URL redirection to untrusted sites
- Path traversal
- Bugs
- Weak passwords
- Software that is already infected with virus

Unit V:

New Trends in MIS

Introduction

21st century has been defined by application of and advancement in information technology. Information technology has become an integral part of our daily life. According to Information Technology Association of America, information technology is defined as "the study, design, development, application, implementation, support or management of computer-based information systems."

Information technology has served as a big change agent in different aspect of business and society. It has proven game changer in resolving economic and social issues.

Advancement and application of information technology are ever changing. Some of the trends in the information technology are as follows:

Cloud computing:

Emerging platforms are new technology developments and business models for which a theory is yet to be formulated, and yet there are rapid, radical innovations happening in their field. In this article, we will learn about one such platform - Cloud Computing by doing a critical assessment of its current trends, appreciate the challenges in implementing it and gain a perspective on how this technology impacts business outcomes.

One of the most talked about concept in information technology is the cloud computing. Clouding computing is defined as utilization of computing services, i.e. software as well as hardware as a service over a network. Typically, this network is the internet.

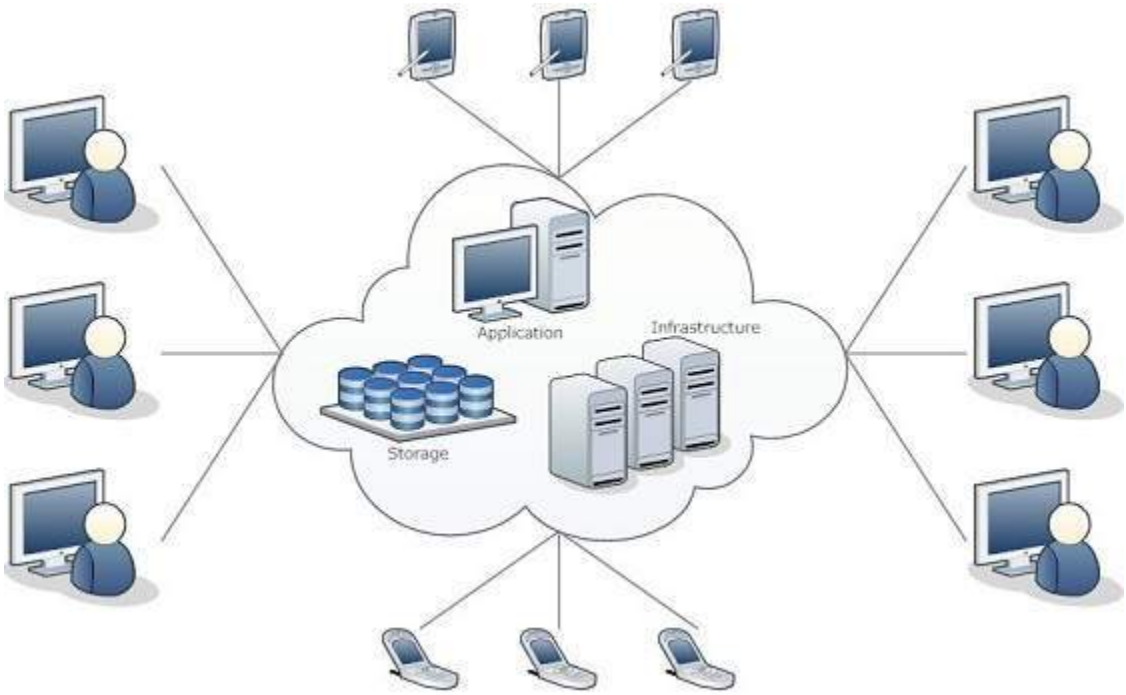
What is Cloud?

The term **Cloud** refers to a **Network** or **Internet.** In other words, we can say that Cloud is something, which is present at remote location. Cloud can provide services over public and private networks, i.e., WAN, LAN or VPN.

Applications such as e-mail, web conferencing, customer relationship management (CRM) execute on cloud.

What is Cloud Computing?

Cloud Computing refers to **manipulating, configuring,** and **accessing** the hardware and software resources remotely. It offers online data storage, infrastructure, and application.



Cloud computing offers **platform independency,** as the software is not required to be installed locally on the PC. Hence, the Cloud Computing is making our business applications **mobile** and **collaborative.**

Cloud computing is a suite of tools which enables companies to lease their digital assets somewhere 'in the cloud'. So unlike the 'on-premise' data centers, the location of computers, applications and databases that employees are using is unknown. The point is to free companies from details and 'rent' whatever is needed from the cloud. They don't need to buy and thus the IT expenses are switched from fixed capital to operating expenses.

Cloud Computing provides us means of accessing the applications as utilities over the Internet. It allows us to create, configure, and customize the applications online.

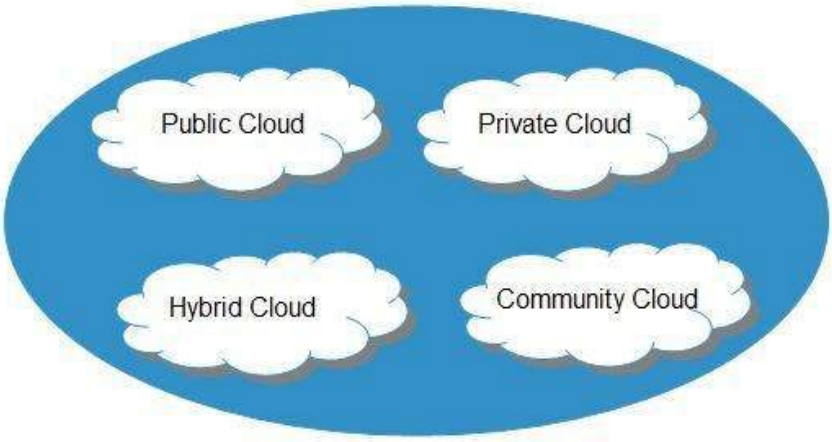
Basic Concepts

There are certain services and models working behind the scene making the cloud computing feasible and accessible to end users. Following are the working models for cloud computing:

- Deployment Models
- Service Models

Deployment Models/Types

Deployment models define the type of access to the cloud, i.e., how the cloud is located? Cloud can have any of the four types of access: Public, Private, Hybrid, and Community.



PUBLIC CLOUD: The **public cloud** allows systems and services to be easily accessible to the general public. Public cloud may be less secure because of its openness.

PRIVATE CLOUD: The **private cloud** allows systems and services to be accessible within an organization. It is more secured because of its private nature.

COMMUNITY CLOUD: The **community cloud** allows systems and services to be accessible by a group of organizations.

HYBRID CLOUD: The **hybrid cloud** is a mixture of public and private cloud, in which the critical activities are performed using private cloud while the non-critical activities are performed using public cloud.

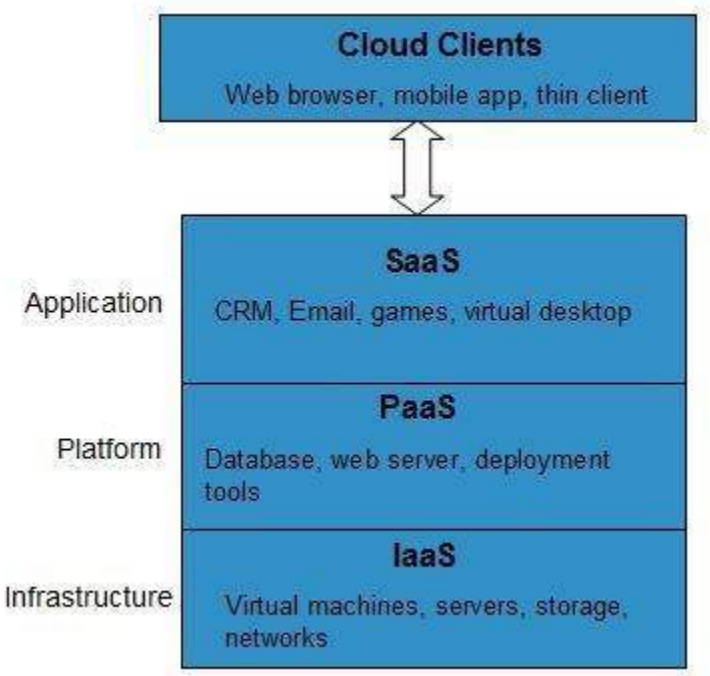
Service Models

Cloud computing is based on service models. These are categorized into three basic service models which are -

- Infrastructure-as–a-Service (IaaS)
- Platform-as-a-Service (PaaS)
- Software-as-a-Service (SaaS)

Anything-as-a-Service (XaaS) is yet another service model, which includes Network-as-a-Service, Business-as-a-Service, Identity-as-a-Service, Database-as-a-Service or Strategy-as-a-Service.

The **Infrastructure-as-a-Service (IaaS)** is the most basic level of service. Each of the service models inherit the security and management mechanism from the underlying model, as shown in the following diagram:



Let us clarify some jargons that are often used in tandem with the cloud terminology. The offerings of the cloud can broadly be categorized into the following:

1. INFRASTRUCTUR-AS-A-SERVICE (IAAS): This is the simplest form wherein server(s) or a storage capacity is there on cloud. Clients opting for this arrangement are typically IT companies who don't want the hassle of installing or maintaining the space, but want to avail access to their material whenever required.

2. PLATFORM-AS-A-SERVICE (PAAS): This platform enables employees to write code, develop applications and integrate with their existing resources. The environment is conducive to development as it comes installed with technologies such as .NET, Java, Ruby on Rails, Python, etc that can prepare code and then host it for sharing.

3. SOFTWARE-AS-A-SERVICE (SAAS): This is the most mature offering of cloud that comprises of applications residing on the cloud as opposed to the physical database. CRM Salesforce.com was the first to implement this offering all customer relationship management data and analytics on cloud instead of on the hard drive.

How does the Cloud help?

Apart from doing away with purchasing and installing massive data centers and making information available on web browsers, cloud has several benefits:

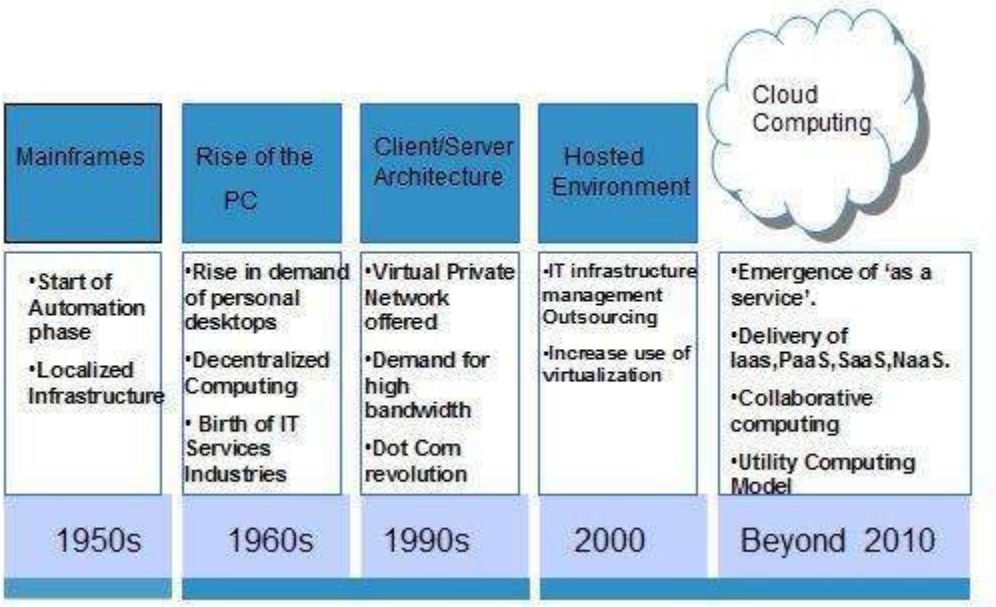
- **Productivity:** Employees can control their own accounts reducing precious time. Consider a non cloud environment such as the FTP server. Usually it is difficult to use and runs out of capacity. The IT department has to perform the repetitive task of creating a

folder for each user and granting them the required access. If the folder details are to be shared with anyone else, the requisition has to again be routed via the IT department. In contrast, a cloud environment can enable self administration of accounts.

