

## Syllabus

### Management Information System (Mumbai University)

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ILO 7013	Management Information System	-	--	--	03	--	--	03

#### **Course objectives :**

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

#### **Course outcomes :**

**Course outcomes :** Learner will be able to...

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making 5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Unit No.	Topics	Hrs.
1	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS  <b>(Refer chapter 1)</b>	04
2	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management  Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results  <b>(Refer chapters 2 and 3)</b>	07
3	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls  <b>(Refer chapter 4)</b>	07

4	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.  <b>(Refer chapter 5)</b>	07
5	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.  <b>(Refer chapter 6)</b>	06
6	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process.  Acquiring Information Systems and Applications: Various System development life cycle models.  <b>(Refer chapter 7)</b>	08






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## 1

# Introduction to Information Systems (IS)

## Syllabus

Introduction to Information Systems (IS) : Computer-Based Information Systems, Impact of IT on organizations  
Importance of IS to Society, Organizational Strategy, Competitive Advantages and IS.

### 1.1 Introduction

Since the time people learnt how to read and write, they started using that knowledge to record various activities. The aim was to use the records to learn about the past and develop further from there. This motive remained with generations. Then the world started developing itself commercially and the records became more important.

The records were collected, organized and then analyzed to get useful information about various business activities, workers, customers, environment, etc. Slowly information became lifeblood for understanding businesses, customers, markets and their surroundings. In short, information became indispensable. Business people constantly looked out for newer ways to collect, organize and analyze information. This led to the development of Information System. Information system was further revolutionized by the introduction of information technology.

A continuous upgradation of technology kept on developing the information system for better which brought a paradigm shift in the way businesses were done.

We are in the 21<sup>st</sup> century and the journey continues. The world has become globalized and highly competitive. Accurate, timely, relevant and complete information about various business aspects has become vital to stay ahead. Every business organization is compelled to develop a strong information system to be relevant in the ever changing business world.

An effective and efficient information system is the need of the hour as it helps organizations not only stay relevant in the business but also stay ahead of competition. This calls for a thorough study and understanding of information system by business organizations.

Apart from impacting businesses positively, information system has left a deep impact on society too. It has brought revolutionary changes in our lives. There is hardly any sphere of life that has not been impacted by it. Information on just any subject is available just on the click of a mouse. E-commerce, E-banking, online training and education have made a huge change in the way we live our life. It has developed the general awareness of the people and taken it to a new level which has a great impact even on businesses.

As information system driven by information technology has penetrated and been proven effective for societies as well as each and every organization irrespective of its nature of business around the world, it has become essential for people from every walk of life to gain and develop its better knowledge.

The study of information system calls for learning its core called database which is a collection of records which itself is a collection of interlinked data. Apart from that, the study also encompasses a variety of topics including system analysis and design, computer networking, information security, database management and data support system. Management Information System (MIS) is another important field of study within the boundary of information system. It is effectively used today for decision making and for the co-ordination, control, analysis and presentation of information in an organization. It is the study of people, processes and technology in the context of an organization.

Thus, on an optimistic note let us begin our study of information system with a clear and firm aim of learning and developing its expertise in an attempt to help organizations take its advantages and remain competitive.

### 1.1.1 Information : Concept & Relevance

Information since ancient times has been playing a very important role in the life of a person as well as in that of an organization. It helps in gaining knowledge which becomes vital in decision making particularly for leadership. Leading without information is like fighting in the dark. As a result, measures and systems are put in place to collect information.

We can define information as a collection of data processed (organized) as per certain pre-defined format in order to understand a subject better.

The creation of information is done through a system called data processing where data is collected and then processed and presented in a useful format that is helpful to everyone.

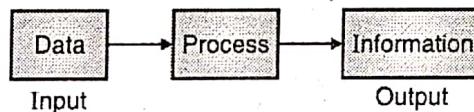


Fig 1.1.1 : Data processing system

For any information to be useful, it must possess the following characteristics:-

1. It must be relevant.
2. It must be accurate.
3. It must be complete.
4. It must be obtained timely.

**The above characteristics bring many benefits such as :**

1. Such information is indisputable.
2. It helps create strong strategies.
3. It is necessary for optimization of performance.
4. It builds a better relationship with customers.
5. It strengthens teams within the organization.

### 1.2 Information System (IS)

**Information System** is a mechanism designed to collect, process, store and distribute information within and outside the organization in order to improve organizational effectiveness and efficiency.

It can also be defined as any organized combination of people, hardware, software, communication networks, data resources, policies and procedures that store, process, retrieve, transfer and disseminate information in an organization.

Today people in their personal lives as well as within organizations rely heavily on modern information systems to search relevant information and communicate with one another.

A well-designed and developed information system helps an organization in managing its operations, interacting with its customers and suppliers and competing in the marketplace.

For example, organizations use their information system to process financial data, to manage their human resource and to identify and reach their potential customers.

Many major companies today are built around information systems. These include Amazon, Flipkart, Google, Alibaba, etc. A lot of companies today are offering **cloud services** which are purely based on information system.

**Computer-based information system** uses modern technologies such as computer hardware, software and communication networks to collect, process, store and exchange information all around. The use of computer has significantly improved the effectiveness of an information system and has proven to be a boon for all the organizations.

**It offers many advantages such as :**

- Efficient storage of the information
- Safety and security of the information
- Quick retrieval of the information
- Fast information processing and distribution anywhere in the world at a very low cost
- Better analytical capability that helps in making the decision-making process highly effective

Thus a computer-based information system has become an essential requirement for every organization be it a small or a large one. With continuous upgradation in technologies, this system has become very powerful over the years.

### 1.2.1 Elements of Information System

An information system is designed with the help of the following key elements:

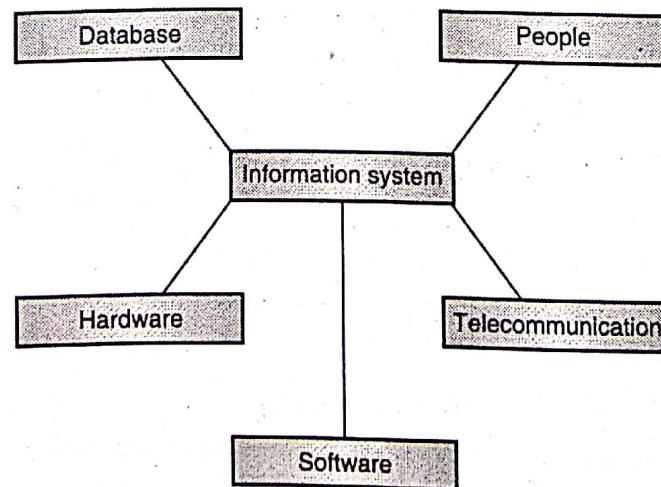


Fig. 1.2.1: Elements of IS

1. **Computer hardware:** Every organization or individual today uses one or other form of computer hardware. It offers advantages as mentioned above and is the core element on which the entire information system is built. Quick, easy, secure and cost-effective are key features of computer hardware.
2. **Computer software :** Software today rules the world through hardware devices. Millions of apps available today for every human and business activity have empowered both the customers as well as the organizations. Customized and packaged - both kinds of software are available today to suit every business and personal needs.
3. **Communication networks :** Communication networks have converted the world into a global village with almost every individual and organization connected with each other round the clock. All the new as well as old information today is instantly available for access from remote locations. Organizations either use a public network or set up their own to remain connected with customers, suppliers and distributors on real-time basis.
4. **Database :** The core of any information system is data and a huge collection of inter-related data is called a database. Organizations spend a lot of time, efforts and resources in creating, processing, storing and analyzing their databases. Simply put, they make businesses more effective and efficient.
5. **People :** People's ability to build an effective and efficient information system decides how far it is going to succeed. People are the creators as well as users and the ultimate beneficiaries of any information system. Employees and customers they both need effective understanding of the information system to take advantage of it.

### 1.2.2 Objectives of Information System

Business organizations today invest heavily in developing an effective and efficient information system to achieve the following objectives:

- **Achieving operational excellence:** Efficiency, productivity and improvements in business practices, policies and management are important for any organization to grow.
- **Identifying and designing new products and business models:** In a globalized and competitive business world, newer product designs that satisfy customers' and needs and wants, and upgraded business models that maintain flow of income are essential.
- **Establishing regular communication with customers and suppliers:** Customers and suppliers both are core to the survival of a business and a regular communication with them ensures a better understanding and a long term relationship. Thus they are important objectives.
- **Improving decision making:** Decision making is a regular and a very important management activity and the success of an organization, to a great extent depends on timely and accurate decision making.
- **Getting competitive advantages:** Competitiveness in the marketplace is a must, not only for the growth but also for the survival, as competition is intense in every industry and place. Thus, getting competitive advantage is always a primary objective to achieve.
- **Ensuring sustainability:** In an uncertain business world, ensuring sustainability is always a challenge. There are plenty of environmental factors that create hurdles for businesses. Therefore, one of the important objectives of information system is to prepare the businesses in such a way that sustainability is ensured.

### 1.2.3 Advantages of Information System

An information system gives many advantages to every organization:

- **Improves business operation management:** Information system offers key information related to business plans, processes and procedures, that prevents the operations from getting deviated. Any deviation occurred is recorded and reported for correction.
- **Business decision making:** Information system greatly supports decision making by providing useful and timely information related to the concerned problem. The available information helps the management analyze the problem better which enables it to take right decisions at the right time.
- **Creating a strong and effective database:** Information system helps an organization to build a strong, effective and comprehensive database that takes care of every business need and helps management in formulating business plans and policies.
- **Developing an effective communication system:** An effective communication system helps the management and the employees exchange necessary information like the business needs, plans, objectives, problem areas and the respective roles and responsibilities. It also helps the organization communicate well with the outside world.
- **Customer information:** Today, information about customer needs, wants, problems and buying behavior is critical to business plans and an information system helps the organization immensely.
- **Real-time information:** Information system offers real-time information enabling the management to take quick decisions to grab opportunities or solve problems.
- **Cost reduction:** Information systems has replaced the old manual system thus reducing the cost of production, which in turn improves the profit ratio and competitiveness of the organization.
- **Better customer service:** Customer service in all the areas has improved drastically with the help of information system. Customer problems are recorded online and are solved within the given time through effective monitoring.
- **Reduced risk of errors:** Information systems today are designed in such a way that there is minimum risk of errors in data processing, which leads to better efficiency and decision making.
- **Safety and security of data:** Information system has an effective safety and security mechanism to protect data and information from getting stolen and manipulated.
- **Gives competitive advantages:** Relevant, timely and accurate information provided by information system gives competitive advantage to every organization.

### 1.3 Types of Information System

Information systems that are used in today's business world can be broadly classified into two types:

1. Operations Support System
2. Management Support System

Information systems are categorized this way to describe the major roles they play in the operations and management of a business. Fig. 1.3.1 illustrates this classification of information systems. Let's have a brief look at such information system categories:

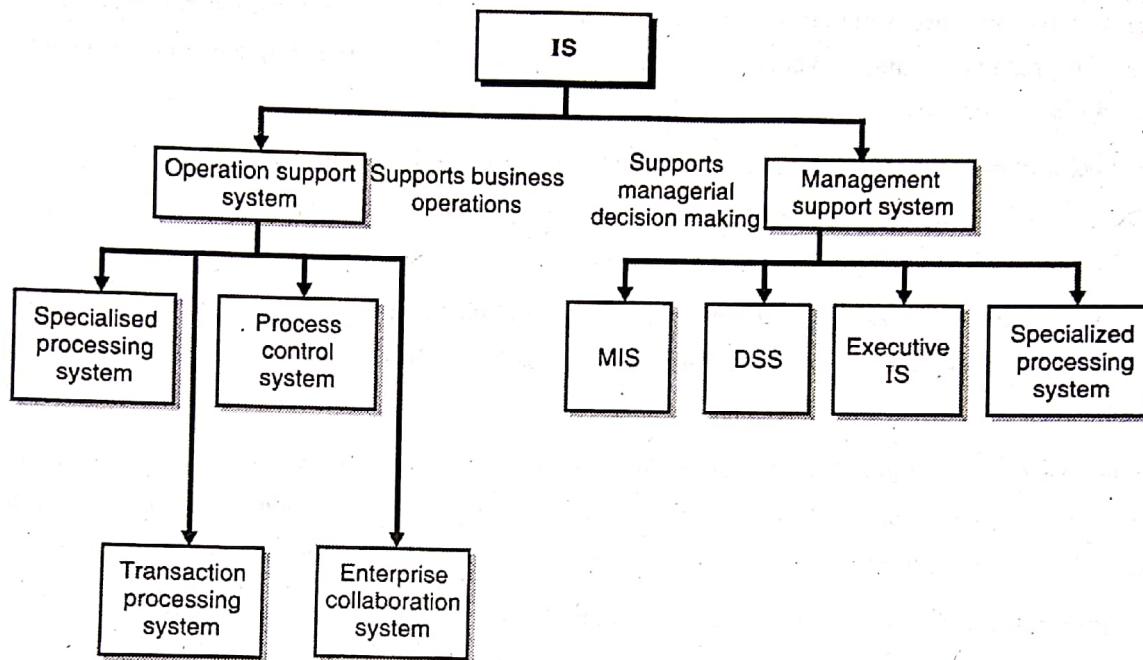


Fig. 1.3.1: Types of IS

### 1.3.1 Operations Support System

Information systems have always been required to process data generated by and used in business operations. Operation support systems produce a variety of information for both internal and external use.

However, they do not provide the specific information that can be used best by managers for analytical decision-making purposes. Management support system is usually used for such purposes.

The role of operations support system is to process business transactions, control industrial processes, support enterprise communications and collaborations and update corporate database efficiently.

- **Transaction processing systems** are important examples of operation support system that record and process the data collected from business transactions. For example, point-of-sale (POS) systems at many retail stores use electronic cash register terminals to capture and transmit sales data electronically over telecommunication network to computer centres for processing.
- **Process control systems** monitor and control physical processes in any organization. For example, a petroleum refinery uses electronic sensors linked to computers to monitor chemical processes continuously and make instant adjustments to control the refinery process.
- **Enterprise collaboration systems** focus on enhancing team and work-group communications and productivity and include applications that are sometimes called as *office automation system*. For example, members in a project team use e-mail to send and receive any messages or use video conferencing to hold meetings to co-ordinate their activities.

### 1.3.2 Management Support System

When information system focuses on providing information and support for effective decision making by managers, they are called *management support systems*. It is a complex task. Several major types of information systems support a variety of decision-making responsibilities such as Management Information Systems (MIS), Decision Support Systems (DSS), Executive Information Systems (EIS).

- **Management Information System (MIS)** provides information in the form of reports to managers and business professionals. For example, sales managers use their computers to receive instant displays about the sales results of their products and then access their corporate intranet for daily sales analysis reports that evaluate sales made by each salesperson.
- **Decision Support Systems (DSS)** give direct support to managers during the decision-making process. For example, an advertising manager may use a DSS to perform an analysis as part of the decision to determine how to spend advertising budget; a production manager may use a DSS to decide how much product to manufacture based on the expected sales and the availability of the raw materials.
- **Executive Information Systems (EIS)** provide critical information from a wide variety of internal and external sources to the executives and managers. For example, top executives can instantly view computer displays that highlight key areas of organisational and competitive performance.

### 1.3.3 Information System Activities

Irrespective of the type of information system, certain similar basic information-system activities take place. Let's take a closer look at these activities.

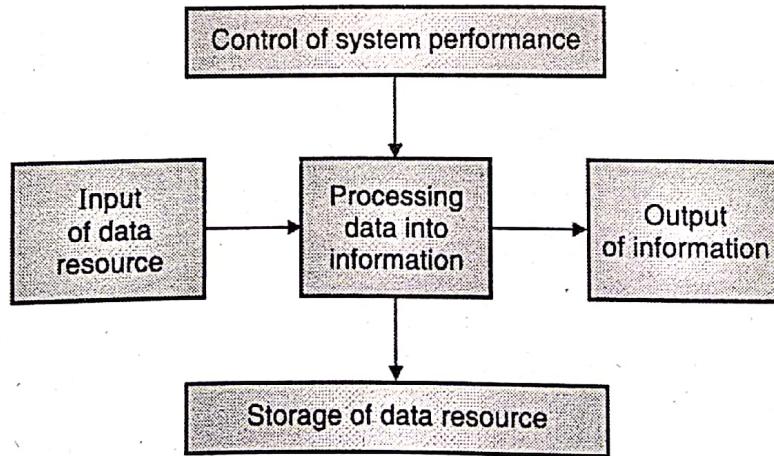


Fig. 1.3.2 : Information system activities

#### Input activity :

Data about business transactions and other events are collected and entered for processing by the input activity. Input is entered in the form of *data entry* activities such as recording and editing. Users usually enter data directly into a computer system.