- **Collaboration:** Teams and communities can work collectively as all resources are shared online. This proves very useful in a typical IT onsite-offshore arrangement.
- **Better Intelligence:** Cloud platforms have their own study softwares that can be combined with company specific resources to create unique results. For example, Google Earth Builder, an application pre loaded on cloud, facilitates to companies to upload their own data on Google Earth or Google Maps thereby establishing their presence on these resources.
- **Cost Savings:** Instead of purchasing and maintaining expensive servers themselves, companies can invest in cloud based platforms which proves out to be a cheaper alternative. This is because cloud providers acquire mammoth quantities of bandwidth, hardware and power to get better price points.
- **Reliability:** Cloud providers build redundancy to avoid major disruptions. This investment may not be possible for individual companies. To illustrate, as monitored in 2010, Gmail was available 99.984% of the times, with an admirable down time of only 7 minutes per month. As per research, this is 32 times more reliable than a typical company email setup.

History of Cloud Computing:

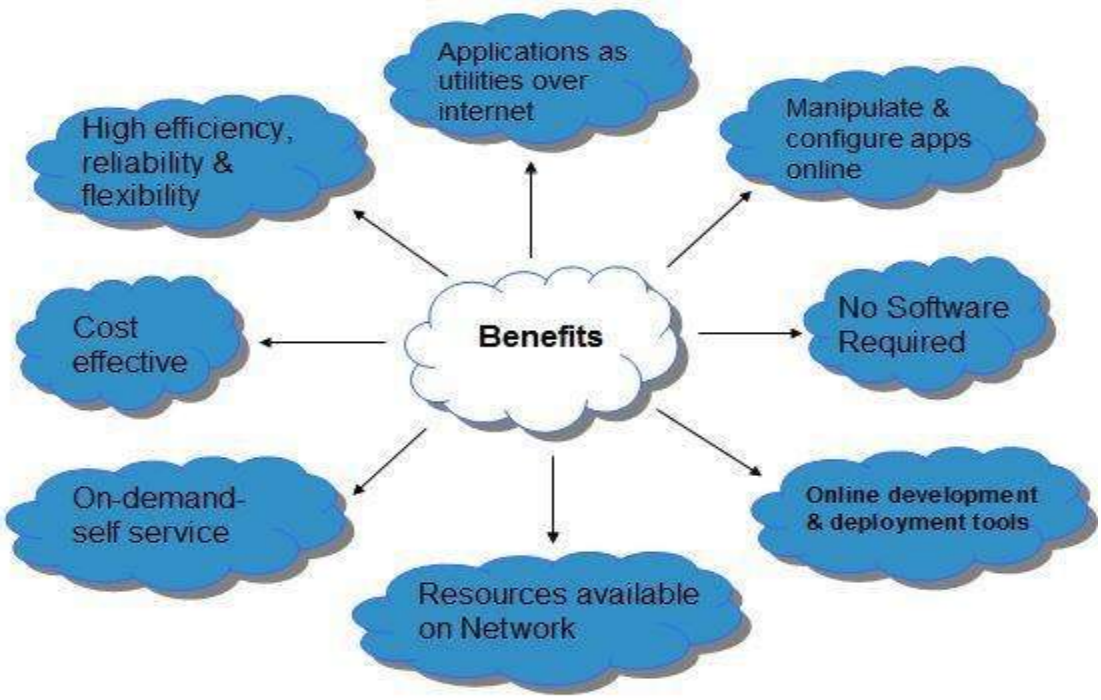
The concept of Cloud Computing came into existence in the year 1950 with implementation of mainframe computers, accessible via thin/static clients. Since then, cloud computing has been evolved from static clients to dynamic ones and from software to services. The following diagram explains the evolution of cloud computing:



Benefits

Cloud Computing has numerous advantages. Some of them are listed below -

1. One can access applications as utilities, over the Internet.
2. One can manipulate and configure the applications online at any time.
3. It does not require installing software to access or manipulating cloud application.
4. Cloud Computing offers online development and deployment tools, programming runtime environment through PaaS model.
5. Cloud resources are available over the network in a manner that provide platform independent access to any type of clients.
6. Cloud Computing offers on-demand self-service. The resources can be used without interaction with cloud service provider.
7. Cloud Computing is highly cost effective because it operates at high efficiency with optimum utilization. It just requires an Internet connection
8. Cloud Computing offers load balancing that makes it more reliable.



Risks related to Cloud Computing

Although cloud Computing is a promising innovation with various benefits in the world of computing, it comes with risks. Some of them are discussed below:

Security and Privacy: It is the biggest concern about cloud computing. Since data management and infrastructure management in cloud is provided by third-party, it is always a risk to handover the sensitive information to cloud service providers.

Although the cloud computing vendors ensure highly secured password protected accounts, any sign of security breach may result in loss of customers and businesses.

Lock In: It is very difficult for the customers to switch from one Cloud Service Provider (CSP) to another. It results in dependency on a particular CSP for service.

Isolation Failure: This risk involves the failure of isolation mechanism that separates storage, memory, and routing between the different tenants.

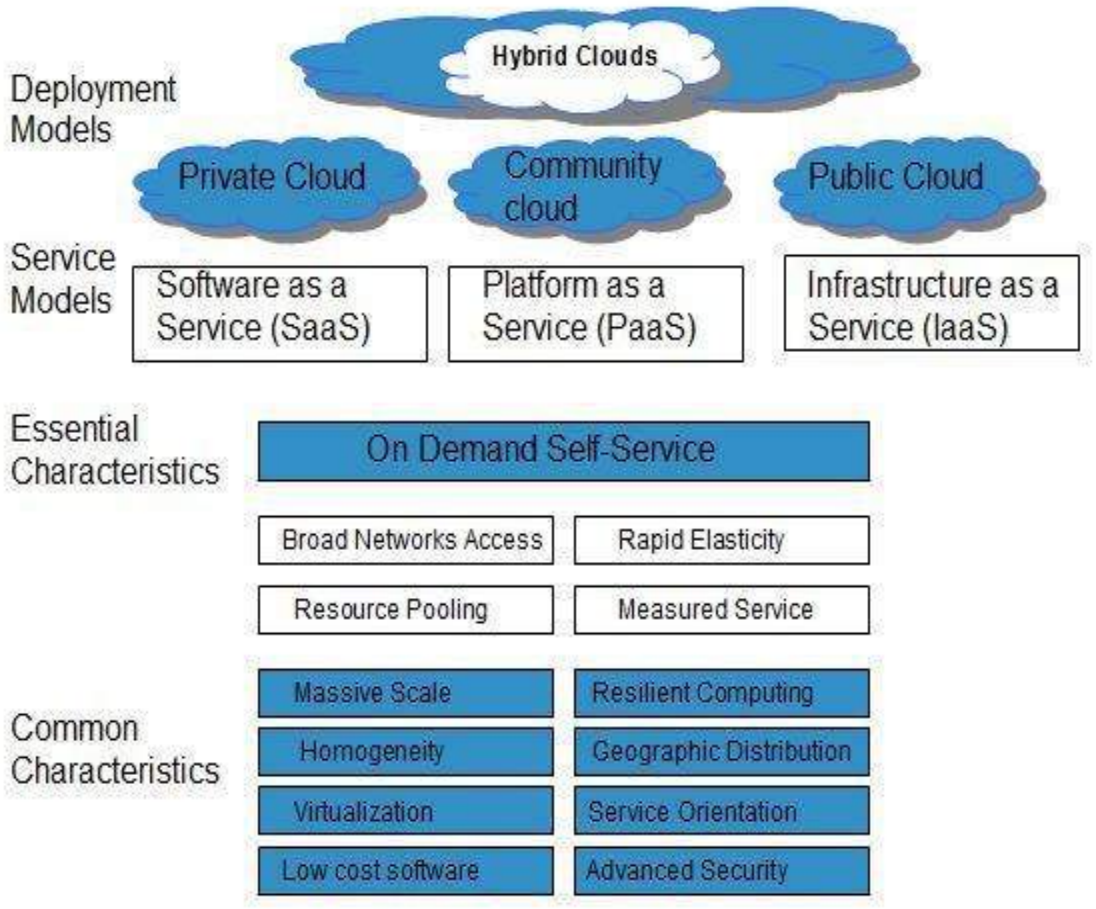
Management Interface Compromise: In case of public cloud provider, the customer management interfaces are accessible through the Internet.

Insecure or Incomplete Data Deletion: It is possible that the data requested for deletion may not get deleted. It happens because either of the following reasons

- Extra copies of data are stored but are not available at the time of deletion
- Disk that stores data of multiple tenants is destroyed**.**

Characteristics of Cloud Computing

There are four key characteristics of cloud computing. They are shown in the following diagram:



Features of Cloud Computing:

1. **High scalability:** It means on demand provisioning of resources on a large scale without requiring human interaction with each service provider.
2. **High availability and reliability:** Availability of servers is more reliable and high because it minimizes the chances of infrastructure failure.
3. **Agility:** It shares the resources between users and works very quickly.
4. **Multi-sharing:** Multiple user and applications work more efficiently with less cost by sharing common infrastructure using cloud computing.
5. **Maintenance:** Maintenance of cloud computing applications is easier as they are not required to be install on each computer and can also be accessed from various places, ultimately reducing the cost.
6. **Low cost:** It is cost effective because the company no more needs to set its own infrastructure. It pays according to resources it has consumed.

7. **Services in pay-per-use mode:** APIs(Application Programming Interfaces) are provided to the users for accessing the services on the cloud and pay according to use of the service.

On Demand Self Service

Cloud Computing allows the users to use web services and resources on demand. One can logon to a website at any time and use them.

Broad Network Access: Since cloud computing is completely web based, it can be accessed from anywhere and at any time.

Resource Pooling: Cloud computing allows multiple tenants to share a pool of resources. One can share single physical instance of hardware, database and basic infrastructure.

Rapid Elasticity: It is very easy to scale the resources vertically or horizontally at any time. Scaling of resources means the ability of resources to deal with increasing or decreasing demand.

The resources being used by customers at any given point of time are automatically monitored.

Measured Service: In this service cloud provider controls and monitors all the aspects of cloud service. Resource optimization, billing, and capacity planning etc. depend on it.

Concluding Remarks:

The cloud is still in its infancy stage and hence is an emerging platform. There is a fast increase in the number of cloud vendors; they are trying to be creative and segregate their offerings. In times ahead, there are expected to be transformative changes in this field and wider acceptance of the technology.

Big Data:

Introduction:

Big data is a blanket term for the non-traditional strategies and technologies needed to gather, organize, process, and gather insights from large datasets. While the problem of working with data that exceeds the computing power or storage of a single computer is not new, the pervasiveness, scale, and value of this type of computing has greatly expanded in recent years.