**Processing :**

Data are then entered into processing activities, such as calculating, comparing, sorting, classifying and summarizing. These activities organize, analyze, and manipulate data, and convert them into information. The quality of any data stored in an information system is maintained by continuously correcting and updating activities.

**Output activity :**

Information in various forms is transmitted to end users and made available to them in the output activity. The goal of information systems is the production of appropriate reports, forms and graphic images.

**Storage of data :**

Storage is a basic system component of information systems in which data are retained in an organized manner for later use. Stored data are commonly organized into a variety of data elements and databases. This organization facilitates their later use in processing or retrieval as output when needed by the users of a system.

**Control of system performance :**

An important information system activity is the control of system performance. An information system produces feedback about its input, processing, output, and storage activities. This feedback is monitored and evaluated to determine whether the system is meeting the established performance standards. If deviations occur, appropriate system activities are adjusted so that proper information is produced.

### 1.3.4 The Expanding Role of Information System in Business Organizations

**Enterprise resource planning and business intelligence: 2000s–2010s**

Enterprise-wide common-interface applications, data mining and data visualization, customer relationship management, supply-chain management.

**Electronic business and commerce: 1990s–2000s**

- Internet-based e-business and e-commerce systems
- Web-enabled enterprise and global e-business operations and electronic commerce on the internet, intranets, extranets and other networks

**Strategic and end-user support: 1980s–1990s**

- End-user computing systems
- Direct computing support for end-user productivity and workgroup collaboration
- Executive information systems
- Critical information for top management
- Expert systems
- Knowledge-based expert advice for end users
- Strategic information systems
- Strategic products and services for competitive advantage

**Decision support: 1970s–1980s**

- Decision-support systems
- Interactive ad hoc support of the managerial decision-making process

**Management reporting: 1960s–1970s**

- Management information systems
- Management reports of pre-specified information to support decision making

**Data processing: 1950s–1960s**

Electronic data processing systems

Transaction processing, record keeping, and traditional accounting applications

## 1.4 Impact of Information System on Organizations

Information system has made a huge impact on business organizations. It has brought a paradigm shift in the way businesses are done. Organizations can no longer afford to ignore information system. Let us have a look at some of the areas where it has made a difference:

- **Better flow of information:** Information system has streamlined the flow of information within the organization. Information related with the status of a particular work, productivity and the performance of the workforce is available easily. There is clear and quick information on the market conditions, government policies and laws, and competitor's next move. All this facilitates better action on the part of the management.
- **Improves transaction processing:** Information system has resulted in better transaction processing, which not only saves valuable time but also improves the accuracy of data and information and that too at reduced cost. All the transactions of any nature are instantly recorded and processed which help the organization in getting useful information about business processes.
- **Supports decision making:** One of the best advantages of information system is the improved decision making. Relevant, accurate and timely information helps the management in better analysis of a problem which results into taking right decision at the right time. Right decisions help an organization in overcoming problems and grabbing opportunities.
- **Supports workgroup and team activity:** Information system provides centralized information to workgroups and teams at the right time. It facilitates better communication and information sharing between members. E-messaging and video conferencing help a team discuss problems and plans without physical presence of all the members at one place.
- **Improves quality of goods and services:** Availability of information all the time helps an organization in having better control over the production of goods and services to the customers and clients. The production scheduling is maintained in such a way as to avoid delays. Services are offered at the right time, which improves customer satisfaction.
- **Provides executive support:** The top executives of an organization always have the required information about different business aspects, be it the production status or sales condition or problem areas. All this helps them analyze conditions better, and take corrective measures and plan their next step.

- **Provides effective data management:** Information systems store and process a variety of data related to business. The data are then analyzed in various ways which allows the management to identify critical areas of business. Data management helps in formulating the right policies and plan action in different conditions.
- **Improves competitiveness:** Information system helps an organization in becoming more effective and efficient. It helps in utilizing the available resources better which improves the overall operations making them more cost effective. All this improves an organization's competitiveness.

## 1.5 Impact of Information System on Society

Over the last two decades particularly, information system has made a huge impact on the people. There is hardly any aspect of life which has not been affected directly or indirectly. From searching any information to communicating anywhere anytime and shopping online, and making transactions are some of the benefits that people today have. At the same time it has also resulted in some negative impact on the society. Let us have a look at both of them

### Positive impact

- **Effective communication system:** E-mail, online chatting, social media are some of the widely used applications by people all over the world. Such applications have brought people closer today. It has made a huge impact on society.
- **Availability of information:** Information system has improved the general awareness of the people to a great extent. You can find any information on any subject just at the click of your mouse. Data warehouses in large numbers are being created everyday to maintain huge amounts of information. The level of education of the people has improved greatly.
- **Improving globalization and reducing cultural gap:** Information system today connects people across the world through data and information. Even customer-to-customer business model has improved a lot. Large number of people specialized in different areas promote themselves and get a business for themselves using information system applications.
- **Getting better services:** Due to the wide and improved use of information system, organizations have improved their services to the customers. Customer today is the king. His choice and feedback can make or break a business. Thus, customers are the ultimate beneficiaries of information system.
- **Getting a range of online services:** Large number of online services available today such as online shopping, banking, education, medication, consultation, bill payments, etc. have made people's lives easy. It saves time as well as money for a large number of people.

### Negative Impact

- **Availability of too much information:** The pace of growth of information system is so high that people today have the problem of too much information. Fake information can be harmful to the society. Rumors too spread like wildfire. Controlling them often becomes difficult.
- **Increasing fraud:** Technology used in information system has, on one hand given a lot of benefits to the society, but on the other hand it has also increased online frauds immensely. Billions of dollars are lost every year because of online frauds.

- **Lack of job security:** The growth of information system has reduced large number of traditional jobs, which has resulted into people being removed from their jobs. Although it has resulted in the creation of new jobs, they are less in number. So, there is a lack of job security today.
- **Security threat:** The security threat to people's valuable data has grown manifolds. There are numerous cases of data being leaked or stolen by people and organizations. Organizations are trying hard to improve security systems but have not reduced security threats to zero.

## 1.6 Role of Information System in Framing Organizational Strategy and Bringing Competitive Advantages

Competition is inevitable in any business anywhere in the world. Competitors share a natural, and often healthy, rivalry. Thus, it requires a constant effort to gain competitive advantage in the marketplace. The competitive forces present all the time engage significant resources of a firm in order to deal with them.

Not only do firms need to compete with other firms in the marketplace for survival, but they must also work to stay ahead of them in competition. Although these competitive forces have always been difficult to manage, a business organization must guard itself against them.

How can business experts use information system to support an organization's competitive strategies? Information system can help a business implement some basic competitive strategies. Let's have a look at these key strategies implemented with information system.

They include: engaging customers or suppliers, building switching costs, raising barriers to entry, and utilizing investment in information system technology.

- Investments in information system can allow a business to **engage customers and suppliers** by developing valuable relationships with them. These business relationships should be so valuable to them that they don't even think of switching to its competitors. Attempts are these days made by organizations to use information systems technology to focus on significantly improving the quality of service to customers and suppliers.
- Another important strategy used these days is to put a major emphasis in information systems to find ways to create **high switching costs** in the relationships between an organization and its customers or suppliers. In other words, investments in information systems can make customers or suppliers dependent on the continued use of innovative and beneficial information system. Thus, the benefits which the customers or suppliers get will become costly if they switch to the competitor.
- Another strategy is to invest in information system to improve the quality of operations. By doing this a firm can **raise barriers for new entrants** by discouraging or delaying other companies from entering a market. These barriers increase the amount of investment required to compete with the existing organization, which discourages the new entrants.
- Investing in information system technology helps a firm to improve its capabilities to take advantage of opportunities when they come. For example, Investment in advanced computer-based information systems can improve the efficiency of an organization's own business processes. This way the organization can **utilize investment in information system technology** by developing new products and services that would give them a competitive edge.

## 1.7 Characteristics of a Good Information System

Information system is an important component of an organization's infrastructure and it plays an important role in the success and in gaining competitive advantages. Therefore, it is important that the information system is designed in such a way that it achieves its objectives. The following are the characteristics of a good information system:

- **Relevance of information** : The information a manager receives from an IS impacts his decisions. Thus, the information received must have right origin so that it is relevant to the cause.
- **Accuracy and reliability of information** : A key measure of the effectiveness of an information system is the accuracy and reliability of its information. The accuracy of the data it uses and the calculations it applies, generally determine the effectiveness of the resulting information.
- **Usefulness of information** : The information a manager receives from an IS may be relevant and accurate, but it is only useful if it helps him with the particular decisions he has to make.
- **Timeliness of information** : IS output must be current. Management has to make decisions about the future of the organization based on data from the present. The more recent the data, the better these decisions. When the collection and processing of data delays its availability, the IS must take into consideration its potential inaccuracies due to age and present the resulting information accordingly, with possible ranges of error.
- **Completeness of information** : An effective IS presents the most relevant and useful information for a particular decision. If some information is not available due to missing data, it highlights the gaps. Management can either add the missing data or make the appropriate decisions while being aware of the missing information. An incomplete or partial presentation of information can lead to decisions that do not have the desired results.

### Exercises

#### Answer the following questions in short

- Q. What is information system?
- Q. What are the elements of information system?
- Q. Explain the types of information system with neat and labeled diagram.
- Q. What are the advantages of information system?
- Q. What are the characteristics of a good information system?

#### Answer the following questions in long

- Q. Explain with necessary diagrams elements, objectives and types of information system.
- Q. Explain the types and activities of information system in detail.
- Q. What is the impact of information system on organizations and society?
- Q. Explain the role of information system in framing organizational strategy and bringing competitive advantages.

# Data and Knowledge Management

## Syllabus

Database Approach, Big Data, Data Warehouse and Data Marts, Knowledge Management

## 2.1 Introduction

In the previous chapter, you learnt about the fundamentals of information system. Information system has become an integral part of today's business world. Every organization has implemented it in numerous ways to stay competitive. There is a continuous attempt by IS experts to make it more effective.

In this chapter, you are going to learn about the core element of information system i.e. data. Data and its management make an effective information system. Data when processed results into information and analyzing, using and sharing information creates knowledge which when used judiciously takes an organization on the path of growth. Today management of knowledge more popularly known as *knowledge management* has become an important area of investment for all the organizations. It is going to be another area of focus for you in this chapter.

### 2.1.1 Data

Data are the main raw material of information systems. Data constitute valuable organizational resources that must be managed effectively to benefit all stakeholders in an organization. The increasing importance of data as a valuable organizational resource has brought a variety of changes in the organizations everywhere.

Data that are generated as a result of various transactions are now stored, processed, and analyzed using software applications like Database Management System (DBMS).

They show relationships among various organizational entities such as sales, customers, competitors, and markets. In today's globalized world running on communication network, data are protected with the same energy as the cash in a bank vault.

Data have become the lifeblood of today's organizations, and the effective and efficient management of data is considered an integral part of organizational strategy.

**Data today are available in many forms such as**

- Traditional alphanumeric data composed of numbers, letters, and other characters that describe business transactions and other entities
- Text data, which consist of sentences and paragraphs used in written communications
- Image data, such as graphic shapes and figures or photographs
- Video and audio data

### Data used as an input to the information systems are organized, stored, and accessed by

- Databases that store processed and organized data
- Knowledge bases that store knowledge in a variety of forms, such as facts, rules, and cases about businesses
- For example, data about product sales is stored, processed, and shared by a database management system for sales analysis by managers. Knowledge bases are used by knowledge management systems to share knowledge or give expert advice on specific subjects.

**Data and Information:** Data are raw facts, figures or observations, particularly about physical activities or business transactions. For example, the sale of an automobile generates a lot of data describing the process. Data are identified by its types and attributes. For example: people, places, things, events, they all are data.

People often use the terms *data* and *information* interchangeably. However, there is a difference. Data is a raw fact or figure that after processing results into information. We can further define information as a collection of data that after processing is converted into something meaningful and useful to various specific entities such as organizations and people.

Data by itself does not provide any understanding of the context in which it was recorded. For example a list of numbers or names simply doesn't reveal anything. In fact, the same list could be recorded in a variety of contexts. In contrast, for information, both the context of the data and the motive of the person accessing the data become essential. The same data may be valuable information to one person and completely irrelevant to the other.

#### 2.1.2 Fundamental Concepts of Data

Before we go any further, it is important to learn about some fundamental concepts about how data are organized in information systems.

Data are logically organized into *data types*, *fields*, *records*, *files*, and *databases*:

**Data types:** Every data has a type by which it is identified. This could be a character, a number, an alphanumeric or any other symbol. For example, Rohit, 25, 5A

- **Field :** It is also called a data attribute. A field symbolizes the category to which the data belongs. In other words, a data field represents an attribute (a characteristic or quality) of some data (object, person, place, or event). For example, in the above data, 'Name' could be a field name for Rohit; 'Age' could be a field name for 25; and 'Address' could be the field name for 5A. Every data has a field name and all the data belonging to the same field are called its domain.
- **Record :** Generally, fields are organized in such a way that they represent some logical order. For example, first\_name, last\_name, address, city, state, and zip code. All of the fields used to describe the attributes of an entity are grouped together to form a **record**. Thus, a record represents a collection of *attributes* that describe a single entity.
- **File :** A group of related records is a data file is also referred to as a *table*. When it is independent of any other data files related to it, a single *table* may be referred to as a *flat file* which refers to any database that exists in a single file in the form of rows and columns. Thus, an employee file would contain the records of the employees of a firm. Data files are of different types. For example, a *transaction file* is a kind of file which contains records of all transactions occurring during a particular period. A *master file* is another kind of file which contains permanent records and is updated periodically by transaction files. A *history file* is an obsolete transaction or master file retained for backup purposes or for long-term historical storage.
- **Database :** A database is an integrated collection of logically related data elements. A database consolidates records previously stored in separate files into a common pool of data elements that provides data for many applications. The data stored in a database are independent of the application programs using them and of the type of storage devices on which they are stored. Thus, databases contain data elements describing entities and relationships among them.

- For example, in Facebook, Google, or YouTube, all of the pictures, videos, songs, messages, chats, icons, e-mail addresses, and everything else are stored as fields, records, files in large databases. The data are stored in such a way that there is an easy access to it, it can be shared by its respective owners, and it can be protected from unauthorized access or use. Fig. 2.1.1, 2.1.2, 2.1.3 give the details of database elements and interconnected files.

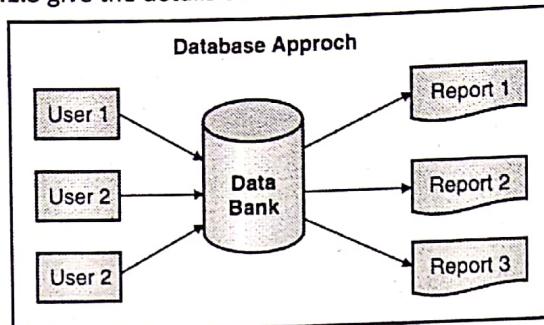


Fig. 2.1.1

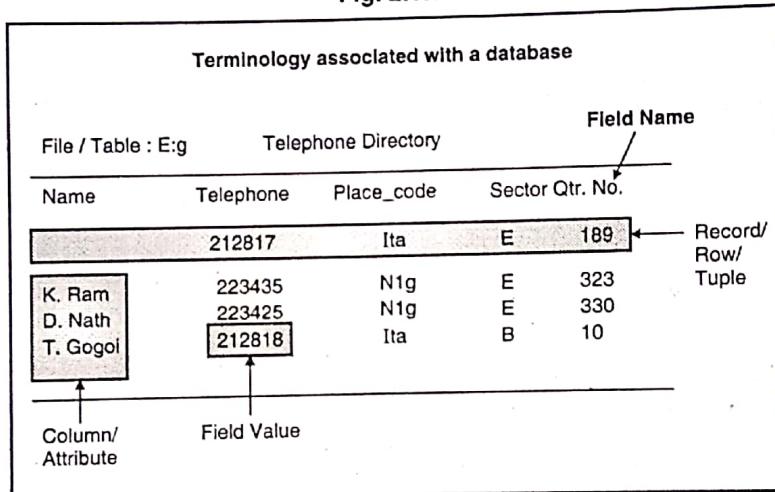


Fig. 2.1.2

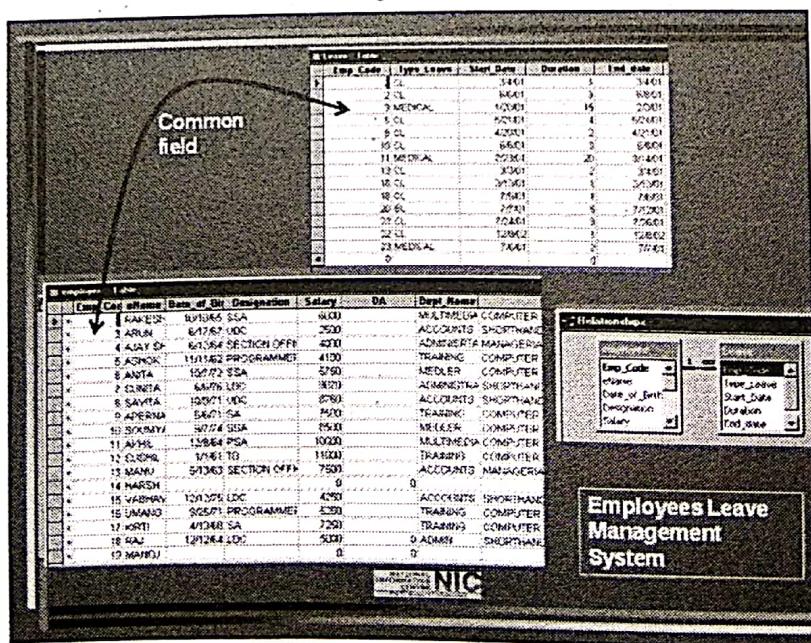


Fig. 2.1.3

## 2.2 Database Management System (DBMS)

A DBMS is a set of software programs that controls the organization, storage, management, and retrieval of data in a database. DBMS are categorized according to their data structures or types. They are used to store, update and retrieve a database. The DBMS accepts requests for data from the application program and instructs the operating system to transfer the appropriate data.

When a DBMS is used, information systems can be changed much more easily as the organization's information requirements change. New categories of data can be added to the database without disruption to the existing system.

Organizations may use one kind of DBMS for daily transaction processing and then move the detail onto another computer that uses another DBMS better suited for random inquiries and analysis. Overall systems design decisions are performed by data administrators and systems analysts. Detailed database design is performed by database administrators.

### DBMS building blocks

A DBMS includes four main parts: Modeling language, data structure, database query language, and transaction mechanism.

#### Modelling language

A data modeling language defines the schema of each database hosted in the DBMS, according to the DBMS database model. The four most common types of organizations are the: Hierarchical model, network model, relational model, and object model

A given database management system may provide one or more of the four models. The optimal structure depends on the natural organization of the application's data, and on the application's requirements (which include transaction rate i.e. speed, reliability, maintainability, scalability, and cost).

#### Data structure

A data structure is a way of storing data in a computer so that it can be used efficiently. It is an organization of mathematical and logical concepts of data. Often a carefully chosen data structure will allow the most efficient algorithm to be used. The choice of the data structure often begins with the choice of an abstract data type. A well-designed data structure allows a variety of critical operations to be performed using few resources reducing both execution time and memory space. Data structures are implemented by a programming language.

#### Database query language

A database query language and report writer allows users to interactively interrogate the database, analyze its data and update it according to the users' privileges on data. It also controls the security of the database. Data security prevents unauthorized users from viewing or updating the database. Using passwords, users are allowed access to the entire database or subsets of it. For example, an employee database can contain all the data about an individual employee, but one group of users may be authorized to view only payroll data, while others are allowed access to only work history and medical data. Following languages are used:-

1. Data Definition Language (DDL) - Defines structure and provides link between logical and physical views of the database

2. Data manipulation Language (DML) - Tool to write procedures for automating various DBMS functions.  
It can be used with other high level languages.
3. Structured Query language (SQL) - Allows user to request the information in the most natural way

### Transaction mechanism

A database transaction mechanism ensures data integrity, despite concurrent user accesses (concurrency control), and faults (fault tolerance). It also maintains the integrity of the data in the database. The DBMS can maintain the integrity of the database by not allowing more than one user to update the same record at the same time. The DBMS can help prevent duplicate records via unique index constraints; for example, no two customers with the same customer numbers (key fields) can be entered into the database.

### 2.2.1 Functions of a DBMS

- Creation / modification / deletion of tables, which may be physically located at one computer or different networked computers
- Manipulation of records in tables by sorting / filtering them
- Searching of desired records & updating / deleting them
- Mathematical /logical operations on the values in the fields
- Design of user interface to link and automate various modules of application
- Processing of user queries and presentation of results in tabulated form or pre-designed reports form.
- Linking with other databases

### 2.2.2 Managing Data Resources (Data management)

Data are vital assets for an organization therefore they need to be managed like other important business assets. Today's business organizations cannot survive or succeed without quality data about their internal operations and external environment.

Organizations need to practice data management which is a managerial activity that applies information systems technologies like *database management system*, *data warehousing*, *data mining* and other data management tools to manage an organization's data resources so that they can meet the information needs of their businesses. This section will show you different data resource management technologies and methods to manage an organization's data to meet business information requirements.

### 2.2.3 Types of Databases

Over last several decades there has been continuous development in information technology and its business applications which have resulted in the evolution of several major types of databases. Some of them are given below:

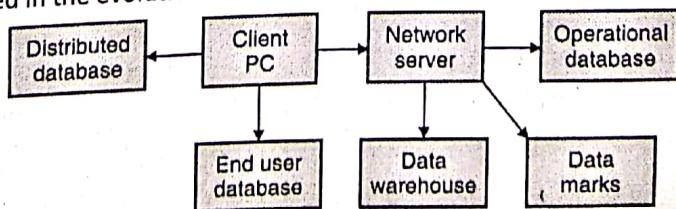


Fig. 2.2.1

— **Operational databases** are used to store data which are needed in details to support different business processes and operations of a company. Some of the examples are a customer database, human resource database, inventory database, and similar other databases that contain data generated by different business operations.

For example, a human resource database may include, data identifying each employee and his or her work time, compensation, benefits, performance appraisals, training and development status, and other related human resource data. Some of the common operational databases can be created and managed for a small business using Microsoft Access database management software.

— **Distributed database** is another type of database which resides on network servers on the World Wide Web, on corporate intranets or extranets, or on other company networks.

Distributed databases contain copies of operational or analytical databases or hypermedia databases, or any other type of database. Replication and distribution of databases improve database performance at users' end. Distributed databases are regularly updated.

Distributed databases have both, advantages and disadvantages. One primary advantage lies with the protection of valuable data. If all the data of an organization is stored on a single server, there is a chance of heavy loss in case a physical damage is done to the database because of fire, stealing or any other harmful event. By having databases distributed in multiple locations, the damage can be minimized.

Another advantage of distributed databases is their storage requirement. Often, a large database system is distributed into smaller databases based on some logical relationship between the data and the location.

For example, a company with several branch operations may distribute its data so that each branch operation location is also the location of its branch database. Since multiple databases in a distributed system are joined together, each branch has not only control of its local data but also has access to other databases present in other branches.

— **Web-based database:** The growth of Web sites on the internet, intranets and extranets has rapidly increased the demand and use of web-based databases. A website stores information in the form of a hypermedia database. Such a database is a collection of hyperlinked pages of multimedia based information (text, graphic, images, video clips, audio segments, and so on).

Figure 2.2.2 shows how you might use a web browser on your PC to connect with a Web network server. This server runs Web server software to access and transfer the Web pages you request. The Web server software acts as a database management system to manage hypermedia files for downloading.

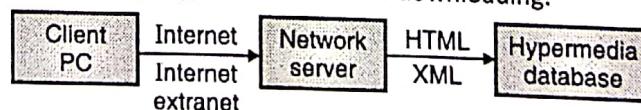


Fig. 2.2.2

## 2.3 Data warehouses

Data warehousing is defined as a technique for collecting and managing data from various sources to provide meaningful business insights. It stores data that have been extracted from the various operational, external, and other databases of an organization.

It is a central source of the data that have been cleaned, transformed, and cataloged so that they can be used by managers and other business professionals for data mining, online analytical processing, and other forms of business analysis, market research, and decision support.

Data warehousing is core for business intelligence (BI) system which is built for data analysis and reporting. It provides a new design which reduces response time and helps to enhance the performance of queries for reports and analytics.

#### How it works

A data warehouse works as a central depository where information arrives from one or more data sources and merges into one comprehensive database. It is then processed, transformed and ingested so that users can access data through different tools like SQL clients, spreadsheet, etc. By merging all the information, an organization is able to analyze data more holistically which ensures that it has considered all the information available.

#### 2.3.1 Types of Data Warehouses

- Enterprise data warehouse:** It is a centralized warehouse which provides decision support service across the organization. It also has the ability to distinguish and classify data according to different subjects and also gives access accordingly.
- Operational data warehouse:** It stores data which is preferred to be used for routine activities like storing the records of the employees. It is refreshed in real time.
- Data marts:** It is a subset of the data warehouse designed specifically to cater a particular line of business such as sales, finance, operations. Here data are directly collected from the sources. It focuses on the specific aspects of a business by offering specific information.

#### 2.3.2 Components of Data Warehouses

Figure 2.3.1 illustrates the components of a complete data warehouse system.

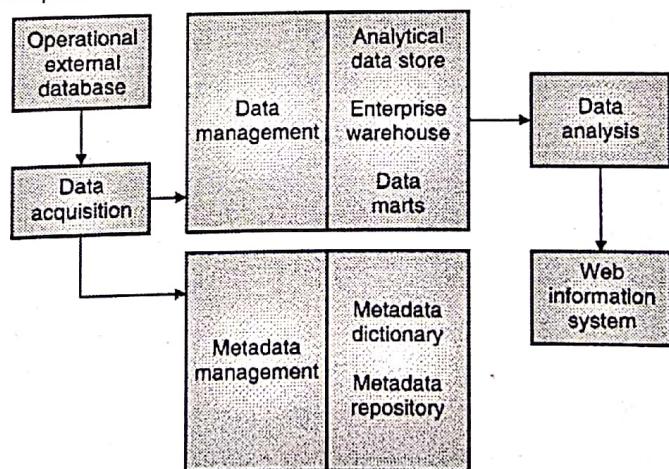


Fig. 2.3.1

- Operational, external and other databases :** These are different sources from where data are collected and transferred to the data warehouse.
- Data acquisition center :** After data from various operational and external databases are captured, they are cleaned and transformed into data that can be better used for analysis. The acquisition process includes activities like consolidating data from several sources, filtering out unwanted data, correcting incorrect data, converting data to new data elements, or aggregating data into new data subsets.

- **Data management** : These data are then stored in the enterprise data warehouse, from which they can be moved into data marts or to an *analytical data store* that holds data in a more useful form for certain types of analysis.
- **Metadata** : It is the data that define and describe the data in the data warehouse. Data are stored in a metadata repository and maintained by a metadata directory.
- **Data analysis system** : It is a set of variety of analytical software tools which help to query, report, mine, and analyze the data for delivery.
- **Web information system** : It is the final component used to display the final information to the end users via internet and intranet.

### 2.3.3 Who needs Data Warehouse

- Managers who make decisions based on mass amount of data
- Users who require and use customized, complex process to obtain information from multiple data sources
- People who want a simple technology and a systematic approach to access data for making decisions
- Users who want fast performance on a huge amount of data which is necessary for creating reports, grids or charts
- People who want to know and analyze hidden and minute patterns of data flow and grouping

### 2.3.4 Application Areas of Data Warehouse

Following are the most common areas where data warehouses are extensively used these days:

- **Airline** : In the airline system, it is used for operation purpose like crew assignment, analysis of route profitability, frequent flyer program promotions, etc.
- **Banking** : It is widely used in the banking sector to manage effectively the resources available on desk. Few banks also use it for market research, performance analysis of the product, and operations.
- **Healthcare** : Healthcare sector use data warehouse to make strategies and predict outcomes, generate patients' treatment reports, share data with insurance companies, medical aid services, etc.
- **Public sector** : In the public sector, data warehouse is used for intelligence gathering. It helps government agencies to maintain and analyze tax records, and health policy records, for every individual.
- **Investment and insurance sector** : In this sector, the warehouses are primarily used to analyze data patterns, customer trends, and to track market movements.
- **Retail chain** : In retail chains, data warehouse is widely used for distribution and marketing. It also helps to track items, customer buying pattern, promotions and is also used for determining pricing policy.

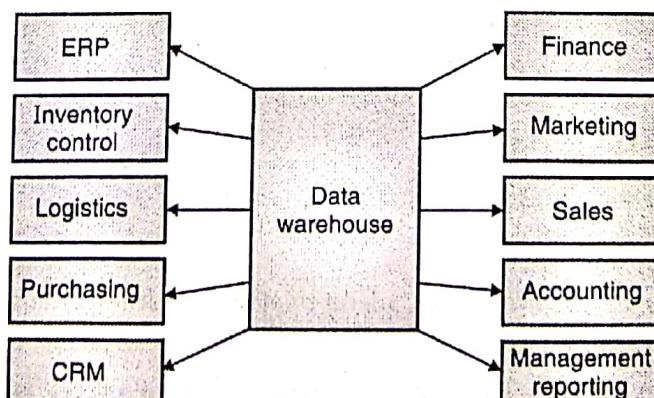


Fig. 2.3.2

### 2.3.5 Advantages of Data Warehouse

- Data warehouse allows business users to quickly access critical data from various sources all in one place.
- Data warehouse provides consistent information on various cross-functional activities.
- 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 of data make it easier for the user to use it for reporting and analysis.
- Data warehouse allows users to access critical data from a 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.

### 2.3.6 Disadvantages of Data Warehouse

- It is not an ideal option for unstructured data.
- Creation and implementation of data warehouse is time consuming.
- Data warehouse can be outdated relatively quickly.
- It is difficult to make changes in data types and ranges, data source, indexes, and queries.
- Organizations need to spend lots of their resources for training and implementation purpose.

### 2.3.7 Data Mining

Data mining is a major use of data warehouse databases and the static data they contain. In data mining, the data in a data warehouse are analyzed to reveal hidden patterns and trends in historical business activity.

This analysis can be used to help managers make decisions about strategic changes in business operations to gain competitive advantages in the marketplace.

Data mining can discover new correlations, patterns, and trends in vast amounts of business data stored in data warehouses. Data mining software uses advanced pattern recognition algorithms, as well as a variety of mathematical and statistical techniques to extract previously unknown strategic business information.

**Many companies use data mining to:**

- Perform market analysis to identify new products that can be launched
- Find root causes of quality or manufacturing problems
- Prevent customer attrition and acquire new customers
- Profile customers with more accuracy

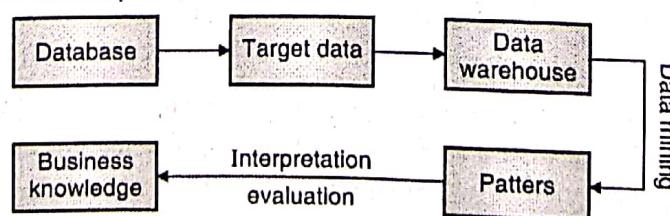


Fig. 2.3.3

## 2.4 Knowledge Management Approach

### 2.4.1 Knowledge and Its Relevance

Knowledge is a set of information which provides capability to understand different situations, anticipate results and judge their effects, offer solutions or clues to handle the situation.

Whether it is a person or an organization, knowledge plays a vital role in its growth and development. In today's challenging, tough and competitive business environment, having knowledge and capability to use and manage it gives an edge.

Data forms the basis of information. Data when organized in the right context becomes information. Information when shared utilized and applied at the right time and right place to sort out problems becomes knowledge.

In short, knowledge is the capability to handle a complex situation. More the knowledge, higher is the capability.

Knowledge-based capability has three elements - visualization of right options to handle complex situations, anticipation and assessment of its result and forecasting its effect in terms of benefits, cost, losses and damages.

Knowledge further develops wisdom which is the ability to decide when and where knowledge is truly applicable to resolve the complex problem situation.