In this article, we will talk about big data on a fundamental level and define common concepts you might come across while researching the subject. We will also take a high-level look at some of the processes and technologies currently being used in this space.

What Is Big Data?

An exact definition of "big data" is difficult to nail down because projects, vendors, practitioners, and business professionals use it quite differently. With that in mind, generally speaking, big data is:

- large datasets
- the category of computing strategies and technologies that are used to handle large datasets

In this context, "large dataset" means a dataset too large to reasonably process or store with traditional tooling or on a single computer. This means that the common scale of big datasets is constantly shifting and may vary significantly from organization to organization.

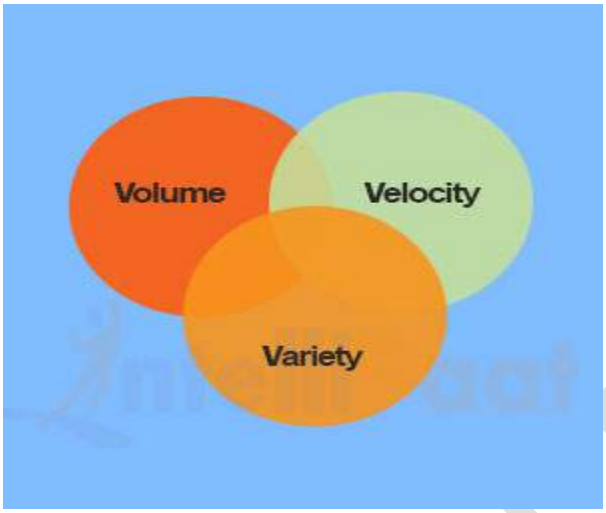
Big Data is a collection of large datasets that cannot be adequately processed using traditional processing techniques. Big data is not only data it has become a complete subject, which involves various tools, techniques and frameworks.

Big data term describes the volume amount of data both structured and unstructured manner that adapted in day-to-day business environment. It's important that what organizations utilize with these with the data that matters.

Big data helps to analyze the in-depth concepts for the better decisions and strategic taken for the development of the organization.

The Evolution of Big Data

While the term "big data" is the new in this era, as it is the act of gathering and storing huge amounts of information for eventual analysis is ages old. The concept came into existence in the early 2000s when Industry analyst Doug Laney the definition of big data as the three categories as follows:



Volume: Organizations collects the data from relative sources, which includes business transactions, social media and information from sensor or machine-to-machine data. Before, storage was a big issue but now the advancement of new technologies (such as Hadoop) has reduced the burden.

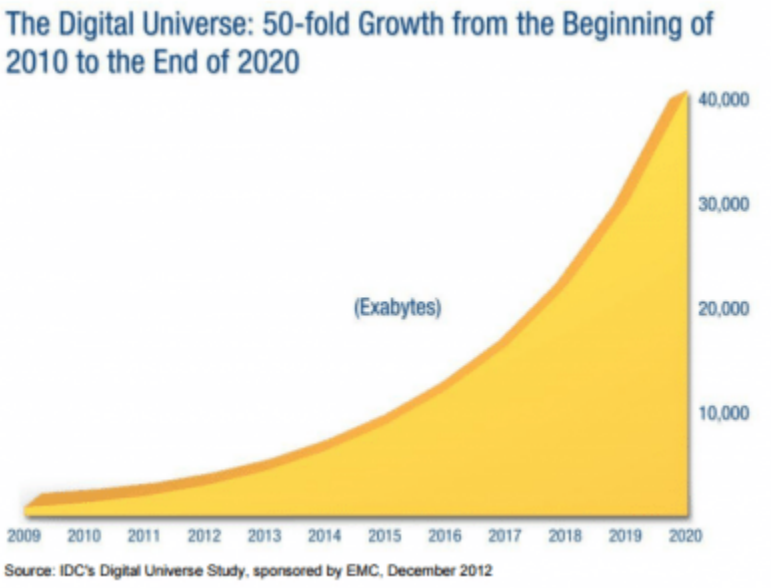
Velocity: Data streams unparalleled speed of velocity and have improved in timely manner. RFID tags, sensors and smart metering are driving the need to deal with torrents of data in real time operations.

Variety: Data comes in all varieties in form of structured, numeric data in traditional databases to unstructured text documents, email, video, audio, stock ticker data and financial transactions.

Big Data Characteristics

The five characteristics that define Big Data are: Volume, Velocity, Variety, Veracity and Value.

1. **Volume:** Volume refers to the 'amount of data', which is growing day by day at a very fast pace. The size of data generated by humans, machines and their interactions on social media itself is massive. Researchers have predicted that 40 Zettabytes (40,000 Exabytes) will be generated by 2020, which is an increase of 300 times from 2005.



2. **Velocity**: Velocity is defined as the pace at which different sources generate the data every day. This flow of data is massive and continuous. There are 1.03 billion Daily Active Users (Facebook DAU) on Mobile as of now, which is an increase of 22% year-over-year. This shows how fast the numbers of users are growing on social media and how fast the data is getting generated daily. If you are able to handle the velocity, you will be able to generate insights and take decisions based on real-time data.

3. **Variety:** As there are many sources which are contributing to Big Data, the type of data they are generating is different. It can be structured, semi-structured or unstructured. Hence, there is a variety of data which is getting generated every day. Earlier, we used to get the data from excel and databases, now the data are coming in the form of images, audios, videos, sensor data etc. as shown in below image. Hence, this variety of unstructured data creates problems in capturing, storage, mining and analyzing the data.

4. **Veracity:** Veracity refers to the data in doubt or uncertainty of data available due to data inconsistency and incompleteness. In the image below, you can see that few values are missing in the table. Also, a few values are hard to accept, for example – 15000 minimum values in the 3rd row, it is not possible. This inconsistency and incompleteness is Veracity.

Min	Max	Mean	SD
4.3	?	5.84	0.83
2.0	4.4	3.05	50000000
15000	7.9	1.20	0.43
0.1	2.5	?	0.76

Data available can sometimes get messy and maybe difficult to trust. With many forms of big data, quality and accuracy are difficult to control like Twitter posts with hashtags, abbreviations, typos and colloquial speech. The volume is often the reason behind for the lack of quality and accuracy in the data.

- Due to uncertainty of data, 1 in 3 business leaders don't trust the information they use to make decisions.
- It was found in a survey that 27% of respondents were unsure of how much of their data was inaccurate.
- Poor data quality costs the US economy around $3.1 trillion a year.

5. **Value:** After discussing Volume, Velocity, Variety and Veracity, there is another V that should be taken into account when looking at Big Data i.e. Value. It is all well and good to have access to big data butunless we can turn it into value it is useless. By turning it into value I mean, Is it adding to the benefits of the organizations who are analyzing big data? Is the organization working on Big Data achieving high ROI (Return On Investment)? Unless, it adds to their profits by working on Big Data, it is useless.

Types of Big Data:

Big Data could be of three types:

1. Structured
2. Semi-Structured
3. Unstructured

1. **Structured:** The data that can be stored and processed in a fixed format is called as Structured Data. Data stored in a relational database management system (RDBMS) is one example of 'structured' data. It is easy to process structured data as it has a fixed schema. Structured Query Language (SQL) is often used to manage such kind of Data.

2. **Semi-Structured:** Semi-Structured Data is a type of data which does not have a formal structure of a data model, i.e. a table definition in a relational DBMS, but nevertheless it has some organizational properties like tags and other markers to separate semantic elements that makes it easier to analyze. XML files or JSON documents are examples of semi-structured data.

3. **Unstructured:** The data which have unknown form and cannot be stored in RDBMS and cannot be analyzed unless it is transformed into a structured format is called as unstructured data. Text Files and multimedia contents like images, audios, videos are example of unstructured data. The unstructured data is growing quicker than others, experts say that 80 percent of the data in an organization are unstructured.

Till now, I have just covered the introduction of Big Data. Furthermore, this Big Data tutorial talks about examples, applications and challenges in Big Data.

Thus Big Data includes huge volume, high velocity, and extensible variety of data. The data in it will be of three types.

- **Structured data** − Relational data.
- **Semi Structured data** − XML data.
- **Unstructured data** − Word, PDF, Text, Media Logs.

Examples of Big Data

Daily we upload millions of bytes of data. 90 % of the world's data has been created in last two years.

- Walmart handles more than **1 million** customer transactions every hour.
- Facebook stores, accesses, and analyzes **30+ Petabytes** of user generated data.
- **230+ millions** of tweets are created every day.
- More than **5 billion** people are calling, texting, tweeting and browsing on mobile phones worldwide.
- YouTube users upload **48 hours** of new video every minute of the day.
- Amazon handles **15 million** customer click stream user data per day to recommend products.
- **294 billion** emails are sent every day. Services analyses this data to find the spams.
- Modern cars have close to **100 sensors** which monitors fuel level, tire pressure etc. , each vehicle generates a lot of sensor data.

Applications of Big Data:

We cannot talk about data without talking about the people, people who are getting benefited by Big Data applications. Almost all the industries today are leveraging Big Data applications in one or the other way.

- **Smarter Healthcare**: Making use of the petabytes of patient's data, the organization can extract meaningful information and then build applications that can predict the patient's deteriorating condition in advance.
- **Telecom**: Telecom sectors collects information, analyzes it and provide solutions to different problems. By using Big Data applications, telecom companies have been able to significantly reduce data packet loss, which occurs when networks are overloaded, and thus, providing a seamless connection to their customers.
- **Retail**: Retail has some of the tightest margins, and is one of the greatest beneficiaries of big data. The beauty of using big data in retail is to understand consumer behavior. Amazon's recommendation engine provides suggestion based on the browsing history of the consumer.
- **Traffic control**: Traffic congestion is a major challenge for many cities globally. Effective use of data and sensors will be key to managing traffic better as cities become increasingly densely populated.
- **Manufacturing**: Analyzing big data in the manufacturing industry can reduce component defects, improve product quality, increase efficiency, and save time and money.
- **Search Quality**: Every time we are extracting information from google, we are simultaneously generating data for it. Google stores this data and uses it to improve its search quality.

Someone has rightly said: ***"Not everything in the garden is Rosy!"***. Till now in this Big Data tutorial, I have just shown you the rosy picture of Big Data. But if it was so easy to leverage Big data, don't you think all the organizations would invest in it? Let me tell you upfront, that is not the case. There are several challenges which come along when you are working with Big Data.

Benefits of Big Data:

- Using the information kept in the social network like Facebook, the marketing agencies are learning about the response for their campaigns, promotions, and other advertising mediums.
- Using the information in the social media like preferences and product perception of their consumers, product companies and retail organizations are planning their production.

- Using the data regarding the previous medical history of patients, hospitals are providing better and quick service.

Challenges with Big Data

Let me tell you few challenges which come along with Big Data:

1. **Data Quality:** The problem here is the 4th V i.e. Veracity. The data here is very messy, inconsistent and incomplete. Dirty data cost $600 billion to the companies every year in the United States.
2. **Discovery:** Finding insights on Big Data is like finding a needle in a haystack. Analyzing petabytes of data using extremely powerful algorithms to find patterns and insights are very difficult.
3. **Storage:** The more data an organization has, the more complex the problems of managing it can become. The question that arises here is "Where to store it?". We need a storage system which can easily scale up or down on-demand.
4. **Analytics:** In the case of Big Data, most of the time we are unaware of the kind of data we are dealing with, so analyzing that data is even more difficult.
5. **Security:** Since the data is huge in size, keeping it secure is another challenge. It includes user authentication, restricting access based on a user, recording data access histories, proper use of data encryption etc.
6. **Lack of Talent:** There are a lot of Big Data projects in major organizations, but a sophisticated team of developers, data scientists and analysts who also have sufficient amount of domain knowledge is still a challenge.
7. Capturing data
8. Curation
9. Storage
10. Searching
11. Sharing
12. Transfer
13. Analysis
14. Presentation

To fulfill the above challenges, organizations normally take the help of enterprise servers.