Knowledge is of three types: explicit, tacit and intellectual. **Explicit knowledge** is the knowledge and skill that can be easily articulated and understood and which can be modeled and transferred to others. Software products are examples of explicit knowledge. **Tacit knowledge** is intangible and cannot be articulated and transferred easily such as body language or innovative thinking. The consultants and experts possess tacit knowledge. **Intellectual knowledge** could be tacit or explicit and is owned by somebody. It is also termed as intellectual capital.

Knowledge is not a static entity. It improves and also gets obsolete after sometime.

In a business, knowledge plays a key role today. Regardless of industry, all organizations today rely on the power of knowledge. They aim to build in processes to store, grow and share knowledge to increase knowledge base of the overall workforce.

Today businesses are also affected by the pace of the change. The change is rapid, innovative and path breaking. The product life cycles are shorter and organizations have to improve products and services to remain competitive.

To manage this shift, knowledge is the key resource of the organization and workplace. Due to this critical importance of knowledge, business economy is today termed as knowledge economy.

### 2.4.2 Knowledge Management

Knowledge management is the planned and systematic management of knowledge related activities, practices, programs and policies within an organization to create a big knowledge database and then share it with others and improve continuously its contents and quality.

Knowledge management relies on an understanding of knowledge. The core goal of knowledge management is to connect those with knowledge and those seeking knowledge so that ultimately it increases the knowledge within an organization.

To be competitive in today's challenging environment organizations are always motivated by several goals and they evolve strategies to achieve them. In such an environment, it becomes essential for business organizations to manage knowledge systematically through knowledge management. The objective is to develop the best available knowledge to make people and enterprise capable as a whole so that they act effectively to implement various strategies.

### 2.4.3 Driving Forces behind Knowledge Management

In today's tough and challenging business world, KM is a necessity due to various forces which drive KM. They are both external and internal.

#### External forces:

External forces are business environmental factors which are often beyond control. An organization's success depends on how it deals with these forces and still grows. The forces in external environment are the following:

- **Globalization of business:** With loosening of trade barriers and advanced internet technologies, businesses today operate beyond the local and national boundaries. It has a bigger market to tap and more sources and resources to bank upon. But there is a stiff competition everywhere. Overcoming them is a pre-requisite for success.
- **Changing customers and their demands:** Customers today easily access information about product and services, and are now more knowledgeable to demand more value at the least cost. They drive your business by demanding better quality, new features, quick response and delivery.
- **Innovative competitors:** Competition is no longer limited to quality and cost but extended to providing value-added services using technologies and best practices. This puts a heavy demand on organizations to compete with the same force.
- **Resourceful vendors:** Vendors continue to increase their capabilities by use of technologies, innovative product features and better logistics and the organizations have to match them.

These external forces compel business organizations to be more effective, be more knowledgeable on customer needs, be in learning mode all the time to remain competitive and get into collaborative partnership arrangements with resourceful vendors.

#### Internal forces:

There are forces internal to organizations which too impact business operations although they are within control. Some of these internal forces are the following:

- **Effectiveness:** Organizations' effectiveness in handling operations, and seizing opportunities, plays an important role in their success. Effectiveness is anticipating the change in market and environment requiring pro-active actions to deal with it.
- **Technological capability:** Businesses need technology to bring in efficiency and effectiveness. Businesses must operate through collaborative work, high end information management and technology. All this put together defines an organization's technological capability.
- **Effectiveness of human resource:** People and organization behavior affects effectiveness of the business enterprise. Knowledge about its human resource in terms of understanding their mental models and associations, which affect them and the decision making is essential. KM Initiative is the result of this requirement.

These forces require organizations to work with knowledge, calling for formal implementation of KM with initiatives on number of technology fronts, behavior and information management.

### 2.4.4 Benefits of Knowledge Management

It increases collaboration among different business units and also helps in idea generation

- It optimizes a culture of knowledge sharing within the organization.

- The repository of knowledge as a central database protects intellectual capital
- Knowledge management system treats human capital as an asset, which makes employees feel respected for their knowledge
- The system captures and stores knowledge which proves quite beneficial for the future workforce

#### 2.4.5 Challenges of Knowledge Management

- **Creating a flexible culture and collaboration:** This is one of the most significant challenges of KM. Organizations struggle to implement new policies, because people by nature tend to resist change. Employees generally want to protect their skills and knowledge, or are reluctant to learn from their peers.
- **Security:** This is another challenge as it is important not just to protect sensitive information but also the intellectual capital. KM is based on sharing and storing of knowledge by individual employees.
- **Measuring knowledge:** At times, it is difficult to define a system to measure the knowledge within your organization, especially for tacit knowledge that cannot be easily quantified.
- **Document storage and management:** Knowledge will have to be stored and organized in some form which is never easy. Document management is a challenge for many companies. Documents must be well organized otherwise, it will be impossible to locate and use the knowledge you have stored.
- **Disseminating knowledge:** You'll need to devise a process where once you store knowledge other team members can access it. This is complicated both theoretically and tactically. So many organizations opt for a software system designed specifically for this purpose.
- **Continuous improvement:** You should continuously improve upon the knowledge management system that you implement. Periodic reviews of delicate resources must be done to continuously improve your process.

#### 2.4.6 Working of Knowledge Management

Knowledge management approach suggests that in order to make the best business decisions, the workforce must be as educated and skillful as much as possible. This practice ensures not only that existing knowledge is codified and stored, but it can be dispersed among other employees so that people can continue to develop skills.

There are three main ways that people approach knowledge management:

- **People-centric:** KM is centered on people, relationships, and how people form learning communities and develop other informal ways of knowledge sharing.
- **Tech-centric:** Here the focus is on the technology that facilitates knowledge storage and transfer, and aims to create technology systems that encourage knowledge sharing.
- **Process-centric:** This approach focuses on developing standard processes under KM, which include the production processes, the organizational hierarchy, and the cultural framework.

**Exercises****Solved Questions****Answer the following questions in short****1. Define data.**

Data are raw facts, figures or observations, particularly about physical activities or business transactions. For example, the sale of an automobile generates a lot of data describing the process. Data are identified by its types and attributes. For example: people, places, things, events, etc. they all are data.

**2. Why is data important for an organization?**

Data constitute valuable organizational resources. Data have become the lifeblood of today's organizations, and the effective and efficient management of data is considered an integral part of organizational strategy.

**3. What is the difference between data and information?**

People often use the terms *data* and *information* interchangeably. However, there is a difference. Data is a raw fact or figure that after processing results into information. Data by itself does not provide any understanding of the context in which it was recorded. In contrast, for information, both the context of the data and the motive of the person accessing the data become essential.

**4. Describe the logical organization of data.**

Data are logically organized into *data types, fields, records, files, and databases*.

**5. Describe database.**

A database is an integrated collection of logically related data elements. A database consolidates records previously stored in separate files into a common pool of data elements that provides data for many applications. The data stored in a database are independent of the application programs using them and of the type of storage devices on which they are stored. Thus, databases contain data elements describing entities and relationships among them.

**6. What is Database Management System (DBMS). Give any example**

A DBMS is a set of software programs that controls the organization, storage, management, and retrieval of data in a database. DBMS are categorized according to their data structures or types. They are used to store, update and retrieve a database. The DBMS accepts requests for data from the application program and instructs the operating system to transfer the appropriate data. For example: MS-Access, Oracle, etc.

**7. Define data structure**

A data structure is a way of storing data in a computer so that it can be used efficiently. It is an organization of mathematical and logical concepts of data. A well-designed data structure allows a variety of critical operations to be performed using few resources reducing both execution time and memory space.

**8. What is a query language?**

A database query language is a part of DBMS which allows users to interactively interrogate the database, analyze its data and update it according to the users' privileges on data. It also controls the security of the database.

**9. State any two functions of DBMS.**

- Creation / modifications / deletion of tables, which may be physically located at one computer or different networked computers
- Manipulation of records in tables by sorting / filtering them
- Searching of desired records & updating / deleting them

**10. What do you mean by data management?**

Data management is a managerial activity that applies information systems technologies like *database management system*, *data warehousing*, *data mining* and other data management tools to manage an organization's data resources so that they can meet the information needs of their businesses.

**11. What is a distributed database?**

Distributed database is a type of database which resides on network servers. It contains copies of operational or analytical databases or hypermedia databases, or any other type of database which are shared among various users.

**12. What is data warehouse?**

Data warehousing is defined as a technique for collecting and managing data from various sources to provide meaningful business insights. It stores data that have been extracted from the various operational, external, and other databases of an organization.

**13. What is data mart?**

It is a subset of the data warehouse designed specifically to cater to a particular line of business such as sales, finance, operations. Here data are directly collected from the sources. It focuses on the specific aspects of a business by offering specific information.

**14. Define metadata.**

It is the data that define and describe the data in the data warehouse. Data are stored in a metadata repository and maintained by a metadata directory.

**15. State any two application areas of data warehouse.**

Following are the most common areas where data warehouses are extensively used these days:

- **Airline:** In the airline system, it is used for operation purpose like crew assignment, analysis of route profitability, frequent flyer program promotions, etc.
- **Banking:** It is widely used in the banking sector to manage effectively the resources available on desk. Few banks also use it for the market research, performance analysis of the product and operations.

**16. What is data mining?**

Data mining is a major use of data warehouse databases and the static data they contain. In data mining, the data in a data warehouse are analyzed to reveal hidden patterns and trends in historical business activity.

This analysis can be used to help managers make decisions about strategic changes in business operations to gain competitive advantages in the marketplace.

**17. Describe knowledge.**

Knowledge is a set of information which provides capability to understand different situations, anticipate results and judge their effects, offer solutions or clues to handle the situation.

Whether it is a person or an organization, knowledge plays a vital role in its growth and development.

**18. What is knowledge management?**

Knowledge management is the planned and systematic management of knowledge related activities, practices, programs and policies within an organization to create a big knowledge database and then share it with others and improve its contents and quality continuously.

**19. What are the types of knowledge?**

Knowledge is of three types: explicit, tacit and intellectual. **Explicit knowledge** is the knowledge and skill that can be easily articulated and understood and which can be modeled and transferred to others. Software products are examples of explicit knowledge. **Tacit knowledge** is intangible and can not be articulated and transferred easily such

as body language or innovative thinking. The consultants and experts possess tacit knowledge. Intellectual knowledge could be tacit or explicit and is owned by somebody.

**20. What are the benefits of knowledge management?**

It increases collaboration among different business units and also help in idea generation.

It optimizes a culture of knowledge sharing within the organization.

The repository of knowledge as a central database protects intellectual capital

**21. State any two challenges of knowledge management.**

- **Security:** This is another challenge as it is important not just to protect sensitive information but also the intellectual capital. KM is based on sharing and storing of knowledge by individual employees.

- **Measuring knowledge:** At times, it is difficult to define a system to measure the knowledge within your organization, especially for tacit knowledge that cannot be easily quantified.

**Answer the following questions in detail**

**1. Describe the importance of data in today's business environment.**

Data are the main raw material of information systems. Data constitute valuable organizational resources that must be managed effectively to benefit all stakeholders in an organization. The increasing importance of data as a valuable organizational resource has brought a variety of changes in the organizations everywhere.

Data that are generated as a result of various transactions are now stored, processed, and analyzed using software applications like Database Management system (DBMS).

They show relationships among various organizational entities such as sales, customers, competitors, and markets. In today's globalized world running on communication network, data are protected with the same energy as the cash in a bank vault.

Data have become the lifeblood of today's organizations, and the effective and efficient management of data is considered an integral part of organizational strategy.

**2. Explain the organization of data.**

Data are logically organized into *Data types, fields, records, files, and databases*:

- **Data types:** Every data has a type by which it is identified. This could be a character, a number, an alphanumeric or any other symbol. For example, Rohit, 25, 5A.
- **Field:** It is also called a data attribute. A field symbolizes the category to which the data belongs. In other words, a data field represents an attribute (a characteristic or quality) of some data (object, person, place, or event). For example, in the above data, 'Name' could be a field name for Rohit, 'Age' could be a field name for 25, and 'Address' could be the field name for 5A. Every data has a field name and all the data belonging to the same field are called its domain.
- **Record:** Generally, fields are organized in such a way that they represent some logical order, For example, first\_name, last\_name, address, city, state, and zip code. All of the fields used to describe the attributes of an entity are grouped together to form a record. Thus, a record represents a collection of attributes that describe a single entity.
- **File:** A group of related records is a data file also referred to as a *table*. When it is independent of any other data files related to it, a single *table* may be referred to as a *flat file* which refers to any database that exists in a single file in the form of rows and columns. Thus, an employee file would contain the records of the employees of a firm.
- **Database:** A database is an integrated collection of logically related data elements. A database consolidates records previously stored in separate files into a common pool of data elements that provides data for many applications.

### 3. Describe database management system. What are its building blocks? Describe.

A DBMS is a set of software programs that controls the organization, storage, management, and retrieval of data in a database. DBMS are categorized according to their data structures or types. They are used to store, update and retrieve a database. The DBMS accepts requests for data from the application program and instructs the operating system to transfer the appropriate data.

#### DBMS building blocks

A DBMS includes four main parts: Modelling language, data structure, database query language, and transaction mechanism:

##### Modeling language

A data modeling language defines the schema of each database hosted in the DBMS, according to the DBMS database model.

##### Data structure

A data structure is a way of storing data in a computer so that it can be used efficiently. It is an organization of mathematical and logical concepts of data.

##### Database query language

A database query language and report writer allow users to interactively interrogate the database, analyze its data and update it according to the users privileges on data. It also controls the security of the database. Following languages are used: -

1. Data Definition Language (DDL) – It defines the structure and provides a link between logical and physical views of the database.
2. Data manipulation Language (DML) – It is a tool to write procedures for automating various DBMS functions. It can be used with other high level languages.
3. Structured Query language (SQL) – It allows the user to request information in the most natural way.

##### Transaction mechanism

A database transaction mechanism ensures data integrity, despite concurrent user accesses (concurrency control), and faults (fault tolerance). It also maintains the integrity of the data in the database.

#### 4. Write the importance of data management.

Data are vital assets for an organization therefore they need to be managed like other important business assets. Today's business organizations cannot survive or succeed without quality data about their internal operations and external environment.

Organizations need to practice data management which is a managerial activity that applies information systems technologies like *database management system*, *data warehousing*, *data mining* and other data management tools to manage an organization's data resources so that they can meet the information needs of their businesses.

#### 5. Explain different type of databases in detail.

Over the last several decades there has been continuous development in information technology and its business applications which have resulted in the evolution of several major types of databases. Some of them are given below:

- **Operational databases** are used to store data which are needed in details to support different business processes and operations of a company. Some of the examples are a customer database, human resource database, inventory database, and similar other databases that contain data generated by different business operations.

- **Distributed database** is another type of database which resides on network servers on the World Wide Web, on corporate intranets or extranets, or on other company networks.
- Distributed databases contain copies of operational or analytical databases or hypermedia databases, or any other type of database. Replication and distribution of databases improve database performance at users end.
- **Web-based database:** The rapid growth of websites on the internet, intranets and extranets has rapidly increased the demand and use of web-based databases. A website stores information in the form of a hypermedia database. Such a database is a collection of hyperlinked pages of multimedia based information (text, graphic, images, video clips, audio segments, and so on)

#### 6. What is data warehouse? Explain its different types.

Data warehousing is defined as a technique for collecting and managing data from various sources to provide meaningful business insights. It stores data that have been extracted from the various operational, external, and other databases of an organization.

It is a central source of the data that have been cleaned, transformed, and cataloged so that they can be used by managers and other business professionals for data mining, online analytical processing, and other forms of business analysis, market research, and decision support.

#### Types of data warehouses

1. **Enterprise data warehouse:** It is a centralized warehouse which provides decision support service across the organization. It also has ability to distinguish and classify data according to different subjects and also gives access accordingly.
2. **Operational data warehouse:** It stores data which is preferred to be used for routine activities like storing the records of the employees. It is refreshed in real time.
3. **Data marts:** It is a subset of the data warehouse designed specifically to cater to a particular line of business such as sales, finance, operations. Here data are directly collected from the sources. It focuses on the specific aspects of a business by offering specific information.

#### 7. Describe data warehouse components.

#### Components of data warehouses

Following are the components of a complete data warehouse system.

- **Operational, external and other databases:** These are different sources from where data are collected and transferred to the data warehouse.
- **Data acquisition center:** After data from various operational and external databases are captured, they are cleaned and transformed into data that can be better used for analysis. The acquisition process includes activities like consolidating data from several sources, filtering out unwanted data, correcting incorrect data, converting data to new data elements, or aggregating data into new data subsets.
- **Data management:** These data are then stored in the enterprise data warehouse, from which they can be moved into data marts or to an *analytical data store* that holds data in a more useful form for certain types of analyses.
- **Metadata:** It is the data that define and describe the data in the data warehouse. Data are stored in a metadata repository and maintained by a metadata directory.
- **Data analysis system:** It is a set of variety of analytical software tools which help to query, report, mine, and analyze the data for delivery.

- **Web information system:** It is the final component used to display the final information to the end users via internet and intranet.

#### 8. Define knowledge. How is it different from information? What is its significance for a business firm?

**Knowledge** is a set of information which provides capability to understand different situations, anticipate results and judge their effects, and offer solutions or clues to handle the situation.

Data when organized in the right context becomes information. Information when shared, utilized and applied at the right time and right place to sort out problems becomes knowledge.

Whether it is a person or an organization, knowledge plays a vital role in its growth and development. In today's challenging, tough and competitive business environment, having knowledge and the capability to use and manage it gives an edge. In a business, knowledge plays a key role today. Regardless of industry, all organizations today rely on the power of knowledge. They aim to build processes to store, grow and share knowledge to increase knowledge base of the overall workforce.

Today businesses are also affected by the pace of the change. The change is rapid, innovative and path breaking. The product life cycles are shorter and organizations have to improve products and services to remain competitive.

To manage this shift, knowledge is the key resource of the organization and workplace. Due to this critical importance of knowledge, business economy is today termed as knowledge economy.

#### 9. What is knowledge management? What factors have led to its development?

Knowledge management is the planned and systematic management of knowledge-related activities, practices, programs and policies within an organization to create a big knowledge database and then share it with others and improve its contents and quality continuously.

In today's tough and challenging business world, KM is a necessity due to various forces which drive KM. They are both external and internal.

##### External forces

The forces in external environment are the following:

- **Globalization of business :** With loosening of trade barriers and advanced internet technologies, businesses today operate beyond the local and national boundaries. It has a bigger market to tap and more sources and resources to bank upon. But there is a stiff competition everywhere. Overcoming them is a pre-requisite for success.
- **Changing customers and their demands :** Customers today easily access information about product and services, and are now more knowledgeable to demand more value at least cost. They drive your business by demanding better quality, new features, quick response and delivery.
- **Innovative competitors :** Competition is no longer limited to quality and cost but extended to providing value added services using technologies and best practices. This puts a heavy demand on organizations to compete with the same force.

##### Internal forces

- **Effectiveness :** Organizations effectiveness in handling operations, seizing opportunities play an important role in their success. Effectiveness is anticipating the change in market and environment requiring pro-active actions to deal with it.
- **Technological capability :** Businesses need technology to bring in efficiency and effectiveness. Businesses must operate through collaborative work, high end information management and technology. All this put together defines an organization's technological capability.

- **Effectiveness of human resource :** People and organization behavior affects effectiveness of the business enterprise. Knowledge about its human resource in terms of understanding their mental models and associations which affect them and the decision making is essential. KM initiative is the result of this requirement.

#### 10. Describe the challenges faced by KM.

##### Challenges of knowledge management

- **Creating a flexible culture and collaboration :** This is one of the most significant challenges of KM. Organizations struggle to implement new policies, because people by nature tend to resist change. Employees generally want to protect their skills and knowledge, or they are reluctant to learn from their peers.
- **Security :** This is another challenge as it is important not just to protect sensitive information but also the intellectual capital. KM is based on sharing and storing of knowledge by individual employees.
- **Measuring knowledge :** At times it is difficult to define a system to measure the knowledge within your organization, especially for tacit knowledge that cannot be easily quantified.
- **Document storage and management :** Knowledge will have to be stored and organized in some form which is never easy. Document management is a challenge for many companies. Documents must be well organized otherwise, it will be impossible to locate and use the knowledge you have stored.
- **Disseminating knowledge :** You'll need to devise a process where once you store knowledge other team members can access it. This is complicated both theoretically and tactically. So many organizations opt for a software system designed specifically for this purpose.

#### Unsolved Questions

##### Answer in short

- Q. How do we identify data? (**Refer section 2.1.1**)
- Q. How do we get information? (**Refer section 2.1.1**)
- Q. State two advantages of information (**Refer section 2.1**)
- Q. What is use of database for an organization? (**Refer section 2.2**)
- Q. Name the components/building blocks of a database management system. (**Refer section 2.2**)
- Q. Name any two DBMS. (**Refer section 2.2**)
- Q. Define data definition and data manipulation language (**Refer section 2.2**)
- Q. What do you mean by management of data? (**Refer section 2.1**)
- Q. State any three benefits of data warehouse. (**Refer section 2.3.5**)
- Q. What is the function of data mining? (**Refer section 2.3.7**)
- Q. Explain the relevance of knowledge management for an organization. (**Refer section 2.4.1**)

##### Long Questions

- Q. What is a database management system? Describe its functions. (**Refer section 2.2**)
- Q. What is a distributed database? How is it beneficial? How is it different from operational database? (**Refer section 2.2.3**)
- Q. What is data warehouse? How does it work? Describe. (**Refer section 2.3**)
- Q. Explain advantages and disadvantages of data warehouse. (**Refer sections 2.3.5 and 2.3.6**)
- Q. What is KM? Describe its working in detail. (**Refer section 2.4**)

# Business Intelligence

## Syllabus

Managers and Decision Making, Business Intelligence for Data Analysis and Presenting Results

### 3.1 Introduction

In the previous chapters, we have discussed data, information and knowledge concepts. We have illustrated how they are used in design and development of an information system.

The concepts that we have discussed so far work well when a business organization is small. Even if it is large, its processes are routine and the business model is simple. Business processes are not distributed, rather they are centralized.

But as the globalization expanded and liberalization unified the global market, the business growth has taken a rapid pace. Organizations have expanded their operations both vertically and horizontally.

The number of operating units has spread nationally and internationally. Business strategies and objectives are governed by market conditions and customer requirements of a country. Transactions are more specific to the tax system and corporate laws of a country.

Today operating units of business organizations differ with each other in their business models, revenue models, data models, software and their application areas and business strategies.

In short, we can say businesses are no more routine activities. Survival and then growth have become key considerations. Under these circumstances, Business Intelligence(BI) has become a key system to resolve many of the above issues.

Building business intelligence for organizations is seen as a solution to meet the complex strategic decision making, competitive challenges and never ending requirements for better operational efficiency and effectiveness.

Hence, building BI for an organization becomes the next natural extension of information system. You are going to learn more about BI in the following sections :

### 3.2 What is Business Intelligence?

Business Intelligence (BI) is a set of tools, technologies, applications, and practices used to collect, integrate, analyze, and present an organization's raw data in order to create insightful and actionable business information.

As per Wikipedia: "Business Intelligence (BI) is a set of theories, methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information for business purposes. BI can handle large amounts of information to help identify and develop new opportunities. Making use of new opportunities and implementing an effective strategy can provide a competitive market advantage and long-term stability."

IBM researcher Hans Peter Luhn is credited with coining the term Business Intelligence in a 1958 article. He defines BI as "the ability to apprehend the interrelationships of presented facts in such a way as to guide action towards a desired goal."

Forrester further develops this idea with the following broad definition: "Business Intelligence is a set of methodologies, processes, platforms, applications, architectures, and technologies that transform raw data into meaningful and useful information used to enable more effective strategic, tactical, and operational insights and decision making."

Building upon this idea, Howard Dresner in 1989 (later a Gartner Group analyst) proposed "Business Intelligence" as an umbrella term to describe "concepts and methods to improve business decision making by using fact-based support systems."

BI is made up of several related activities like:

1. Data mining
2. Online analytical processing (OLAP)
3. Querying
4. Reporting

### **3.3 Purpose of using Business Intelligence**

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The purpose of business intelligence in a business is to help corporate executives, business managers, and other operational workers make better and more informed business decisions. Companies also use business intelligence to cut costs, identify new business opportunities, and spot inefficient business processes.

### **3.4 Benefits of Business Intelligence**

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The following are the benefits of business intelligence programs:

1. It accelerates and improves decision making within organizations.
2. BI optimizes internal business processes by improving work methods and focusing on activities critical to the processes.
3. It increases the operational efficiency of each functional unit within the organization by modifying processes.
4. BI revises organizational processes, identifies new work areas and opportunities that also creates new revenue models for the organization.
5. By analyzing the data and information collected from within and outside the organization; BI helps the organization in gaining vital competitive advantages over business rivals.
6. The data analysis done by BI helps an organization in identifying market trends that help it make better decisions.
7. BI is quick in spotting business problems that need to be addressed.

### 3.5 How is BI used in Organizations?

Business intelligence has a positive impact on organization's people in a similar way as it has on performance, projects, and decisions. Business intelligence is used to convert data into useful information for leadership, management, organization and decision making. For every organization, it is important to learn how to use Business Intelligence.

The following are some of the ways business intelligence is used in organizations:

- By analyzing customer behavior, buying patterns and sales trends to make decisions at the right time
- By measuring, tracking and predicting sales and financial performance to support business strategies
- By budgeting and doing financial planning for different processes, projects and forecasting the likely sales and business growth
- By tracking the performance of marketing campaigns so as to analyze the positives and negatives in an attempt to plan further
- By optimizing the processes and operational performance in order to boost productivity and take corrective measures if required
- By improving delivery and supply chain effectiveness of the organization, which have the potential to improve the market presence that is as critical as the product itself
- By doing web and e-commerce data analytics to better cater to the online customers which are fast growing
- By focusing on and improving customer relationship management which is a vital focus area for every organization
- By doing risk analysis which is so important for organizations operating in an uncertain market environment.

Simply put, business intelligence helps people make better business decisions by showing present and historical data within its business context. It offers performance benchmarks to make the business run smoother and more efficiently. It helps people spot market trends to increase sales or revenue. If used effectively, just about any aspect of business can be improved through business intelligence.

BI technology is used in a number of applications where customer is treated as special. For example, in manufacturing for order shipment and customer support, in retail for customer profiling to target grocery coupons during check out, in financial services for claims analysis and fraud detection, in tourism industry for proactively identifying tourists choices and offering them least prices.

### 3.6 Tools and Techniques of BI

#### 3.6.1 Online Analytical Processing (OLAP)

OLAP is a technique by which the data collected from a data warehouse or data mart is visualized and summarized to provide multi-dimensional view across multiple domains. OLAP tools help to accomplish these tasks.

OLAP works on data or business information stored in data warehouse, which is a repository of data and information selected and stored for specific information-support objectives. OLAP tools enable aggregation of data, and partial or total view across several dimensions through Info-Cube application. OLAP tools also provide options to drill-down the data from one hierarchy to another exposing its details for insights into its generation.

### 3.6.2 Market Basket Analysis

The term market basket analysis refers to investigative research on buyer behavior. The buyer behavior often reveals information like group of products purchased together which suggests new promotion campaigns. The store is made to keep in line the items that are picked together to save buyers pick-up time. Discount schemes on products which are bought in association, developing cross-selling schemes and so on are designed based on the available information on buyer behavior.

### 3.6.3 Data Mining

Data mining is a major use of data warehouse databases and the static data they contain. In data mining, the data in a data warehouse are analyzed to reveal hidden patterns and trends in historical business activity.

This analysis can be used to help managers make decisions about strategic changes in business operations to gain competitive advantages in the marketplace.

Data mining can discover new correlations, patterns, and trends in vast amounts of business data stored in data warehouses. Data mining software uses advanced pattern recognition algorithms, as well as a variety of mathematical and statistical techniques to extract previously unknown strategic business information.

Many companies use data mining to:

- Perform market analysis to identify new products that can be launched.
- Find root causes of quality or manufacturing problems.
- Prevent customer attrition and acquire new customers.
- Profile customers with more accuracy.

## 3.7 Process of BI System Creation

Business intelligence is created with the help of data, structured and semi-structured, from different domains and sources which is searched and passed through a process through different BI processing tools. The entire process is termed as ETL (Extraction, Transformation and Loading). Following are the steps of the process:

1. **Data acquisition:** Data structured or unstructured are captured from various domains and sources
2. **Integration:** The collected data is then integrated for the next step
3. **Cleanup data:** Since the data are collected from various sources, domains and applications, they may have different formats, models and incompleteness. Therefore, such data need to go through cleanup, alignment and formatting to make it ready for BI processing
4. **Search related data:** In this step, Data which are related with your problem solving and decision making requirements are searched as only they are needed.
5. **Analyze the data:** In this step, analysis of the data is done for two purposes, one to get insight of the problem and second to go for identification of relevant data and information to solve the problem.
6. **Identify relevant data:** The analysis of relevant data and information helps you find most relevant information which will serve the purpose which is solving the problem.

7. **Format data:** Relevant information needs to be presented in the right format so that the user finds it easy to understand. The format could be a word document, PDF or a spreadsheet.
8. **Load in data warehouse:** This is the last step. Formatted data is delivered to the users through BI data warehouse.

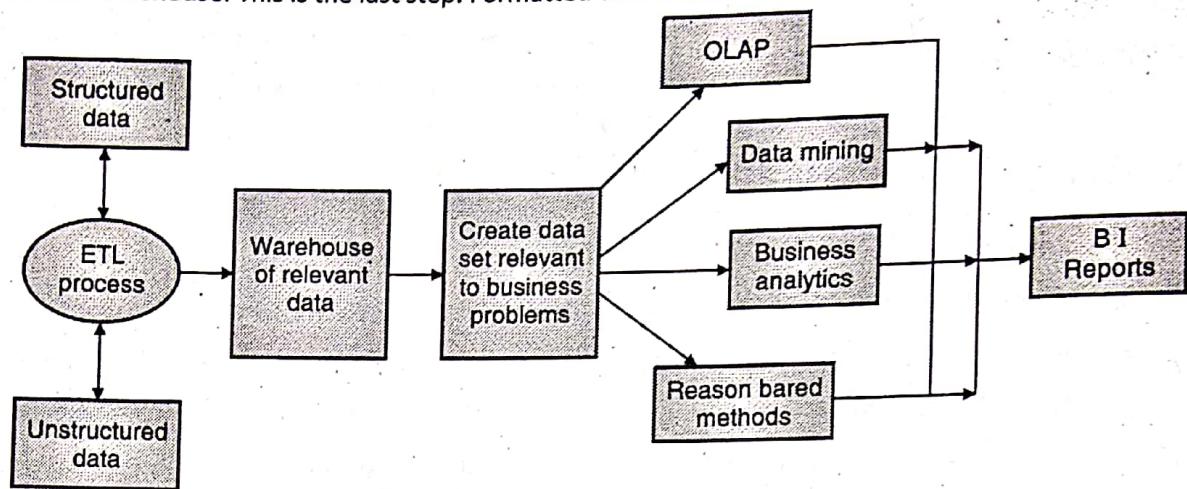


Fig. 3.7.1 : Process of converting data into BI

### 3.8 Impact of Business Intelligence on Functional Units

Today, business intelligence has a huge direct or indirect impact on every department within an organization. For example:

- It helps the marketing department analyze the results of their campaign and promotional yields, and it helps them fine tune their spending to get better ROI.
- Business intelligence helps the sales department to find the best path and best practices, the cost and length of customer acquisition, process improvement, and year-by-year analysis of turnover and sales.
- Business intelligence helps the human resource department track and manage important areas of concern like employee turnover, attrition rate, recruitment process, and so on.

#### 3.8.1 Impact of Business Intelligence on Decision Making

According to a survey, a decision made based on data analysis has 79% chances of success more than one made based on pure intuition. Business intelligence helps businesses take a more structured look at data, which helps the experts in having its right interpretations. That greatly improves decision making. Further, real-time and interactive access to the data, and analysis of important corporate information, help them make better decisions. Let's have a look at some of the techniques used by BI that help in decision making:

##### 1. Improving interactivity

BI facilitates a high level of interactivity between the dashboard and the difference report. For example, if an employee is analyzing the total sales report, some interaction should be involved. This helps the person go further deep into the report to figure out region-wise, product-wise, time period-wise sales to have a more holistic understanding of the data. The more the level of interaction, the more the volume of vital information that will be retrieved which in turn will help make better decisions that will be made.

## 2. Data visualization

Data visualization done in a correct format is very important, as this facilitates better understanding of the data. For example, month-on-month sales could be represented in the form of a line graph rather than just words or verbal communication. Similarly, a component-wise contribution could be best represented with a pie chart. Only when data is represented in the correct format can any useful insight be extracted from it.