Big Data Technologies

Big data technologies are important in providing more accurate analysis, which may lead to more concrete decision-making resulting in greater operational efficiencies, cost reductions, and reduced risks for the business.

To harness the power of big data, you would require an infrastructure that can manage and process huge volumes of structured and unstructured data in realtime and can protect data privacy and security.

There are various technologies in the market from different vendors including Amazon, IBM, Microsoft, etc., to handle big data. While looking into the technologies that handle big data, we examine the following two classes of technology:

Operational Big Data: This include systems like MongoDB that provide operational capabilities for real-time, interactive workloads where data is primarily captured and stored.

NoSQL Big Data systems are designed to take advantage of new cloud computing architectures that have emerged over the past decade to allow massive computations to be run inexpensively and efficiently. This makes operational big data workloads much easier to manage, cheaper, and faster to implement.

Some NoSQL systems can provide insights into patterns and trends based on real-time data with minimal coding and without the need for data scientists and additional infrastructure.

Analytical Big Data: These includes systems like Massively Parallel Processing (MPP) database systems and MapReduce that provide analytical capabilities for retrospective and complex analysis that may touch most or all of the data.

MapReduce provides a new method of analyzing data that is complementary to the capabilities provided by SQL, and a system based on MapReduce that can be scaled up from single servers to thousands of high and low end machines.

These two classes of technology are complementary and frequently deployed together.

Operational vs. Analytical Systems

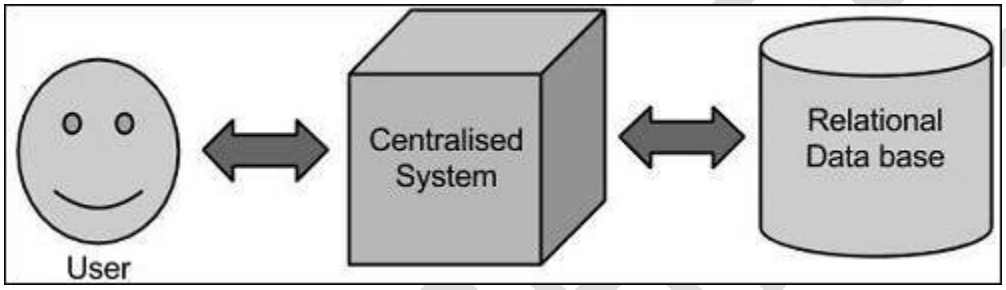
	Operational	**Analytical**
Latency	1 ms - 100 ms	1 min - 100 min
Concurrency	1000 - 100,000	1 - 10
Access Pattern	Writes and Reads	Reads
Queries	Selective	Unselective
Data Scope	Operational	Retrospective
End User	Customer	Data Scientist

Technology	NoSQL	MapReduce, MPP Database

Big Data Solutions:

Traditional Approach:

In this approach, an enterprise will have a computer to store and process big data. For storage purpose, the programmers will take the help of their choice of database vendors such as Oracle, IBM, etc. In this approach, the user interacts with the application, which in turn handles the part of data storage and analysis.

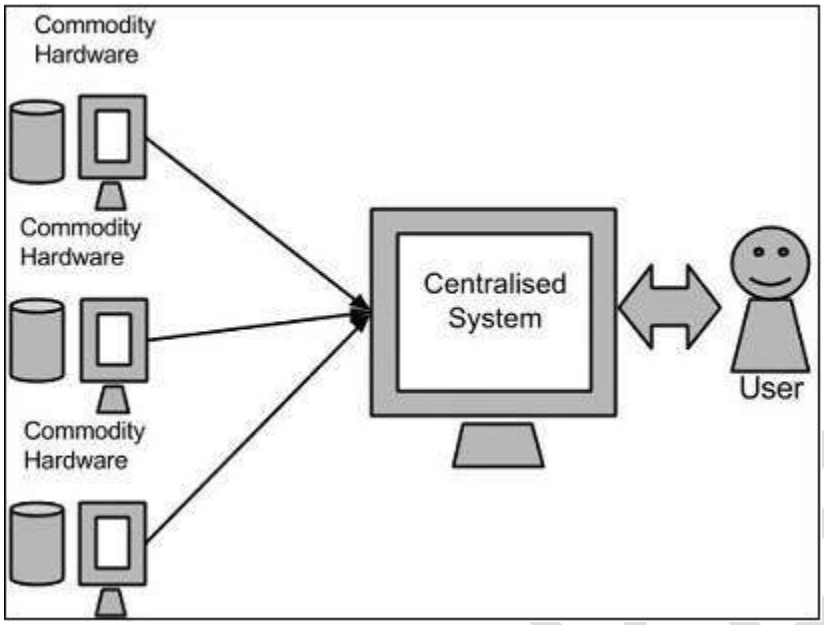


Limitation:

This approach works fine with those applications that process less voluminous data that can be accommodated by standard database servers, or up to the limit of the processor that is processing the data. But when it comes to dealing with huge amounts of scalable data, it is a hectic task to process such data through a single database bottleneck.

Google's Solution:

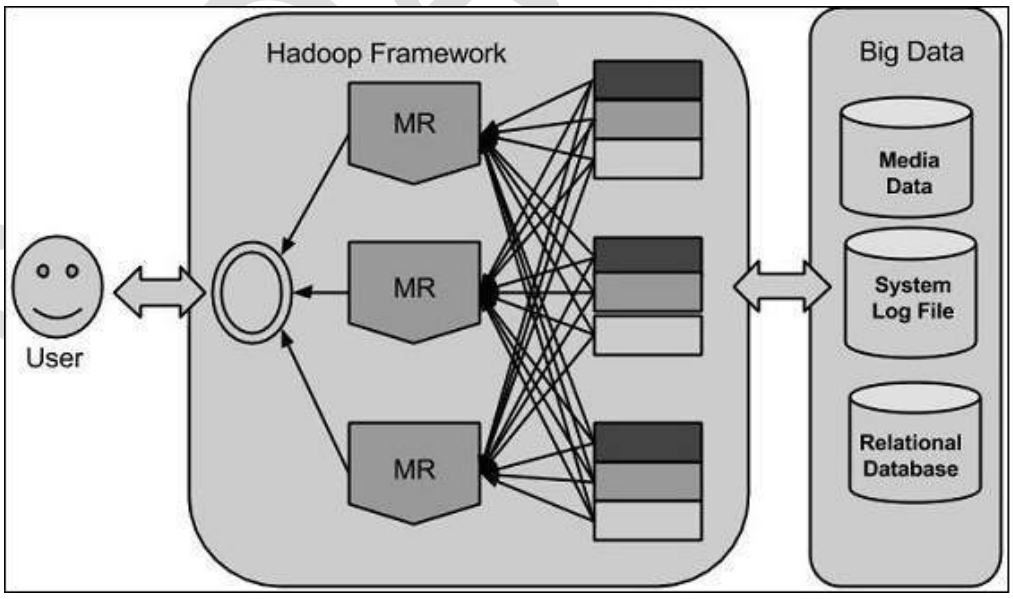
Google solved this problem using an algorithm called MapReduce. This algorithm divides the task into small parts and assigns them to many computers, and collects the results from them which when integrated, form the result dataset.



Hadoop:

Using the solution provided by Google, Doug Cutting and his team developed an Open Source Project called HADOOP.

Hadoop runs applications using the MapReduce algorithm, where the data is processed in parallel with others. In short, Hadoop is used to develop applications that could perform complete statistical analysis on huge amounts of data.



What Comes Under Big Data/ categories?

Big data involves the data produced by different devices and applications. Given below are some of the fields that come under the umbrella of Big Data.

- **Black Box Data** − It is a component of helicopter, airplanes, and jets, etc. It captures voices of the flight crew, recordings of microphones and earphones, and the performance information of the aircraft.
- **Social Media Data** − Social media such as Facebook and Twitter hold information and the views posted by millions of people across the globe.
- **Stock Exchange Data** − The stock exchange data holds information about the 'buy' and 'sell' decisions made on a share of different companies made by the customers.
- **Power Grid Data** − The power grid data holds information consumed by a particular node with respect to a base station.
- **Transport Data** − Transport data includes model, capacity, distance and availability of a vehicle.
- **Search Engine Data** − Search engines retrieve lots of data from different databases.

Who are the ones who use the Big Data Technology?

1. **Banking:** Large amounts of data streaming in from countless sources, banks have to find out unique and innovative ways to manage big data. It's important to analyze customers needs and provide them service as per their requirements, and minimize risk and fraud while maintaining regulatory compliance. Big data have to deal with financial institutions to do one step from the advanced analytics.
2. **Government:** When government agencies are harnessing and applying analytics to their big data, they have improvised a lot in terms of managing utilities, running agencies, dealing with traffic congestion or preventing the affects crime. But apart from its advantages in Big Data, governments also address issues of transparency and privacy.
3. **Education:** Educator regarding Big Data provides a significant impact on school systems, students and curriculums. By analyzing big data, they can identify at-risk students, ensuring student's progress, and can implement an improvised system for evaluation and support of teachers and principals in their teachings.
4. **Health Care:** When it comes to health care in terms of Patient records. Treatment plans. Prescription information etc., everything needs to be done quickly and accurately and some aspects enough transparency to satisfy stringent industry regulations. Effective management results in good health care to uncover hidden insights that improve patient care.
5. **Manufacturing:** Manufacturers can improve their quality and output while minimizing waste where processes are known as the main key factors in today's highly competitive market. Several manufacturers are working on analytics where they can solve problems faster and make more agile business decisions.
6. **Retail:** Customer relationship maintains is the biggest challenge in the retail industry and the best way to manage will be to manage big data. Retailers must have unique marketing

ideas to sell their products to customers, the most effective way to handle transactions, and applying improvised tactics of using innovative ideas using BigData to improve their business.

Job opportunities in big data:

Knowledge about big data is one of the most important skills required for some of the hottest job profiles which are in high demand right now and the demand in these profiles won't be dropping down any time soon, because let's be honest, accumulation of data is only going to increase over time, increasing the number of talents required in this field, opening up multiple doors of opportunities for you.

- **Data analysts** analyze and interpret data, visualize data and build reports to help make better business decisions.
- **Data scientists** mine data by assessing data sources and use algorithms and machine-learning techniques.
- **Data architects** design databases systems and tools.
- **Database managers** control database system performance, perform troubleshooting and upgrade hardware and software.
- **Big data engineers** design, maintain and support big data solutions.

Once you learn big data and understand its use, you will find there are many analytics problems you can solve which were earlier not possible due to technology limitation. Organizations are now relying more on this cost effective and robust method for easy data processing and storage of huge volumes of data.

CRM technology for Business:

Business people started using the term Customer Relationship Management (CRM) since the early 1990s when the concept of business started to change from being transactional to relational. CRM directly contributes towards customer benefits and the growth of businesses.

Information Technology plays a very critical role in identifying, acquiring, and retaining the customers, and thereby managing a healthy relationship with them.

What is CRM?

There can be multiple definitions of CRM from different perspectives −

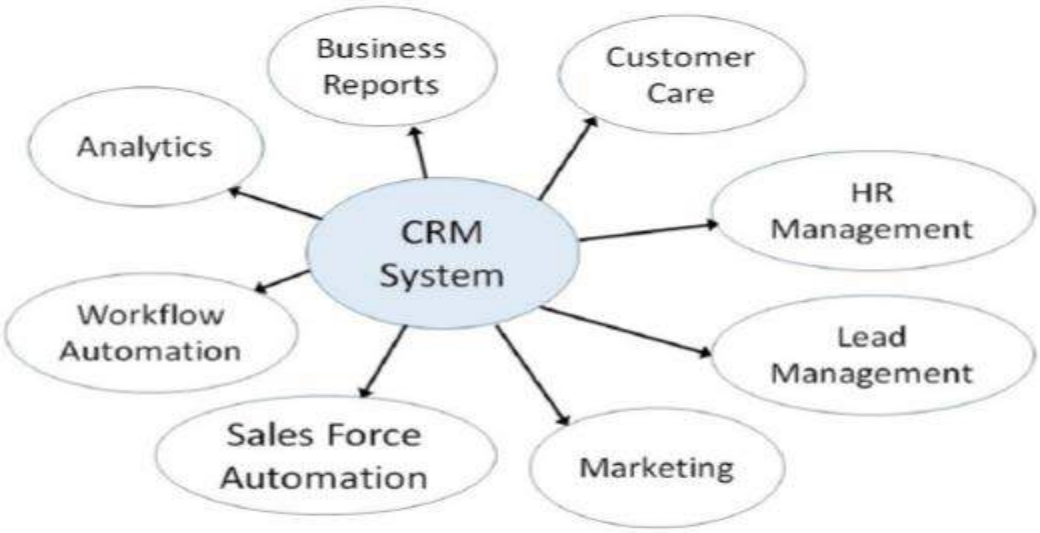
- From the viewpoint of the Management, CRM can be defined as *an organized approach of developing, managing, and maintaining a profitable relationship with customers*.

- By equating the term with technology, the IT organizations define CRM as *a software that assists marketing, merchandising, selling, and smooth service operations of a business*.
- As per Franics Buttle, World's first professor of CRM, it is the core business strategy that integrates internal processes and functions, and external networks, to create and deliver value to a target customer at profit. It is grounded on high quality customer data and information technology.

The primary goal of CRM is to increase customer loyalty and in turn improve business profitability.

Ingredients of CRM

Take a look at the following illustration. It shows the ingredients that work together to form a successful CRM system.



Here are some of the important ingredients of CRM:

- **Analytics** − Analytics is the process of studying, handling, and representing data in various graphical formats such as charts, tables, trends, etc., in order to observe market trends.
- **Business Reporting** − Business Reporting includes accurate reports of sales, customer care, and marketing.
- **Customer Service** − Customer Service involves collecting and sending the following customer-related information to the concerned department −
    - Personal information such as name, address, age
    - Previous purchase patterns.

- Requirements and preferences.
- Complaints and suggestions.

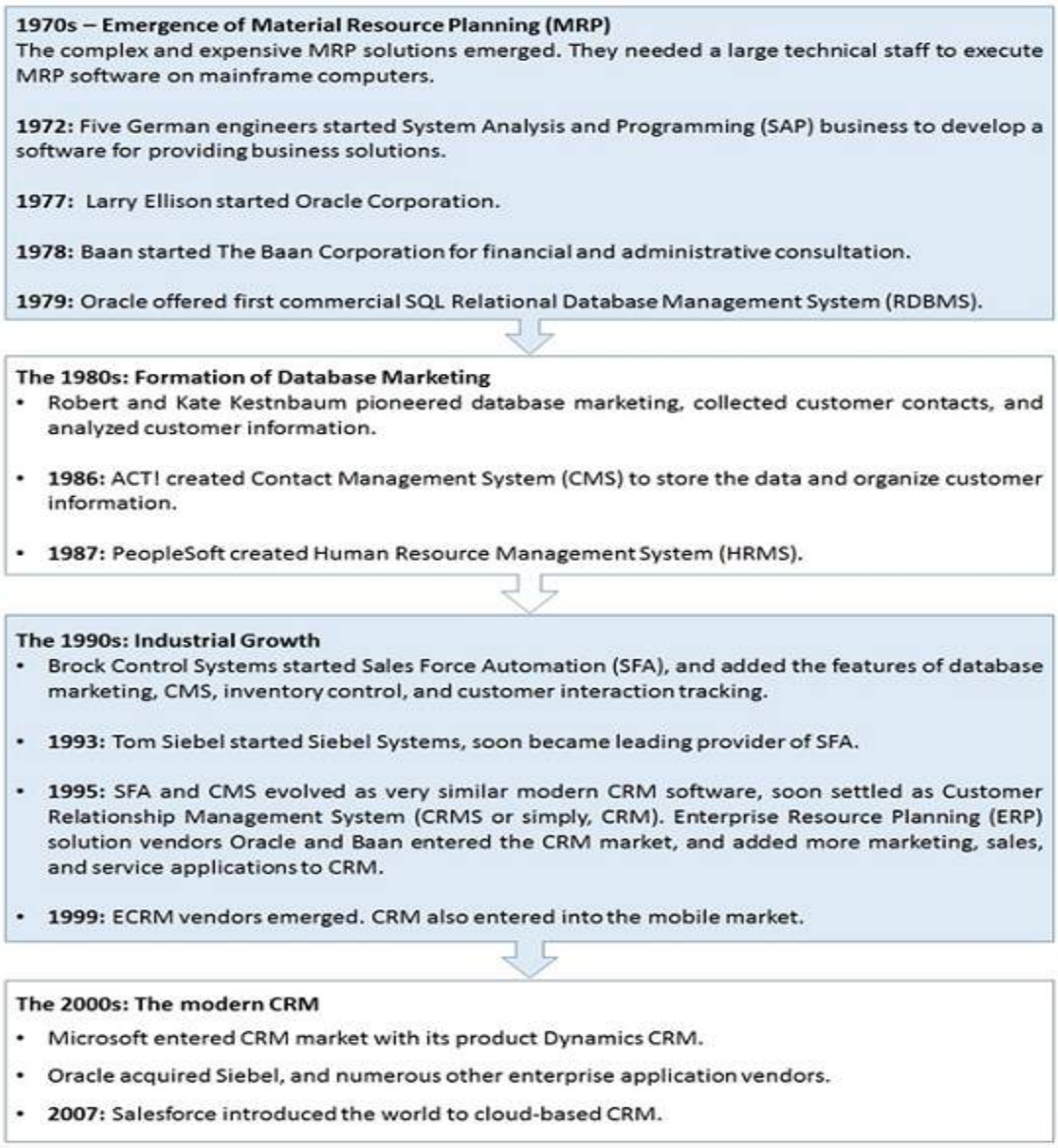
- **Human Resource Management** − Human Resource Management involves employing and placing the most eligible human resource at a required place in the business.
- **Lead Management** − Lead Management involves keeping a track of the sales leads and distribution, managing the campaigns, designing customized forms, finalizing the mailing lists, and studying the purchase patterns of the customers.
- **Marketing** − Marketing involves forming and implementing sales strategies by studying existing and potential customers in order to sell the product.
- **Sales Force Automation** − Sales Force Automation includes forecasting, recording sales, processing, and keeping a track of the potential interactions.
- **Workflow Automation** − Workflow Automation involves streamlining and scheduling various processes that run in parallel. It reduces costs and time, and prevents assigning the same task to multiple employees.

Objectives of CRM

The most prominent objectives of using the methods of Customer Relationship Management are as follows −

- **Improve Customer Satisfaction** − CRM helps in customer satisfaction as the satisfied customers remain loyal to the business and spread good word-of-mouth. This can be accomplished by fostering customer engagement via social networking sites, surveys, interactive blogs, and various mobile platforms.
- **Expand the Customer Base** − CRM not only manages the existing customers but also creates knowledge for prospective customers who are yet to convert. It helps creating and managing a huge customer base that fosters profits continuity, even for a seasonal business.
- **Enhance Business Sales** − CRM methods can be used to close more deals, increase sales, improve forecast accuracy, and suggestion selling. CRM helps to create new sales opportunities and thus helps in increasing business revenue.
- **Improve Workforce Productivity** − A CRM system can create organized manners of working for sales and sales management staff of a business. The sales staff can view customer's contact information, follow up via email or social media, manage tasks, and track the salesperson's performance. The salespersons can address the customer inquiries speedily and resolve their problems.

History of CRM



In the past twenty years, the focus of global markets has shifted from sellers to customers. Today, customers are more powerful than sellers, if we consider the driving factors of market. We have different types of CRM according to the changes in customer portfolios, speed of business operations, requirement of handling large data, and the need of sharing information, resources, and efforts jointly.

Types of CRM systems:

CRM systems are divided based on their prominent characteristics. There are four basic types of CRM systems −

1. Strategic CRM
2. Operational CRM
3. Analytical CRM

4. Collaborative CRM

The following table lists the types of CRM and their characteristic features:

Type	Characteristic
Strategic CRM	Customer-centric, based on acquiring and maintaining profitable customers.
Operational CRM	Based on customer-oriented processes such as selling, marketing, and customer service.
Analytical CRM	Based on the intelligent mining of the customer data and using it tactically for future strategies.
Collaborative CRM	Based on application of technology across organization boundaries with a view to optimize the organization and customers.

Strategic CRM: Strategic CRM is a type of CRM in which the business puts the customers first. It collects, segregates, and applies information about customers and market trends to come up with better value proposition for the customer.

The business considers the customers' voice important for its survival. In contrast to Product-Centric CRM (where the business assumes customer requirements and focuses on developing the product that may sometimes lead to over-engineering), here the business constantly keeps learning about the customer requirements and adapting to them.

These businesses know the buying behavior of the customer that happy customers buy more frequently than rest of the customers. If any business is not considering this type of CRM, then it risks losing the market share to those businesses, which excel at strategic CRM.

Operational CRM: Operational CRM is oriented towards customer-centric business processes such as marketing, selling, and services. It includes the following automations: Sales Force Automation, Marketing Automation, and Service Automation.

Salesforce is the best suitable CRM for large established businesses and **Zoho** is the best CRM for growing or small-scale businesses.

Sales Force Automation: SFA is the application of technology to manage selling activities. It standardizes a sales cycle and common terminology for sales issues among all the sales employees of a business. It includes the following modules −

- **Product Configuration** − It enables salespersons or customers themselves to automatically design the product and decide the price for a customized product. It is based on if-then-else structure.
- **Quotation and Proposal Management** − The salesperson can generate a quotation of the product prices and proposal for the customer by entering details such as customer name, delivery requirements, product code, number of pieces, etc.
- **Accounts Management** − It manages inward entries, credit and debit amounts for various transactions, and stores transaction details as records.
- **Lead Management** − It lets the users qualify leads and assigns them to appropriate salespersons.
- **Contact Management** − It is enabled with the features such as customers' contact details, salespersons' calendar, and automatic dialing numbers. These all are stored in the form of computerized records. Using this application, a user can communicate effectively with the customers.
- **Opportunity Management** − It lets the users identify and follow leads from lead status to closure and beyond closure.

Marketing Automation: Marketing automation involves market segmentation, campaigns management, event-based marketing, and promotions. The campaign modules of Marketing Automation enable the marketing force to access customer-related data for designing, executing and evaluating targeted offers, and communications.