## 3. Connection to databases

Business intelligence helps analysts to fetch information by connecting to different databases and web services, so that they get access to the right information irrespective of its source. With the right information, helpful recommendations can be made that will help an organization grow.

## 4. Predictive analytics

Historical data and high-end algorithms, which are part of BI help in making certain predictions, such as the chances of customers coming back for repeat business, expected revenue, expected region-wise sales, machine failure, and so on. This can help a company to be proactive.

## 5. Application integration

A business intelligence tool is easily integrated with your existing application or software regardless of whether it is developed in Java, C, Ruby, PHP, or any other platform. That gives an advantage of inter operability. Data can be exchanged across the platforms helping do better analysis.

## 6. Mobile business intelligence

With the growing use of mobile phones and more and more workforce going mobile and handling tasks on the move, they need to have the right information on their mobile devices. So, all reports dashboards and graphs should be compatible with mobile devices. It helps in taking instant decision.

## 3.9 Business Intelligence Tools

Business intelligence tools are very important to effectively measure the organizational performance using key performance indicators and metrics across all levels of an organization, in all industries. Business intelligence tools allow companies to see and analyze both historical and current data in context, which helps in better decision making and predicting development depending on your business objectives.

### 3.9.1 Business Intelligence Software

Business intelligence software is the tools that make it possible to create value from big data. Some examples of business intelligence technologies include data warehouses, dashboards, ad hoc reporting, data discovery tools and cloud data services.

Some of the popular BI software are the following:

#### 1. Sisense

Sisense is a business intelligence software that lets users collect, analyze, and use information that they require to make better and more intelligent business decisions and prepare workable plans and strategies.

Sisense currently occupies one of the highest spots on the list of top 10 business intelligence apps. This business intelligence solution gives you one of the easiest ways to create insights and business value from complex data.

## 2. Looker

Looker is another BI application software with insights for every department. It's a data-discovery app that provides an intuitive approach to data exploration. It offers a web-based interface that business users can utilize to tap into the expertise of their data analytics team.

They can build and share reports on the fly, so other functional groups can benefit from the questions they're asking and the knowledge they've created. Thus, Looker can help all companies use data to drive their business decisions and activities in the right direction.

## 3. Datapine

Datapine is a popular BI and data visualization application that helps you make sense of your organization's data. With its capabilities, you'll be able to create action plans and you can make smart business decisions, craft and implement effective strategies, and realize corporate goals in the most efficient manner.

This application offers limitless dashboards, intuitive drag and drop interface, and a large selection of charts to help you dig deep into your data and visualize it. Datapine's centralized data management allows you to connect every source of data in your company, whether internal and external, or consolidate them in one location.

## 4. Zoho Analytics

Zoho Analytics is the data analytics app in the Zoho software family. It was formerly known as Zoho Reports which was re-engineered into a more robust cloud-hosted platform which comes complete with online reporting, drill down analytics, and self-service business intelligence. The software is designed to process big data, track KPIs, identify trends, and discover insights.

Zoho Analytics provides tools and capabilities to give you a complete picture of your business' health and performance across the various units in your organizations. It is able to consolidate data coming from different sources and give you reports through dashboards and visualizations. The software comes with a smart assistant named Zia which harnesses AI natural language processing to give you answers through reports and KPI widgets in response to your questions.

### 3.9.2 How to Choose the Right Software

As there is a large number of applications software available it is not easy to choose one that suits your requirement. Therefore, following are certain steps that help decide the right software.

- First of all you need to analyze how executives in your organization make decisions.
- Then identify what information executives need in order to facilitate quick, accurate decisions.
- It is important to pay attention to data quality.
- You should devise the performance metrics that are most relevant to the business.
- Then identify the factors and the context that influence performance metrics.

### 3.10 Steps to Implement BI System

Implementing BI successfully in your organization is an important process. Doing it successfully will ensure the right result. Following are the steps taken while implementing BI in the organization.

- The first and foremost step is to make sure the data is accurate, relevant and complete.
- Users of the BI application must be well trained so that they understand the entire BI functions.
- Once decided, BI should be deployed quickly. Later on, newer adjustments can be made as you go on. Care should be taken not to spend too much time up front developing the "perfect" reports because needs keep evolving as the business evolves. Deliver reports that provide the most value quickly, and then tweak them.
- Take an integrated approach to building your data warehouse from the beginning. Make sure you're not locking yourself into an unworkable data strategy.
- Define Return on Investment (ROI) clearly even before you start BI implementation. Outline the specific benefits you expect to achieve and then review the BI outcomes every quarter or six months.
- It is important to focus on achieving business objectives out of BI.
- Don't buy business intelligence software because you think you need it. Deploy BI with the idea that there are data there that you need to find, and process.

### 3.11 Problems Faced in BI Implementation

**User resistance :** Employees by nature resist any change out of fear and cultural differences. They do not learn the right ways to use it.

- **Irrelevant and poor quality data :** The success of BI outcomes depends on how accurately you collect data. Standard data gives accurate insights. Therefore, it is important to get your data in good working order before extracting and acting on insights.
- **BI tools :** Choosing the right BI is equally important. Wrong selection of BI application will not give the right result. Then, the core of BI is reporting, not process management. So, you should be careful not to confuse business intelligence with business analytics.
- **Companies don't understand their business processes well enough :** A lot of organizations don't have the standard management practices. So, they fail to identify their business processes and activities well enough. Therefore, it is important to understand all the activities that make up a particular business process before starting a BI project.

#### Exercises

Answer the following questions in short

- Q. What is business intelligence? (Refer section 3.2)
- Q. What is the purpose of using BI? (Refer section 3.3)
- Q. State any two benefits of using BI. (Refer section 3.4)
- Q. Describe OLAP. (Refer section 3.6)
- Q. What is market basket analysis ? (Refer section 3.6.2)

- Q. State impact of BI on functional units. (Refer section 3.8)
- Q. What are BI tools? (Refer section 3.9)
- Q. What BI software? Name any two. (Refer section 3.9.1)
- Q. How do you choose the right BI software? (Refer section 3.9.2)
- Q. State the problems faced in the implementation of BI. (Refer section 3.11)

**Answer the following questions in long**

- Q. What is BI? Describe its benefits. (Refer section 3.2 & 3.4)
- Q. Describe the steps to use BI in an organization. (Refer section 3.5)
- Q. Describe the process of BI creation. (Refer section 3.7)
- Q. Explain the impact of BI on decision making. (Refer section 3.8.1)
- Q. Describe the steps used in the implementation of BI. (Refer section 3.10)

# Ethical Issues and Privacy

## Syllabus

Information Security, Threats to IS, and Security Controls

### 4.1 Introduction

As information system use becomes more widespread and more individuals and organizations rely on the internet as a means of conducting business, it becomes ever more important to assure that the internet is a place where privacy is protected.

Additionally, as organizations rely more on information systems, they become vulnerable to attacks on these precious technologies. These are just some of the ethical issues professionals face when dealing with information systems and emerging technologies. Although often overlooked, ethical decision-making is an important issue for all organizations and individuals in the arena of information technologies. In order to better understand the ethical dilemmas faced by professionals and private citizens and appreciate their consequences, researchers, practitioners and academics do a lot of thinking and practice concerning ethics and information systems.

The chapter discusses the ethical issues and privacy concerning information system which is constantly threatening this era of information technology. You are going to learn about all kinds of security threats, their causes and prevention management systems.

#### 4.1.1 What are Business Ethics?

"Business ethics is moral rules, standards, codes, or principles which provide guidelines for right and truthful behavior in specific situations". According to this definition, ethical codes are more than a tool to support ethical behavior.

#### 4.1.2 Ethics and Information System

Technology of some type has always been used to control the content and flow of information, but the technology itself is ethically neutral. It is critical for information systems professionals to understand this concept and realize that it is the users of the technology who make the ethical decisions. When information systems personnel engage in unethical behavior, the entire organization suffers. Ethical dilemmas regarding conflict of interest, theft, equal opportunity, and environmental impact cut across professions.

#### 4.1.3 Ethical Issues

Information systems confront society with a variety of ethical issues. Ethics are required in information systems to overcome the following ethical issues:

- **Privacy** : What information about one's self or one's associations must a person reveal to others, under what conditions and with what safeguards? What things can people keep to themselves and not be forced to reveal to others?
- **Accuracy** : Who is responsible for the authenticity and accuracy of information? Similarly, who is to be held accountable for errors in information?
- **Property** : Who owns information? What are the just and fair prices for its exchange? Who owns the channels, especially the airways, through which information is transmitted? How should access to this scarce resource be allocated?
- **Accessibility** : What information does a person or an organization have a right or a privilege to obtain, under what conditions and with what safeguards?

Ethics in information system seek to protect and safeguard individuals and society by using information systems responsibly. Most professions usually have defined a code of ethics or code of conduct guidelines that all professionals affiliated with the profession must adhere to.

Throughout this chapter we are going to address such challenges that are posed by information systems and what can be done to minimize or eliminate the risks.

## 4.2 Introduction to Information Security

In the previous chapters, we have learnt about information systems, their applications and impact on business and society. The progress of information systems driven by information technology has taken place at a fast speed and is still going on. Organizations around the world too have grown with it.

But the growth has brought with it threats also and the more the growth the more has been the threat. We are facing major threat to our information and information systems. Particularly in the era of internet, information threats and its security have become a vital area of concern. Every year billions of dollars are lost by organizations and people around the world due to security breaks and lapses. Therefore, organizations have become quite concerned of it and have been focusing hard on building strong security systems to prevent and minimize damages.

### 4.2.1 Information Security

Information security can be described as a set of strategies for managing the processes, tools and policies which are necessary to prevent, detect, document and counter threats to digital and non-digital information. Information security is responsible for establishing a set of business processes that protects information assets regardless of how the information is formatted or whether it is in transit, is being processed or is at rest in storage.

Today, many large organizations employ a dedicated security group to implement and maintain the organization's information security program. The security group is generally responsible for conducting risk management, a process through which vulnerabilities and threats to information assets are continuously assessed, and the appropriate protective controls are decided on and applied. The value of information for an organization is immense and therefore its security becomes critical for business operations, as well as its credibility and earning the trust of all its stakeholders.

### 4.2.2 Principles of Information Security

Information security systems are built keeping three objectives in mind, which are popularly known as CIA i.e. Confidentiality, Integrity, Availability.

- **Confidentiality :** It means information is not to be disclosed to unauthorized individuals, entities and processes. For example, if I have a password for my Yahoo account, but someone sees it while I was performing a login into my Yahoo account. In that case, it will be said that my password has been compromised and confidentiality has been breached.
- **Integrity :** It means maintaining accuracy and completeness of data. This means data cannot be edited in an unauthorized way. For example if an employee leaves an organization then in that case data for that employee in all departments like accounts, should be updated to reflect status to JOB LEFT so that data is complete and accurate. In addition to this only authorized person should be allowed to edit employee data.
- **Availability :** It means information must be available when needed. For example if one needs to access information of a particular employee to check whether the employee has already crossed the number of leaves, in that case it requires collaboration from different organizational teams to know the actual status. Denial of service attended is one of the factors that can hamper the availability of information.

Apart from this there some more principles that govern information security programs. They are

- **Non-repudiation :** It means one party cannot deny receiving a message or a transaction nor can the other party deny sending a message or a transaction. For example in cryptography it is sufficient to show that message matches the digital signature signed with the sender's private key and that sender could have sent a message and nobody else could have altered it in transit. Data integrity and authenticity are pre-requisites for non-repudiation.
- **Authenticity :** It means verifying that users who access information are the authorized ones and that each input data arriving at destination is coming from a trusted source. This principle if followed properly ensures that only the valid and genuine message is received from a trusted source through a valid transmission. For example, in the above example sender sends the message along with a digital signature, which was generated using the hash value of message and private key. Now at the receiver side, this digital signature is decrypted using the public key generating a hash value and message is again hashed to generate the hash value. If the 2 values match then it is known as a valid transmission with authenticity or we say a genuine message was received at the recipient end.
- **Accountability :** It means that it should be possible to trace the actions of an entity uniquely to that entity. For example, as we discussed in integrity section not every employee should be allowed to make changes in another employee's data. For this there is a separate department in an organization that is responsible for making such changes. When they receive request for a change the request letter must be signed by a higher authority. Once it is done the change in data will be made after verifying his biometrics. This way time stamp with the user (making the changes) details gets recorded. Thus we can say if a change goes like this then it will be possible to trace the actions uniquely to an entity.

At the core of any information security is information assurance, which means the act of maintaining CIA of information, ensuring that information is not compromised in any way.

The field of information security has grown and evolved significantly in recent years. It offers many areas for specialization including securing networks and allied infrastructure, securing applications and databases, security testing, information systems auditing, business continuity planning, etc.

#### **4.3 Security Threats**

The security threats are posed from internal as well as external sources of the organization. Following are the reasons which affect the security of the information and information systems.



- Destruction
- Deletion
- Bug infections
- Theft
- Corruption

The threat to information and information systems could be accidental or malicious, and it could be generated purposely by the personnel from within organization who have an authorised access or from personnel who are not authorised to access the system. The famous case of Neerav Modi is a good example in this case. A bank employee who had access and authorization to the system regularly issued him Letter of Credit (LOC) that allowed him to siphon off money abroad.

We now go more into the details of threats and vulnerability to get better insight into the security problems in the organization

- **Failure :** Hardware, software or network at times fail causing non-availability of the system to the users. Hardware failure may occur due to poor handling or maintenance. Software failure may occur due to its bad quality and poor maintenance or incorrect and incomplete user actions. Sometimes, system failure is also caused by not having power backup devices to control power and voltage variations. Telecommunication networks, sometimes, fail due to misuse and mishandling by network administrator, system developers, computer operators, maintenance staff, and end users.
- **Human action :** Information systems are also vulnerable to human actions. Their actions could go wrong accidentally or purposely with the intention of theft, copying, damaging and corrupting the information system. The result of such human actions is non-availability of the system, data and information, for usage. The loss and theft of data to benefit competitors for affecting the business is also a possibility at times.
- As most of the information systems today work on the internet and we know that internet security can be breached, there is an increasing risk of system data and information falling in the hands of unauthorised persons.
- Another source of failure is information system's quality problems due to developer's actions in the process of software development. If sufficient care is not taken in the development of design and architecture of the software the quality assurance would fail frequently while in use.
- **Natural disasters :** Information systems are also insecure in the event of destruction due to natural disasters such as fire, earthquake, floods and so on. In such events, impact on the system can be very large. It may result in the total loss of both hardware and software data files and reports. The effect of such impact is not easily manageable for the system to make up and run for the users.

#### 4.4 Controlling Security Threats to Information

In response to the ever growing security threats to information, it is important to control it before it damages an organisation badly. To control the threats and the degree of vulnerabilities in the existing system, it is important for an organisation to invest in developing proper security systems. A comprehensive information security management system is a stop solution to prevent and protect information.

An information security management system is a set of policies and procedures for systematically managing an organization's sensitive data. The goal of ISMS is to minimize risk and ensure business continuity by pro-actively limiting the impact of a security breach.

#### 4.4.1 Objectives

- Identification of threat sources and possibilities of their occurrence
- Protection of the information and information systems from unauthorized access and its potential misuse
- Minimization of the loss of physical and information assets
- Ensuring system integrity and reliability of data
- Ensuring the privacy of individual and personal information
- Providing methods and systems to recover from damage and to put the information system on track

The security management system therefore has the goal of controlling the impact of security threats. The real challenge in security management system is to design and implement it effectively to prevent, limit and protect data and information but at the same time to not violate the right to privacy of an individual.

#### 4.4.2 Security Threats Control Measures

Some of the common ways of controlling information security threats are as follows:

##### Develop a data security plan/policy

It is important to have a data security policy when you are looking to improve data security. It's important to have a plan in place when threats may occur at any time and a plan that determines which employees need and have access to data. Thus, these sorts of policies can keep employees in line and organized. By having data access rules that are strictly enforced, you better protect your data on a day-to-day basis.

##### Secure the IT infrastructure

Organizations need a firm infrastructure to build the foundation of a strong and resilient data security plan. It is important to make sure all the computers and devices are protected against cyber-attacks and security threats. The IT team must update the systems with the latest operating systems, anti-virus and filtering software. The organization must ensure that every software installed on the computer is up to date.

##### Know and protect your most important data

It's important to take the time to identify what you consider the most valuable data and work on protecting that first. Commonly referred as the "crown jewels" of data, this type of data usually makes up 5-10 percent of the company's data. Any breach to them causes the most damage to the company. Once identified, you should work on procedures to not only secure the data but also limit the amount of employees that have access to it.

##### Manage file access permissions

Although data breaches from external attacks get the headlines, data loss is often a result of employee error. Therefore, you must define who needs to have access to specific data and the rights your staff should have to print, email, export or save documents outside of your software.

### Use stronger passwords

Attackers are just one password away from any network. Organizations must implement password related policies at work. Easy to guess passwords such as a simple alphabetical or numeric password shouldn't be allowed. Employees must be required to change their passwords after a specific time period. One of the most efficient ways to secure access is to replace the regular password code option with a biometric or behavioral password. Such passwords are hard to crack because they are almost impossible to recreate.

### Regularly backup data

It's important to backup your data on a regular basis. In addition to hacks, loss of data is a serious issue, and organizations need to be prepared for the unexpected. As a business, get in the habit of either automatically or manually backing up data on a weekly or daily basis.

### Regular audits

A data security plan is not complete without regular audits. Audits allow organizations to identify loopholes in the current system. Data collected in a post-attack audit can help understand the shortcomings that lead to the breach. That information can prove vital in the development of a stronger data security plan and more effective data security policies.

### Staff awareness courses should be conducted annually

Two of the biggest threats organizations face are phishing and ransomware, both of which are caused by human error. If employees who receive phishing emails are unable to spot them, the whole organization is at risk. Educating staff helps organizations turn one of their biggest vulnerabilities into an area of strength. Training courses should be given to employees during their induction and then repeated annually.

## 4.5 Information Security in E-commerce

### 4.5.1 E-commerce

Electronic Commerce (E-commerce) refers to the buying and selling of goods and services via electronic channels, primarily the internet. The applications of E-commerce includes online book store, e-banking, online ticket reservation(railway, airway, movie, etc.), buying and selling goods, online funds transfer and so on. During E-commerce is the main concern in E-commerce. E-commerce applications are vulnerable to various security threats. So security loss of consumer confidence. So we need security tools to counter such security threats. This results in the

### 4.5.2 Security Needs in E-commerce

The six security needs in E-commerce applications are :

- Access control
- Confidentiality
- Authentication
- Non-repudiation
- Integrity
- Availability

**Access control :** Access control ensures only those with authorized access to resources are given access.

**Confidentiality :** When information is copied or read by someone not authorized to do so, the result is known as loss of confidentiality. Confidentiality or privacy is a very important attribute.

**Authentication :** In e-business, computing and information security, it is necessary to ensure that the data, transactions, communications or documents are genuine. It is also very important for authenticity to validate that both parties involved are who they claim to be.

**Non-repudiation :** In law, non-repudiation means one's intention to fulfill their obligations to a contract. It also means that one party of a transaction cannot deny having received a transaction nor can the other party deny having sent a transaction. E-commerce uses technology such as digital signatures and encryption to establish authenticity and non repudiation.

**Integrity :** Integrity is particularly important for critical safety and financial information used for activities such as electronic funds transfers, air traffic control, and financial accounting. Information can be erased or can become inaccessible, resulting in a loss of availability. This means that persons who are authorized to get information cannot get what they need.

**Availability :** For any information system to serve its purpose, the information must be available whenever it is needed. This means that the computing systems used to store and process the information, the security controls used to protect that information, and the communication channels used to access it must be functioning correctly.

#### 4.5.3 Threats to E-commerce

##### 1. Authentication attacks

These types of attacks occur when a user changes system resources or gains access to system information without authorization by either sharing logins or passwords or using an unattended terminal with an open session.

##### 2. Integrity attacks

In this type of attack, data or information is added, modified, or removed in transit across the network.

##### 3. Confidentiality attacks

Because network computers communicate serially and contain limited immediate buffers, data and information are transmitted in small blocks or pieces called packets. The hackers use a variety of methods known collectively as social engineering attacks. With the use of dozens of shareware and freeware packet sniffers available, which do not require the user to understand anything about the underlying protocols, the attackers would capture all network packets and thereby the users' login names, passwords, and even accounts.

##### 4. Virus

Viruses are computer programs designed to replicate themselves and infect specific computers when triggered by a specific event. The effects of some viruses are relatively benign and cause annoying interruptions such as displaying the comical message when striking a certain letter on the keyboard. Other viruses are more destructive and cause such problems as deleting files from a hard disk or slowing down a system.

##### 5. Database threats

E-commerce systems store users' personal data and retrieve product information from databases connected to the web-server. Besides product information, databases connected to the web contain valuable and private information

that could irreparably damage a company if it were altered or disclosed. Some databases store username and password pairs in a non-secure way. If someone obtains user authentication information, then he/ she can masquerade as a legitimate database user and reveal private and costly information.

#### 4.5.4 Security Technologies

##### 1. Symmetric encryption

In this, a single key is used both to encrypt and decrypt messages. Symmetric encryption algorithms can be extremely fast and less complex which allows for easy implementation in hardware.

##### 2. Asymmetric encryption

It is also known as public-key cryptography or a two key encryption. Asymmetric encryption differs from symmetric encryption primarily in that, two keys are used: one for encryption and other for decryption.

##### 3. Secure socket layer

Secure Socket Layer (SSL) is a commonly used protocol for managing the security of a message transmission on the internet. When you have SSL, you as well as your customer are protected. The server – which is basically another name for a computer that stores information about your website for viewing by the customers and others – must have a digital SSL certificate. SSL provides these certificates and is able to read them. SSL certificates come from a trusted third party that can guarantee encryption process. The SSL certificate is a proof that the server is what it says it is.

##### 4. Digital signature

Based on the public-key cryptographic method, digital signatures are implemented to verify the origin and contents of the online transaction, translating to consumers proving their identity to vendors in the transaction and providing non-repudiation features. A digital signature functions for an electronic document like a handwritten signature does for printed documents. A digital signature actually provides a greater degree of security than the handwritten signature. The recipient of a digitally signed message can verify both that the message originated from the person whose signature is attached and that the message has not been modified either intentionally and accidentally since it was signed.

##### 5. Digital certificates

Digital certificates provide a means of proving a person's identity in electronic transactions, much like a driver license or a passport does in face-to-face interactions. With a digital certificate, you can assure business associates, friends and online services that the information they receive from you is authentic. Digital certificates bind an identity to a pair of electronic keys that can be used to encrypt and sign the digital information.

#### 4.6 Information Security in Applications

Application means application software systems developed for data processing, transaction processing, web applications, and database applications and so on. Each of these applications has its own design and architecture. Some have their own data storage.

In applications system security management, attention is given from the development stage so that the application is not under threat by unauthorized individual attackers. The focus of the security is on

- data security
- database security
- application security

#### 4.6.1 Data Security

Security of the data is always of prime concern. The best way to provide security is to take regular backup of the data collected from various sources. Data loss whether accidental or due to any third party is always a heavy cost and risk to the business.

#### 4.6.2 Database Security

A database is a collection of inter-related data and a strong security needs to be built around the database. A database is considered to be secure if it shows confidentiality, integrity and availability of the information stored. The database is insecure due to the following reasons:

##### 1. Data tampering

The confidentiality and integrity of information can be at risk due to its tempering during its transmission from one location to another.

##### 2. Data theft

Data theft is always a possibility particularly from an organization's people if they can identify such weak links to crack.

##### 3. Falsifying user identity

Identity theft is one of the greatest threats to individuals in the internet environment. In a distributed digital environment it becomes increasingly possible for a person to falsify an identity to gain access to information.

##### 4. Password related threats

In large systems, application users generally manage multiple passwords by selecting easy to guess passwords such as name, date of birth or a word from a dictionary for some code numbers. All of these methods compromise password security and service availability.

##### 5. Unauthorized access to data

The database may contain confidential tables for confidential data available to all the database users who are authorized to access the database. In such a case the risk of accessing the confidential data is very high if access control by selective control is absent.

#### 4.6.3 Security Techniques

##### Database authentication

Authentication is the process by which the database server recognizes the identity of the user to allow him the access. Today, databases use multiple authentication methods like database authentication, external authentication, global authentication for recognizing users before the access permission.

##### Backup and recovery plan

Every database should have a proper backup and recovery plan. It is also important to have these plans tested in a test environment.

### Auditing of relevant information

Auditing is a feature that allows the database administrators to track what users are actually doing. Audit functions should be specific and limited to monitoring the data and actions necessary to keep the database secure.

### Secured operating system

The security of the database also depends on the operating system on which it is running. Therefore, it is important to secure the operating system from unauthorized users. An unsecured operating system could cause damage to the database and files of the database.

Application level attacks often cannot be prevented or detected by infrastructure security components. The business impact of a successful application level attack can be significantly greater than that of a successful infrastructure attack. The best way to ensure your application security is by making security principle an essential component of the design. Further, software testing should be done in the applications for potential risks. Personnel involved in the software testing process also need to be trained on application security testing to develop the ability to test the design from security angle.

## 4.7 Security Management in a Network

In a time, when the whole world is networked and huge amount of data and information get transferred all the time through these networks, network security becomes a vital area of concern for all the users and experts. Network security is the practice of preventing and protecting against unauthorized intrusion into corporate networks.

*It can be defined as the process of taking physical and software preventative measures to protect the underlying networking infrastructure from unauthorized access, misuse, malfunction, modification, destruction, or improper disclosure, thereby creating a secure platform for computers, users, and programs to perform their permitted critical functions within a secure environment.*

#### A networked system is vulnerable for continuing attacks if

- A weakness in security is present enabling unauthorized network access.
- Defect exploitation by hackers is allowed to continue undetected.
- System defects are known and can be exploited.

#### To secure the information system, a network security focuses on:

- **Protection :** Here, focus is on configuring the systems and networks as correctly as possible.
- **Detection :** The experts must be able to identify if the configuration changes or there is a sudden increase in network traffic indicating a problem.
- **Reaction :** After identifying problems quickly, one must respond to them and return to a safe state as rapidly as possible.

### How does network security work?

Network security combines multiple layers of defence in the network. Each network security layer implements policies and controls. Authorized users gain access to the network resources, but malicious programs are blocked from carrying out threats.

## How do I benefit from network security?

Digitization has transformed our world. How we live, work, play, and learn have all changed. Every organization that wants to deliver the services demanded by customers and employees must protect its network. Network security also helps you protect proprietary information from attack. Ultimately it protects your reputation.

### 4.7.1 Network Security Threats

Network security threats fall into two categories

#### 1. Passive threats

- (a) Release of message contents
- (b) Traffic analysis

#### 2. Active threats

- (a) Masquerade
- (b) Replay
- (c) Modification of message contents
- (d) Denial of service

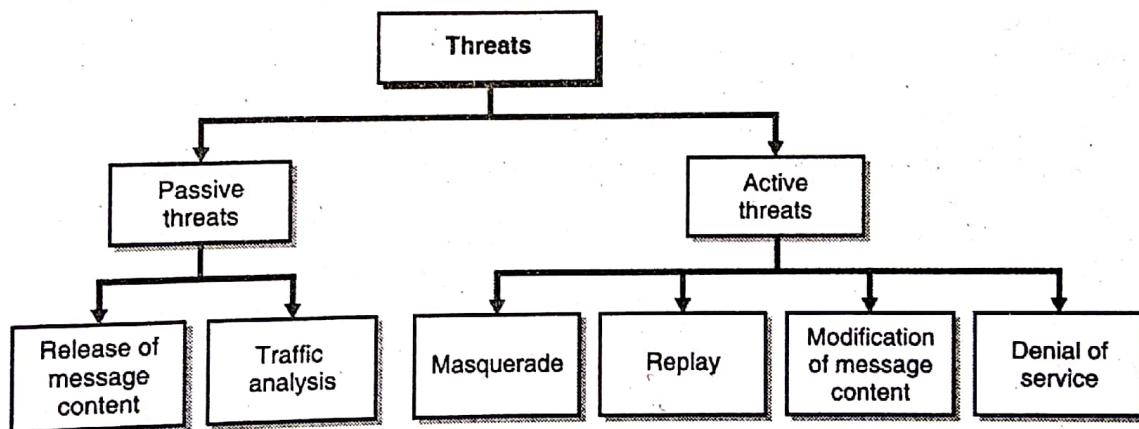


Fig. 4.7.1 : Passive threats

#### Passive threats

Sometimes referred to as eavesdropping, they involve attempts by an attacker to obtain information relating to communication.

##### a. Release of message contents

A telephone conversation, an e-mail message and a transferred file may contain sensitive or confidential information.

##### b. Traffic analysis

It is a kind of attack done on encrypted messages. The hackers might be able to observe the pattern of such encrypted message. They could also determine the location and identity of communicating hosts and could observe the frequency and length of messages being exchanged.

#### Active threats

They involve some modification of the data stream or the creation of a false stream.

**a. Masquerade**

It takes place when someone pretends to be a different entity. A masquerade attack usually includes one or the other forms of active attack. For e.g. authentication sequences can be captured and replayed after a valid authentication sequence has taken place, thus enabling an authorized entity with few privileges to obtain extra privileges by impersonating an entity that has those privileges.

**b. Replay**

It involves the passive capture of a data unit and its subsequent retransmission to produce an unauthorized effect.

**c. Modification of message**

It means some part of a message is altered, or messages are delayed or rendered, to produce an unauthorized effect.

**d. Denial of service**

A denial of service attack takes place when the availability to a resource is intentionally blocked or degraded by an attacker. In this way the normal use or management of communication facilities is blocked. This attack may have a specific target. For e.g. an entity may suppress all messages directed to a particular destination.

Another form of service denial is the disruption of an entire network, either by disabling the network or by overloading it with messages so as to degrade performance.

#### **4.7.2 Network Security Methods**

- **Access control** : You should be able to block unauthorized users and devices from accessing your network. Users that are permitted network access should only be able to work with the limited set of resources for which they've been authorized.
- **Anti-malware** : Viruses, worms, and Trojans attempt to spread across a network, and can infect machines for days or weeks. Security effort should be made to prevent initial infection and also root out malware that does make its way onto your network.
- **Application security** : Insecure applications are often the targets by which attackers get access to a network. Therefore, it is advisable to employ hardware, software, and security processes to lock those apps down.
- **Behavioral analytics** : Focus should be to know what normal network behavior looks like so that you can spot anomalies or breaches as they happen.
- **Data loss prevention** : Human beings are the weakest security link. You need to implement technologies and processes to ensure that employees don't deliberately or unintentionally send sensitive data outside the network.
- **Email security** : Phishing is one of the most common ways for the attackers to gain access to a network. Email security tools can block both incoming attacks and outbound messages with sensitive data.
- **Firewalls** : They are perhaps the most important tools for network security. They follow the rules as defined to permit or deny a message at the border between your network and the internet, establishing a barrier between your trusted zone and the outside world. They don't preclude the need for a defense-in-depth strategy, but they're still a must for your network.
- **Intrusion detection and prevention** : These systems scan network traffic to identify and block attacks, often by correlating network activity signatures with databases of known attack techniques.

- **Mobile device and wireless security :** Wireless devices have all the potential security flaws of any other networked gadget — but also can connect to just about any wireless network anywhere, requiring extra scrutiny.

## 4.8 Cyber Security

Cyber security is important because government, military, corporate, financial, and medical, almost all the organizations collect, process, and store huge amounts of data on computers and other devices. A significant portion of that data can be sensitive information, such as intellectual property, financial data, personal information, or other types of data for which unauthorized access or exposure could have negative consequences. Organizations transmit sensitive data across networks and other devices in the course of doing businesses. They may be vulnerable to attacks.

As the cyber attacks grow, companies and organizations, especially those that are tasked with safeguarding information relating to national security, health, or financial records, need to take steps to protect their sensitive business and personnel information.

Cyber security is the practice of protecting systems, networks, and programs from cyber attacks. These cyber attacks are usually aimed at accessing, changing, or destroying sensitive information, extorting money from users, or interrupting normal business processes.

A successful cyber security approach has multiple layers of protection spread across the computers, networks, programs, or data. In an organization, the people, processes, and technology must all complement one another to create an effective defence from cyber attacks.

Implementing effective cyber security measures is particularly challenging today because there are more devices than people, and attackers are becoming more innovative.

The threats countered by cyber-security are three-fold:

- **Cyber crime :** It includes an individual or groups targeting systems for financial gain.
- **Cyber war :** It often involves information gathering and is politically motivated
- **Cyber terror :** It is intended to undermine electronic systems and cause panic or fear.