Event-based (trigger) marketing is all about messaging and presenting offers at a particular time. For example, a customer calls the customer care number and asks about the rate of interest for credit card payment. This event is read by CRM as the customer is comparing interest rates and can be diverted to another business for a better deal. In such cases, a customized offer is triggered to retain the customer.

Service Automation: Service automation involves service level management, resolving issues or cases, and addressing inbound communication. It involves diagnosing and solving the issues about product.

With the help of Interactive Voice Response (IVR) system, a customer can interact with business computers by entering appropriate menu options. Automatic call routing to the most capable employee can be done.

Consumer products are serviced at retail outlets at the first contact. In case of equipment placed on field, the service expert may require product servicing manual, spare parts manual, or any other related support on laptop. That can be availed in service automation.

Analytical CRM: Analytical CRM is based on capturing, interpreting, segregating, storing, modifying, processing, and reporting customer-related data. It also contains internal business-wide data such as **Sales Data** (products, volume, purchasing history), **Finance Data** (purchase history, credit score) and **Marketing Data** (response to campaign figures, customer loyalty schemes data). **Base CRM** is an example of analytical CRM. It provides detailed analytics and customized reports.

Business intelligence organizations that provide customers' demographics and lifestyle data over a large area pay a lot of attention to internal data to get more detail information such as, "Who are most valuable customers?", "Which consumers responded positively to the last campaign and converted?", etc.

Analytical CRM can set different selling approaches to different customer segments. In addition, different content and styling can be offered to different customer segments. For the customers, analytical CRM gives customized and timely solutions to the problems. For the business, it gives more prospects for sales, and customer acquisition and retention.

Collaborative CRM: Collaborative CRM is an alignment of resources and strategies between separate businesses for identifying, acquiring, developing, retaining, and maintaining valuable customers. It is employed in B2B scenario, where multiple businesses can conduct product development, market research, and marketing jointly.

Collaborative CRM enables smooth communication and transactions among businesses. Though traditional ways such as air mail, telephone, and fax are used in communication, collaborative CRM employs new communication systems such as chat rooms, web forums, Voice over Internet Protocol (VoIP), and Electronic Data Interchange (EDI).

There are collaborative CRMs with in-built **Partner Relationship Management (PRM)** software application which helps in managing partner promotions. **SugarCRM** is a popular collaborative CRM. It enables expert collaboration and provides state-of-the-art social capabilities.

CRM Software Buying Considerations:

A business needs to consider the following points while selecting a CRM software −

- **Business strategy and processes** − It helps to automate a customer management strategy. Hence before selecting a CRM software, a business should be clear with its strategies and desired processes.
- **Business requirements** − CRM systems range from domain specialty solutions that focus on solving a specific area such as sales force automation, marketing automation, services automation, partner management, etc., to complete enterprise management solutions.
- **Size of business** − Small businesses require tools that are easy to learn and can handle a wide range of the most common tasks. Large businesses opt for applications that handle more complex tasks and thousands of users.
- **Customer base** − The size of the customer base a business is required to handle.
- **Budget** − A business needs to set a budget prior vendor selection. The budget allocated for CRM varies according to the degree of customization required.
- **Context** − The context in which a business is functioning, e.g., B2B or B2C, determines which CRM the business should go for.
- **Sales channels** − The sales channels a business is employing: Direct sale, channel sale such as distributors, or Direct to customers via retail. They matter while selecting the most suitable CRM software.
- **System integration** − All the interfaces the business needs and the CRM vendor can support without requiring too much custom services effort.
- **Strength of partners** − The partners must be able to provide a business with additional support, or help to implement the CRM successfully.

Why a Business Wants Relationship with its Customers?

Every business regards its customers as a lifetime stream of revenue; losing a single customer can cost the business very high. **Lifetime Value (LTV)** for a customer is considered to analyze the effectiveness of a particular marketing channel.

For example, if the **Churn Rate** of a business X is 5% and that of business Y is 10%, then in the long-term, business X would have a larger customer base than business Y, which places business X at the position of competitive advantage and directly influences profit of both the businesses.

A business can generate greater sales volume and in turn greater revenue if it knows its customers well and have good relationship with them. Thus, solely for the economic purpose, every business wants to have healthy relationships with their customers.

CRM - Emerging Trends:

Till now, we have have learnt that the CRM software helps businesses to manage customer relationship and enhance customer experience proficiently. It also helps businesses to optimize the marketing programs and use marketing analytics for contemplating future strategies. CRM in services improves customer satisfaction thereby increasing the business ROI. Let us now discuss what new trends are emerging in the field of CRM.

What is ECRM?

This is a new trend in CRM which exploits the power of internet. Electronic Customer Relationship Management (ECRM) aims at developing and establishing all CRM functions with the use of digital communication tools such as EMail, chatrooms, instant messaging, forums, etc.

ECRM is motivated by the ease of internet access from various computing devices such as desktops, laptops, tablets, and smartphones.

Features of ECRM

- It enables the businesses to interact with their customers and employers using internet.
- ECRM offers seamless integration of CRM processes.
- ECRM is speedy and reliable.
- It is highly secured from threats.

Difference between CRM and ECRM

The following table highlights the differences between CRM and ECRM.

CRM	ECRM
Conventional CRM uses telephone, fax, and retail store for contacting customers.	ECRM uses internet with Personal Digital Assistant (PDA) devices.
It takes care of the customers via Internet.	The customer is able to take care of himself using internet.
It needs the user to download supporting Apps to access web-enabled applications.	In ECRM environment, there is no such requirement.
CRM system design is products and functions oriented.	ECRM system is customer oriented.
Cost of maintenance is high.	Cost of maintenance is lesser.
Time taken for maintenance is long.	Maintenance time is lesser.

Future CRM Trends

Here are some upcoming trends the CRM solution vendors are following −

Integrating Data from Multiple Channels

The CRM solution providers are working on moving social media data to more secure communication channel. They are also exploring how they can integrate unstructured data coming from multiple channels such as Email and mobile smartphones.

Handling Big Data

As the data is penetrating from multiple channels with high volume, velocity, and variety, the CRM solution providers are exploring how this big data can be managed well to be able to use effectively.

Shifting to Cloud-based CRM

The businesses are preferring cloud-based CRM software to overcome the problems with on premise CRM software (in which every new feature development requires an expensive upgrade). The cloud-based CRM also lessens the burden of business for investing in infrastructure.

Social CRM

The customers are into the practice of reading reviews, recommendations, and judging the product or service before deciding to purchase. The businesses are keen to employ social CRM tools in their CRM software as the social media can bring an insight of customer preferences and behavior.

The Mobile CRM is Expected to be Powerful

Today's CRM solution providers are investing a handsome amount to bring more rigor in the mobile platforms of CRM applications.

Using CRM data effectively

The historical and current data of the customers is so huge that the CRM users spend more time in entering the same in the system than using it effectively for beneficial purpose. CRM solution providers are also working on providing simpler and easier ways of handling customer data using mobile devices.

CRM Software Systems with Wearables

It is the next big revolution in the development of CRM software systems. Wearable are the devices worn by the consumers to track their health and fitness information.

If CRM applications are integrated with wearable computing devices, then the businesses can get benefited by having real time information of customers and access to their account data. The businesses can then engage with their customers effectively and discover opportunities of selling and enhancing customer relationships.

Creating Best Customer Experiences

Though life is not all segregated between black and white moments; for the customers and businesses it is. The customers remember business products and services by associating with best and worst experiences. The businesses using CRM are placing the activities related to making their customers feel good in their list of top priorities.

CRM to XRM

xRM is evolved CRM. There is little limitation in the word CRM which depicts Customer Relationship Management. XRM is eXtreme Relationship Management, or Any (replace X with any value) Relationship Management. The scope of XRM is different and larger than the scope of CRM.

For example, a business is managing contracts, grievances, policies, building assets, parking violations, property taxes, etc. The list is near to endless. This all management is catered by XRM, a business can manage the relationship of anything within itself.

Data ware housing and artificial intelligence:

The term "Data Warehouse" was first coined by Bill Inmon in 1990. According to Inmon, a data warehouse is a subject oriented, integrated, time-variant, and non-volatile collection of data. This data helps analysts to take informed decisions in an organization.

An operational database undergoes frequent changes on a daily basis on account of the transactions that take place. Suppose a business executive wants to analyze previous feedback on any data such as a product, a supplier, or any consumer data, then the executive will have no data available to analyze because the previous data has been updated due to transactions.

A data warehouses provides us generalized and consolidated data in multidimensional view. Along with generalized and consolidated view of data, a data warehouses also provides us Online Analytical Processing (OLAP) tools. These tools help us in interactive and effective analysis of data in a multidimensional space. This analysis results in data generalization and data mining.

Data mining functions such as association, clustering, classification, prediction can be integrated with OLAP operations to enhance the interactive mining of knowledge at multiple level of abstraction. That's why data warehouse has now become an important platform for data analysis and online analytical processing.

Understanding a Data Warehouse

- A data warehouse is a database, which is kept separate from the organization's operational database.
- There is no frequent updating done in a data warehouse.
- It possesses consolidated historical data, which helps the organization to analyze its business.
- A data warehouse helps executives to organize, understand, and use their data to take strategic decisions.
- Data warehouse systems help in the integration of diversity of application systems.
- A data warehouse system helps in consolidated historical data analysis.

What is Data Warehousing?

Data warehousing is the process of constructing and using a data warehouse. A data warehouse is constructed by integrating data from multiple heterogeneous sources that support analytical reporting, structured and/or ad hoc queries, and decision making. Data warehousing involves data cleaning, data integration, and data consolidations.

A data warehousing is a technique for collecting and managing data from varied sources to provide meaningful business insights. It is a blend of technologies and components which allows the strategic use of data.

It is electronic storage of a large amount of information by a business which is designed for query and analysis instead of transaction processing. It is a process of transforming data into information and making it available to users in a timely manner to make a difference.

Data warehouse system is also known by the following name:

- Decision Support System (DSS)
- Executive Information System
- Management Information System
- Business Intelligence Solution
- Analytic Application
- Data Warehouse

Data Warehouse Features

The key features of a data warehouse are discussed below:

- **Subject Oriented:** A data warehouse is subject oriented because it provides information around a subject rather than the organization's ongoing operations. These subjects can be product, customers, suppliers, sales, revenue, etc. A data warehouse does not focus on the ongoing operations, rather it focuses on modelling and analysis of data for decision making.

- **Integrated:** A data warehouse is constructed by integrating data from heterogeneous sources such as relational databases, flat files, etc. This integration enhances the effective analysis of data.
- **Time Variant:** The data collected in a data warehouse is identified with a particular time period. The data in a data warehouse provides information from the historical point of view.
- **Non-volatile:** Non-volatile means the previous data is not erased when new data is added to it. A data warehouse is kept separate from the operational database and therefore frequent changes in operational database are not reflected in the data warehouse.

Note: A data warehouse does not require transaction processing, recovery, and concurrency controls, because it is physically stored and separate from the operational database.

Types of Data Warehouse

Three main types of Data Warehouses are:

1. **Enterprise Data Warehouse:** Enterprise Data Warehouse is a centralized warehouse. It provides decision support service across the enterprise. It offers a unified approach for organizing and representing data. It also provide the ability to classify data according to the subject and give access according to those divisions.
2. **Operational Data Store:** Operational Data Store, which is also called ODS, are nothing but data store required when neither Data warehouse nor OLTP systems support organizations reporting needs. In ODS, Data warehouse is refreshed in real time. Hence, it is widely preferred for routine activities like storing records of the Employees.
3. **Data Mart:** A data mart is a subset of the data warehouse. It specially designed for a particular line of business, such as sales, finance, sales or finance. In an independent data mart, data can collect directly from sources.

Components of Data warehouse

Four components of Data Warehouses are:

1. **Load manager:** Load manager is also called the front component. It performs with all the operations associated with the extraction and load of data into the warehouse. These operations include transformations to prepare the data for entering into the Data warehouse.
2. **Warehouse Manager:** Warehouse manager performs operations associated with the management of the data in the warehouse. It performs operations like analysis of data to ensure consistency, creation of indexes and views, generation of denormalization and aggregations, transformation and merging of source data and archiving and baking-up data.
3. **Query Manager:** Query manager is also known as backend component. It performs all the operation operations related to the management of user queries. The operations of this

Data warehouse components are direct queries to the appropriate tables for scheduling the execution of queries.

4. **End-user access tools:** This is categorized into five different groups like 1. Data Reporting 2. Query Tools 3. Application development tools 4. EIS tools, 5. OLAP tools and data mining tools.

Advantages of Data Warehouse:

- Data warehouse allows business users to quickly access critical data from some sources all in one place.
- Data warehouse provides consistent information on various cross-functional activities. It is also supporting ad-hoc reporting and query.
- Data Warehouse helps to integrate many sources of data to reduce stress on the production system.
- Data warehouse helps to reduce total turnaround time for analysis and reporting.
- Restructuring and Integration make it easier for the user to use for reporting and analysis.
- Data warehouse allows users to access critical data from the number of sources in a single place. Therefore, it saves user's time of retrieving data from multiple sources.
- Data warehouse stores a large amount of historical data. This helps users to analyze different time periods and trends to make future predictions.

Disadvantages of Data Warehouse:

- Not an ideal option for unstructured data.
- Creation and Implementation of Data Warehouse is surely time confusing affair.
- Data Warehouse can be outdated relatively quickly
- Difficult to make changes in data types and ranges, data source schema, indexes, and queries.
- The data warehouse may seem easy, but actually, it is too complex for the average users.
- Despite best efforts at project management, data warehousing project scope will always increase.
- Sometime warehouse users will develop different business rules.
- Organisations need to spend lots of their resources for training and Implementation purpose.

Data Warehouse Applications

As discussed before, a data warehouse helps business executives to organize, analyze, and use their data for decision making. A data warehouse serves as a sole part of a plan-execute-assess "closed-loop" feedback system for the enterprise management. Data warehouses are widely used in the following fields −

- Financial services

- Banking services
- Consumer goods
- Retail sectors
- Controlled manufacturing

Who needs Data warehouse?

Data warehouse is needed for all types of users like:

- Decision makers who rely on mass amount of data
- Users who use customized, complex processes to obtain information from multiple data sources.
- It is also used by the people who want simple technology to access the data
- It also essential for those people who want a systematic approach for making decisions.
- If the user wants fast performance on a huge amount of data which is a necessity for reports, grids or charts, then Data warehouse proves useful.
- Data warehouse is a first step If you want to discover 'hidden patterns' of data-flows and groupings.

Artificial intelligence:

Since the invention of computers or machines, their capability to perform various tasks went on growing exponentially. Humans have developed the power of computer systems in terms of their diverse working domains, their increasing speed, and reducing size with respect to time.

A branch of Computer Science named *Artificial Intelligence* pursues creating the computers or machines as intelligent as human beings.

What is 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.

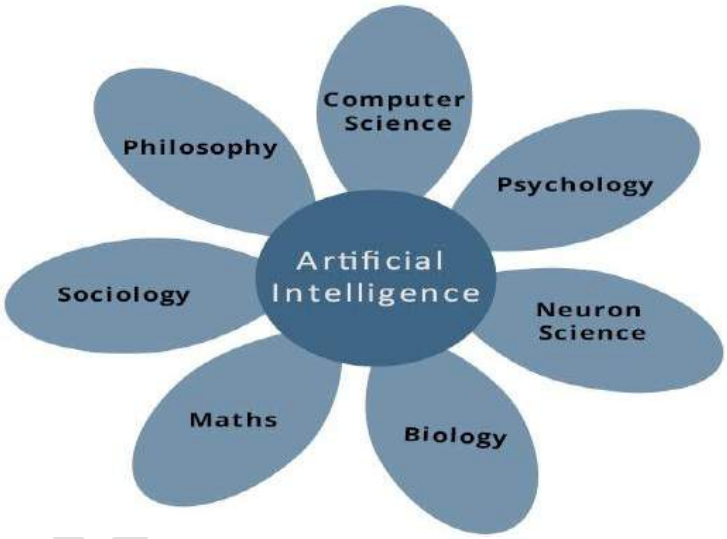
Goals of AI

- 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 Contributes to AI?

Artificial intelligence is a science and technology based on disciplines such as Computer Science, Biology, Psychology, Linguistics, Mathematics, and Engineering. A major thrust of AI is in the development of computer functions associated with human intelligence, such as reasoning, learning, and problem solving.

Out of the following areas, one or multiple areas can contribute to build an intelligent system.



Programming Without and With AI

The programming without and with AI is different in following ways:

Programming Without AI	Programming With AI
A computer program without AI can answer the specific questions it is meant to solve.	A computer program with AI can answer the generic questions it is meant to solve.

Modification in the program leads to change in its structure.	AI programs can absorb new modifications by putting highly independent pieces of information together. Hence you can modify even a minute piece of information of program without affecting its structure.
Modification is not quick and easy. It may lead to affecting the program adversely.	Quick and Easy program modification.

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

  - Doctors use clinical expert system to diagnose the patient.
  - 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.

History of AI

Here is the history of AI during 20th century −

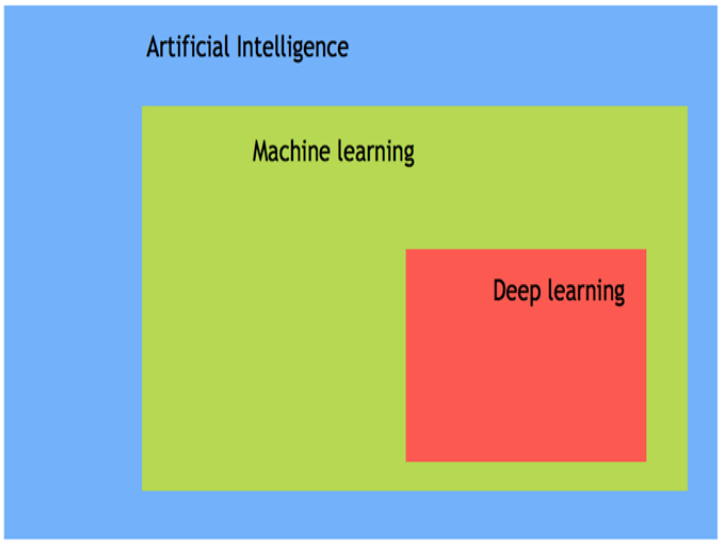
Year	Milestone / Innovation
1923	Karel Čapek play named "Rossum's Universal Robots" (RUR) opens in London, first use of the word "robot" in English.
1943	Foundations for neural networks laid.
1945	Isaac Asimov, a Columbia University alumni, coined the term *Robotics*.
1950	Alan Turing introduced Turing Test for evaluation of intelligence and published *Computing Machinery and Intelligence.* Claude Shannon published *Detailed Analysis of Chess Playing* as a search.
1956	John McCarthy coined the term *Artificial Intelligence*. Demonstration of the first running AI program at Carnegie Mellon University.
1958	John McCarthy invents LISP programming language for AI.

1964	Danny Bobrow's dissertation at MIT showed that computers can understand natural language well enough to solve algebra word problems correctly.
1965	Joseph Weizenbaum at MIT built *ELIZA*, an interactive problem that carries on a dialogue in English.
1969	Scientists at Stanford Research Institute Developed *Shakey*, a robot, equipped with locomotion, perception, and problem solving.
1973	The Assembly Robotics group at Edinburgh University built *Freddy*, the Famous Scottish Robot, capable of using vision to locate and assemble models.
1979	The first computer-controlled autonomous vehicle, Stanford Cart, was built.
1985	Harold Cohen created and demonstrated the drawing program, *Aaron*.
1990	Major advances in all areas of AI − • Significant demonstrations in machine learning • Case-based reasoning • Multi-agent planning • Scheduling • Data mining, Web Crawler • natural language understanding and translation • Vision, Virtual Reality • Games
1997	The Deep Blue Chess Program beats the then world chess champion, Garry Kasparov.
2000	Interactive robot pets become commercially available. MIT displays *Kismet*, a robot with a face that expresses emotions. The robot *Nomad* explores remote regions of Antarctica and locates meteorites.

Type of Artificial Intelligence:

Artificial intelligence can be divided into three subfields:

1. Artificial intelligence
2. Machine learning
3. Deep learning



Machine Learning: Machine learning is the art of study of algorithms that learn from examples and experiences. Machine learning is based on the idea that there exist some patterns in the data that were identified and used for future predictions. The difference from hard coding rules is that the machine learns on its own to find such rules.

Deep learning: Deep learning is a sub-field of machine learning. Deep learning does not mean the machine learns more in-depth knowledge; it means the machine uses different layers to learn from the data. The depth of the model is represented by the number of layers in the model. For instance, Google LeNet model for image recognition counts 22 layers.

In deep learning, the learning phase is done through a neural network. A neural network is an architecture where the layers are stacked on top of each other.

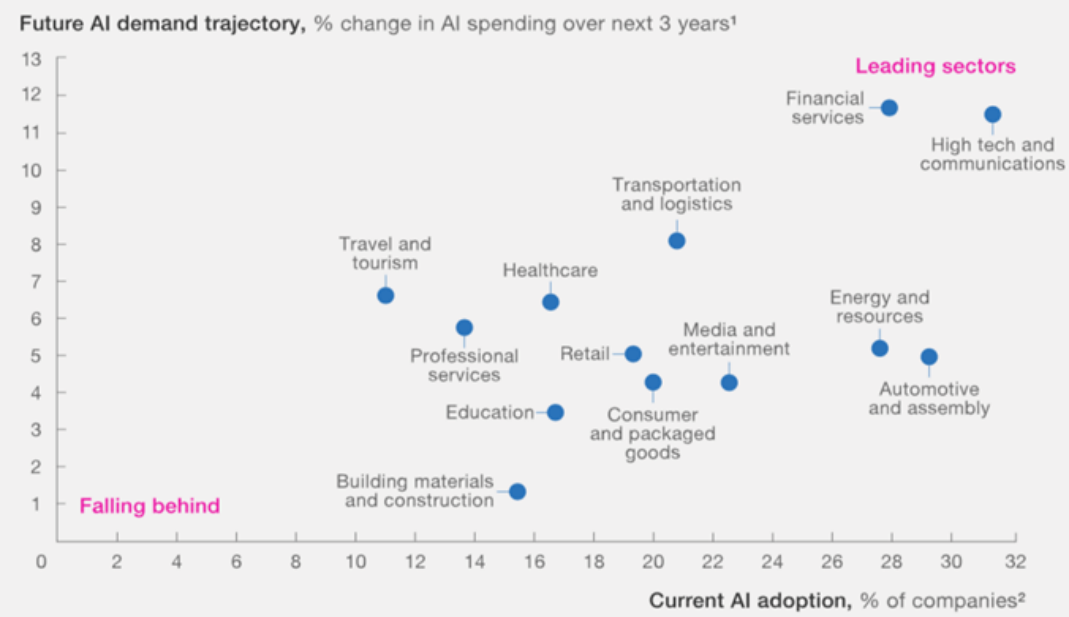
Where is AI used? Examples

AI has broad applications:

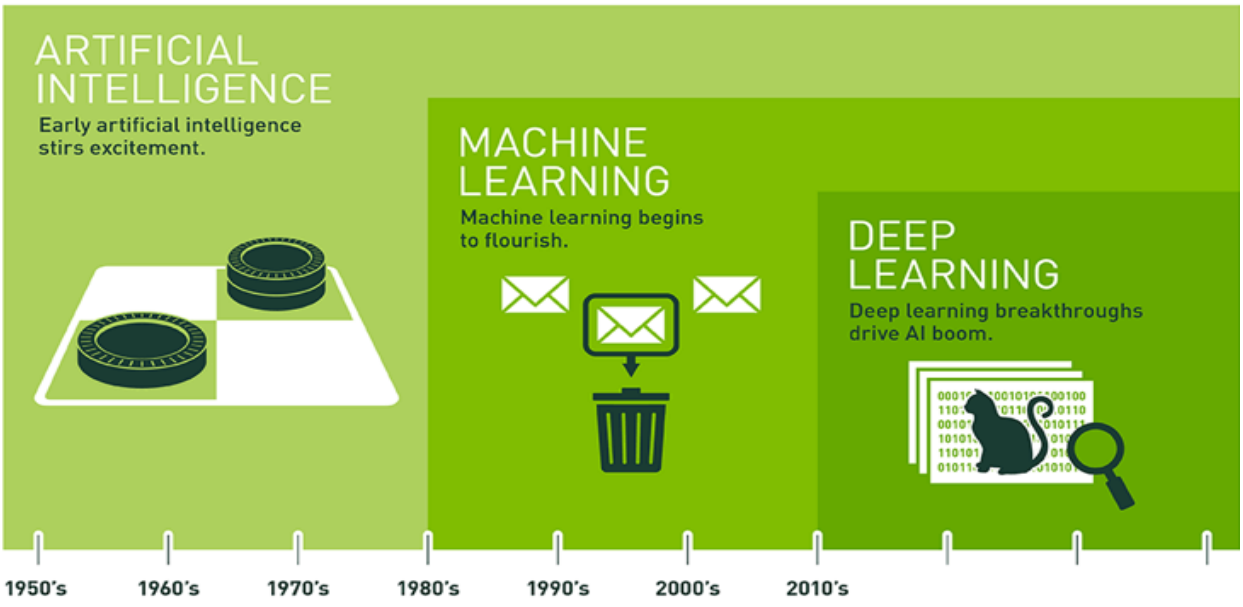
- Artificial intelligence is used to reduce or avoid the repetitive task. For instance, AI can repeat a task continuously, without fatigue. In fact, AI never rests, and it is indifferent to the task to carry out

- Artificial intelligence improves an existing product. Before the age of machine learning, core products were building upon hard-code rule. Firms introduced artificial intelligence to enhance the functionality of the product rather than starting from scratch to design new products. You can think of a Facebook image. A few years ago, you had to tag your friends manually. Nowadays, with the help of AI, Facebook gives you a friend's recommendation.

AI is used in all the industries, from marketing to supply chain, finance, food-processing sector. According to a McKinsey survey, financial services and high tech communication are leading the AI fields.



Why is AI booming now?



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

A neural network has been out since the nineties with the seminal paper of Yann LeCun. However, it started to become famous around the year 2012. Explained by three critical factors for its popularity are:

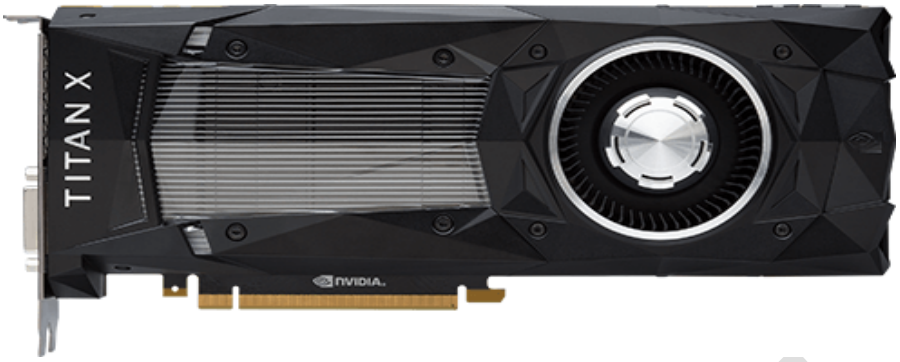
1. Hardware
2. Data
3. Algorithm

Machine learning is an experimental field, meaning it needs to have data to test new ideas or approaches. With the boom of the internet, data became more easily accessible. Besides, giant companies like NVIDIA and AMD have developed high-performance graphics chips for the gaming market.

Hardware

In the last twenty years, the power of the CPU has exploded, allowing the user to train a small deep-learning model on any laptop. However, to process a deep-learning model for computer vision or deep learning, you need a more powerful machine. Thanks to the investment of NVIDIA and AMD, a new generation of GPU (graphical processing unit) are available. These chips allow parallel computations. It means the machine can separate the computations over several GPU to speed up the calculations.

For instance, with an NVIDIA TITAN X, it takes two days to train a model called ImageNetagainst weeks for a traditional CPU. Besides, big companies use clusters of GPU to train deep learning model with the NVIDIA Tesla K80 because it helps to reduce the data center cost and provide better performances.



Data

Deep learning is the structure of the model, and the data is the fluid to make it alive. Data powers the artificial intelligence. Without data, nothing can be done. Latest Technologies have pushed the boundaries of data storage. It is easier than ever to store a high amount of data in a data center.

Internet revolution makes data collection and distribution available to feed machine learning algorithm. If you are familiar with Flickr, Instagram or any other app with images, you can guess their AI potential. There are millions of pictures with tags available on these websites. Those pictures can be used to train a neural network model to recognize an object on the picture without the need to manually collect and label the data.

Artificial Intelligence combined with data is the new gold. Data is a unique competitive advantage that no firm should neglect. AI provides the best answers from your data. When all the firms can have the same technologies, the one with data will have a competitive advantage over the other. To give an idea, the world creates about 2.2 exabytes, or 2.2 billion gigabytes, every day.

A company needs exceptionally diverse data sources to be able to find the patterns and learn and in a substantial volume.

Algorithm

Hardware is more powerful than ever, data is easily accessible, but one thing that makes the neural network more reliable is the development of more accurate algorithms. Primary neural networks are a simple multiplication matrix without in-depth statistical properties. Since 2010, remarkable discoveries have been made to improve the neural network

Artificial intelligence uses a progressive learning algorithm to let the data do the programming. It means, the computer can teach itself how to perform different tasks, like finding anomalies, become a chat-bot.

Near field Communication:

NFC is a short-range wireless technology that enables simple and secure communication between electronic devices. It may be used on its own or in combination with other wireless technologies, such as Bluetooth.

The communication range of NFC is roughly 10 centimeters. However, an antenna may be used to extend the range up to 20 centimeters. This short range is intentional, as it provides security by only allowing devices to communicate within close proximity of each other. This makes NFC ideal for secure transactions, such as contactless payments at a checkout counter.

There are many other uses for NFC as well. Examples include:

- Paying a fare on public transit, such as a bus or train
- Confirming your ticket at a concert or sports event
- Syncing workout data from a fitness machine with your device
- Viewing special offers on your phone when you enter a store
- Loading information about an artist or piece of art at a museum
- Viewing a map and related information at a national park
- Loading a translated menu at a restaurant
- Checking in and checking out at a hotel
- Unlocking an NFC-enabled door lock

NFC is often seen as an alternative to QR codes, which require scanning a square code with your device. Both technologies are designed for short-range transactions, but QR code scanning requires a camera, while NFC communication requires a near-field communication chip. NFC communication is arguably simpler since you don't need to manually scan anything with your device. Additionally, NFC provides two-way communication, while scanning a QR code is a one-way transaction.

NOTE: Since the range of NFC is limited to only a few centimeters, it is ideal for quick data transfers and transactions. For communication that requires a longer time or longer distance, NFC Connection Handover technology may be used to transition the connection to Bluetooth.

Classification NFC:

So NFC devices can be classified into 2 types:

1. **Passive NFC devices:** These include tags, and other small transmitters which can send information to other NFC devices without the need for a power source of their own. These

devices don't really process any information sent from other sources, and can not connect to other passive components. These often take the form of interactive signs on walls or advertisements.

2. **Active NFC devices:** These devices are able to both the things i.e. send and receive data. They can communicate with each other as well as with passive devices. Smartphones the best example of active NFC device. Card readers in public transport and touch payment terminals are also good examples of the technology.

How does NFC work?

Like other wireless signals Bluetooth and WiFi, NFC works on the principle of sending information over radio waves. Near Field Communication is another standard for wireless data transition which means devices must adhere to certain specifications in order to communicate with each other properly. The technology used in NFC is based on older technology which is the RFID (Radio-frequency identification) that used electromagnetic induction in order to transmit information.

This creates one major difference between NFC and Bluetooth/WiFi. NFC can be used to induce electric currents within passive components rather than just send data. This means that their own power supply is not required by passive devices. Instead they can be powered by the electromagnetic field produced by an active NFC component when it comes into range. NFC technology unfortunately does not command enough inductance to charge our smartphones, but QI charging is based on the same principle.

The transmission frequency is 13.56 megahertz for data across NFC. Data can be sent at either 106, 212, or 424 kilobits per second which is quick enough for a range of data transfers like contact details to swapping pictures and music.

Mode of Operation:

The NFC standard currently has three distinct modes of operation to determine what sort of information will be exchanged between devices.

1. The most common used in smartphones is the peer-to-peer mode. Exchange of various piece of information is allowed between 2 devices. In this mode both devices switch between active when sending data and passive when receiving.
2. The second mode i.e. read/write mode is a one-way data transmission. The active device, possibly your smartphone, links up with another device in order to read information from it. NFC advertisement tags use this mode.
3. The third mode of operation is card emulation. The NFC device can function as a smart or contactless credit card and make payments or tap into public transport systems.

NFC applications:

NFC applications can be split into the following four basic categories:

- **Touch and Go**: Applications such as access control or transport/event ticketing, where the user needs only to bring the device storing the ticket or access code close to the reader. Also, for simple data capture applications, such as picking up an Internet URL from a smart label on a poster.
- **Touch and Confirm**: Applications such as mobile payment where the user has to confirm the interaction by entering a password or just accepting the transaction.
- **Touch and Connect**: Linking two NFC-enabled devices to enable peer to peer transfer of data such as downloading music, exchanging images or synchronizing address books.
- **Touch and Explore**: NFC devices may offer more than one possible function. The consumer will be able to explore a device's capabilities to find out which functionalities and services are offered.

Super Beam:

Super Beam is a file sharing app that allows you to quickly and effortlessly transfer files between two devices.

How does Super Beam work?

Super Beam allows you to share any kind of file with another device using WiFi or WiFi Direct, functioning in much the same way as Bluetooth sharing. You can also send files from within applications using the 'Share' button.

You can share files with another Super Beam user via the app, or to any WiFi connected device via their other person's web browser.

Share files in a snap

To share a file with another person using Super Beam you just select the file (or folder, if you upgrade to the Pro version) and the app will generate a QR code. The other person simply scans this QR code and, assuming they're connected to the same WiFi network, the file will be transferred. You can bypass the QR code option and transfer the files via NFC, if your device supports it.