### 4.8.1 Types of Cyber Security Threats

- **Ransomware :** It is a type of malicious software. It is designed to extort money by blocking access to files or the computer system until the ransom is paid. Paying the ransom does not guarantee that the files will be recovered or the system restored.
- **Malware :** It is a type of software designed to gain unauthorized access or to cause damage to a computer.
- **Social engineering :** It is a tactic that attackers use to trick users into revealing sensitive information. They can solicit a monetary payment or gain access to your confidential data. Social engineering can be combined with any of the threats listed above to make you more likely to click on links, download malware, or trust a malicious source.
- **Phishing :** It is the practice of sending fraudulent emails that resemble emails from reputable sources. The aim is to steal sensitive data like credit card numbers and login information. It's the most common type of cyber attack. You can help protect yourself through education or a technology solution that filters malicious emails.

#### 4.8.2 Cyber Security Measures

- **Cryptographic protocols** : Cyber security relies on **cryptographic protocols** used to encrypt emails, files and other critical data. This not only protects information that is transmitted but also guards against loss or theft.
- **End-user security software** : It scans computers for pieces of malicious code, quarantines this code and then removes it from the machine.
- **Electronic security protocols** : They focus on malware detection in real time.
- **Heuristic analysis** : It evaluates the behaviour of a program in addition to its code which helps in defending against viruses or Trojans that can change their shape with each execution.

Following are some ways to protect a business from cyber attacks:

1. **Install a firewall** : A computer firewall blocks unwanted information and people from entering a business' computer system from the Internet. Once the firewall is in place and working, never turn it off of any computer in the business.
2. **Set up an access control list** : This allows system administrator to control which employee has access to the computer system or certain parts of the computer system and whether they can log in remotely or only from the office.
3. **Establish security roles and responsibilities** : Identify which employees need to have access to the business information and set up responsibilities for those employees.
4. **Establish policies for internet and social media usage** : The organization must limit the use of the internet and social media to break time but make sure the employees know the policy.
5. **Use a web-filtering system** : These programs can block harmful sites as well as sites that may be inappropriate for viewing during company time.
6. **Use internet security programs on each computer** : The programs work in addition to the firewall to help block malicious software from attacking the computer and compromising data.
7. **Keep the most critical data offline** : Organize your business' data and keep the most critical information—such as customers' personal information—offline.

#### Exercises

Answer the following questions in short

- Q. Define business ethics. (Refer section 4.1.1)
- Q. How are ethics important in information system? (Refer section 4.1.2)
- Q. Describe in brief the ethical issues in information system. (Refer section 4.1.3)
- Q. What is information security? (Refer section 4.2.1)
- Q. State the importance of information security. (Refer section 4.2)
- Q. What is non-repudiation? (Refer section 4.2.2)
- Q. List some major security threats to IS. (Refer section 4.3)
- Q. How do human actions create information security problems? (Refer section 4.3)
- Q. State the objectives of information security. (Refer section 4.4.1)
- Q. Explain any two security control measures. (Refer section 4.4.2)

- Q. What is e-commerce? (Refer section 4.5)
- Q. How is e-commerce vulnerable to security threats? (Refer section 4.5.1)
- Q. What is virus? How does it damage information system? (Refer section 4.5.3)
- Q. What is data encryption? (Refer section 4.5.4)
- Q. Define digital signature. (Refer section 4.5.4)
- Q. What are digital certificates? (Refer section 4.5.4)
- Q. State any causes of threats to database security. (Refer section 4.6.2)
- Q. What is auditing in information security management? (Refer section 4.6.3)
- Q. What is network security? (Refer section 4.7)
- Q. What are network security threats? (Refer section 4.7.1)
- Q. What are firewalls? (Refer section 4.7.2)
- Q. Define cyber security. (Refer section 4.8)
- Q. What is a ransomware? (Refer section 4.8.1)
- Q. What is phishing? (Refer section 4.8.1)
- Q. What is cryptography? (Refer section 4.8.2)

**Answer the following questions in short**

- Q. How important are ethics and privacy in information system? Explain the ethical issues that an organization deals with. (Refer section 4.1)
- Q. What are the principles on which information security is based? (Refer section 4.2)
- Q. Describe major security threats to information system. (Refer section 4.3)
- Q. Describe the measures taken to control information security threats. (Refer section 4.4)
- Q. Describe the security needs of e-commerce. (Refer section 4.5)
- Q. Describe the security technologies used to secure e-commerce (Refer section 4.5)
- Q. What are applications? What are the security threats to applications? (Refer section 4.6)
- Q. Describe the measures taken to improve network security. (Refer section 4.7)
- Q. Describe the types of security threats to cyber security. (Refer section 4.8)
- Q. Discuss the measures to improve cyber security. (Refer section 4.8)

# Social Computing

## Syllabus

Web 2.0 and 3.0, Social Computing in Business-Shopping, Marketing Operational and Analytical CRM, E-business and E-commerce – B2B B2C, Mobile Commerce

## 5.1 Introduction

Human beings are social by nature. Living and learning together, communicating with and helping each other have been the hallmark of human society. We are at our best when in groups that we feel comfortable with, and at our worst when we see those around us as "different" in some way. We can not live in isolation. It is perhaps then unsurprising that our use of computing and computer tools has turned to the social elements of our lives as well. In fact, if we look at the world around us we find people using electronic medium more to get socially connected.

Internet was a revolution. It introduced web technologies which have brought a huge change in the lives of people everywhere. Billions of people hooked to it, make it the biggest society on earth. From an initial stage when it was a platform to exchange messages through e-mails and search for information (static in nature) it has reached a stage of social media, shopping, transactions, information availability in every form and about just anything. The benefits are so much and so many that we cannot afford to miss it. Businesses are quick to see and avail a huge opportunity which this new world offers.

Through this chapter you are going to learn about the new computing tools that are helping people and businesses change their fortunes.

### 5.1.1 Social Computing

Social computing is an area of computer science concerned with the collaboration of social behavior and computational system. It is basically the use of computer and the internet for social purposes. In social computing, the internet allows users to interact with each other through many mediums. Before the internet, computers were largely used as tools for increasing productivity. The Internet introduced a social element where users could network, share interests, publish personal insights and use their computers for more than just doing a job faster. Blogs, e-mails, instant messaging, social network services, wikis and other services are the media through which people interact with each other.

Social computing can also benefit businesses to a great extent if it is used for business purposes. For example, social computing can be used to market products and promote customer relations. Online marketing and viral marketing are two types of promotional advertising that have grown out of social computing.

### 5.1.2 Benefits

1. It offers a technology-based platform that lowers the cost for individuals to create and distribute contents.
2. It gives the combined effect of TV, radio and magazines for getting and exchanging information.
3. There is an increasing acceptance of information coming out from non-authoritative sources such as social media site, blogging and micro blogging sites.
4. It offers people to form their own community for raising support for any issue, developing a concept, sharing information for mutual benefits.
5. It allows people to showcase their ability by promoting themselves and creating a market for themselves.

### 5.1.3 Benefits for Organizations

#### 1. Increased collaboration

The collaborative exchange of ideas is essential to the success of challenging business initiatives, including software architecture and design, project management and organizational transformation. Tools such as social networking sites, discussion groups and wikis enable people to connect with one another virtually while enhancing and extending face-to-face interaction.

Organizations see improved collaboration surrounding creation of user groups and complex design. In each case, participants from otherwise isolated parts of the organization share problems and solutions, reducing redundancy and increasing common functionality.

#### 2. Enhanced innovation

Use of social computing creates a new stage for innovation, where ideas are more easily exposed and patterns recognized. As communities discuss new ideas in public forums, innovative thinking emerges. For example, Amazon uses social computing (especially wikis) extensively in the development of new features for Amazon.com.

#### 3. Better productivity

The social computing builds the collective intelligence of the community which leads to increased productivity as a result of more efficient access to correct information. This reduces the time needed and accelerates the early stages of a project and simplifies future iterations.

#### 4. Better employee relations

Social computing allows employees to connect more easily with one another and with the corporation. Shared connections enhance face-to-face interactions and a sense of belonging. Social networks, blogs and wikis create a forum for the voice of the employee to be heard. As a result there is a lower rate of attrition, and employees are generally more productive and have a better sense of the overall objectives of the company.

#### 5. Better promotion and public relations

Many organizations today use public-facing social computing as a means of projecting its brand. From executive blogs to consumer communities, organizations are trying their hand at increasing customer loyalty in innovative ways.

## 5.2 World Wide Web (WWW)

The World Wide Web (WWW) is a network of online content that is formatted in HTML and accessed via HTTP. The term refers to all the interlinked HTML pages that can be accessed over the internet. The World Wide Web was originally designed in 1991 by Tim Berners-Lee. The World Wide Web is most often referred to simply as "the Web."

### Development phases of Web

- **Phase 1 (Web 1.0):** According to Tim Berners-Lee the first implementation of the web, representing the Web 1.0, could be considered as the "read-only web." The average internet user's role was limited to reading the information which was presented to him in the form of static web pages. There was very little in the way of user interaction or content contribution.
- **Phase 2 (Web 2.0):** The lack of active interaction of common users with the web lead to the birth of Web 2.0. Now even a non-technical user can actively interact & contribute to the web using different blog or social platforms. According to Berners-Lee's, the Web 2.0, or the "read-write" web has the ability to contribute content and interact with other web users. This interaction and contribution has dramatically changed the landscape of the web. This era empowered the common user with a few new concepts like Blogs, Social-Media & Video-Streaming. Publishing your content is only a few clicks away! Examples are Twitter, YouTube, Facebook, etc.
- **Phase 3 (Web 3.0):** Today in 2019, we're living in this phase. Web 3.0 technology is becoming part of our everyday life. The Web 3.0 would be a "read-write-execute" web. The Web 3.0 promises the potential for applications that can speak to each other directly, and for broader searches for information through simpler interfaces.
- **Phase 4 (Web 4.0):** The next step is actually an alternate version of what we already have. Mobile technology led us to experience the social web in a completely different way...from lap-top to always on. The web needed to adapt to its mobile surroundings. Web 4.0 technology is a mobile version of web 2.0

## 5.3 Web 2.0

Web 2.0 means the internet applications which allow sharing and collaboration opportunities to people and help them to express themselves online.

"**Web 2.0 is the business revolution in the computer industry caused by the move to the internet as a platform, and an attempt to understand the rules for success on that new platform.**" – Tim O' Reilly.

Web 2.0 is an improved version of the web 1.0, characterized specifically by the change from static to dynamic or user-generated content and also the growth of social media. Web 2.0 concept focuses on rich web applications, web-oriented architecture and social web.

Web 2.0 examples are Google Maps, Google Docs, Flickr), YouTube, wikis, blogs, social networking like Facebook, micro-blogging apps like Twitter, podcasting like Podcast Alley & content hosting services and many more.

### 5.3.1 Key Aspects of Web 2.0

At a conceptual level, Web 2.0 is concerned with establishing and maintaining online connections between people, services and information. Web 2.0 defines the three key aspects:

- **Interpersonal computing :** It involves person-to-person interactions provided by websites that enable collaborative content creation, sharing and manipulation.
- **Web services :** It involves application-to-application data and service exchanges facilitated by automated connections between web servers and other internet technologies.
- **Software As A Service (SAAS) :** It involves human interactions with digital content through applications delivered over the web freeing the user from locally installed software.

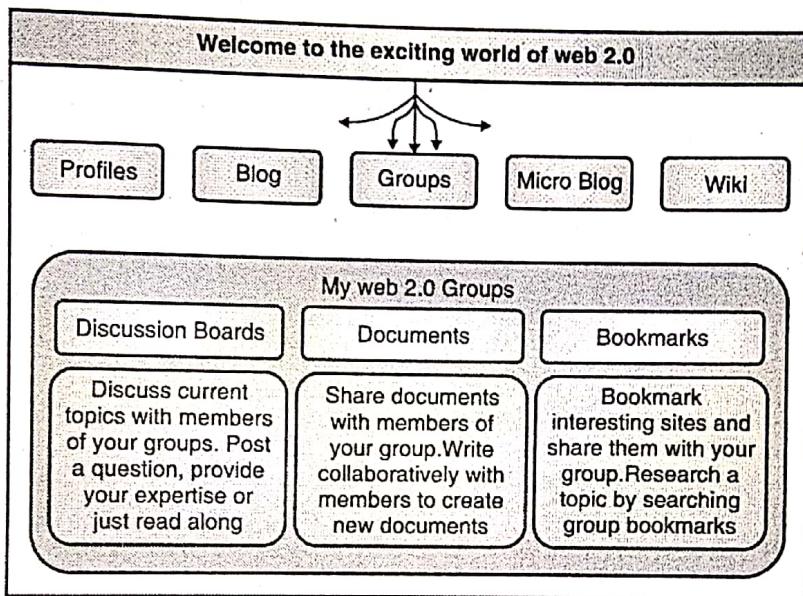


Fig. 5.3.1 : Web 2.0

The interpersonal computing aspects of Web 2.0 are most commonly associated with the development of wikis, blogs, social networking sites, and viral video sites.

- **Wikis** are websites that allow visitors to easily add, remove and edit content, hence enabling the collaborative authorship of comprehensive documents. The best example of a wiki is the multi-lingual, web-based encyclopaedia Wikipedia.
- **Blog** is a chronological, journal-style website which its author or "blogger" maintains like an online diary. There are now a whole host of websites that enable anybody to start their own blog, such as Word Press or Blogger. You can also "micro blog" using Twitter
- **Social Networking Sites (SNS)** enable people to build social networks online. Groups established within such communities are existing friendships and teams and are facilitated by online tools for sending individual messages, file sharing (particularly photo sharing), discussion forums, and online chat. The most popular social networking sites is Facebook.
- **Viral video sites** are websites that allow anybody to post videos online. The significance of viral video sites is that they provide a place to put videos where it is likely that at least some other people will actually find them. The giant of viral video sites is YouTube.

### 5.3.2 Core Web 2.0 Principles

Web 2.0 developments present both individuals and organizations with many new business and computing opportunities. O'Reilly suggests that the core of Web 2.0 is the following seven principles:

- The web to be used as a new platform for content development and sharing
- Harnessing collective intelligence by aggregating more and better content via social networking sites, wikis, blogs and viral video
- Data as the next Intel inside which suggests that value will increasingly become associated with data and its management
- The end of the software release cycle which will be as a consequence of continually updated SaaS applications accessed online.
- Lightweight programming models which relates to the increased use of more open and more flexible online programming tools and languages in systems development
- Software above the level of a single device which refers to a world in which all data, web services and SaaS applications will become accessible from any desktop or mobile computing device that has wired or wireless internet access
- Rich user experiences which reflect the increasing trend for audio, video and interactive online content

### 5.3.3 Five Major Features of Web 2.0

1. Free sorting of information permits users to retrieve and classify the information collectively.
2. Dynamic content that is responsive to user input.
3. Information flows between site owner and site users by means of evaluation & online commenting.
4. Developed APIs to allow self-usage, such as by a software application.
5. Web access leads to connect different, from the traditional internet user base to a wider variety of users.

### 5.3.4 Advantages of Web 2.0

- Available at any time, any place
- Variety of media
- Ease of usage
- Learners can actively be involved in knowledge building.
- Can create dynamic learning communities
- Everybody is the author and the editor, every edit that has been made can be tracked.
- User friendly
- Updates in wiki are immediate and it offers more sources for researchers.
- Provides real-time discussion

The use of web 2.0 technologies and tools attracts greater participation in projects and idea sharing, thus ideally leading to better designs and more efficient production, strengthening bonds with customers and improving communications with partners.

## 5.4 Web 3.0

Web 3.0 is an intelligent web technology that provides third generation of internet-based services. The term was coined by John Markoff in 2006. He explained, "There is no easy consensus about how to define what is meant by Web 3.0, but it is generally seen as a reference to the semantic Web. While it is not that much more precise a phrase, the semantic Web refers to technology to make using the internet better, by understanding the meaning of what people are doing, not just the way pages link to each other."

Web 3.0 is supposed to be more connected and intelligent with the use of major emerging technology trends like semantic web, data mining, machine learning, natural language processing, artificial intelligence and other such technologies. So Web 3.0 is the idea of a web that will store information in such a way that computers and other devices will understand on their own. FB app and Google Voice search, Apple's Siri are some of the examples of web 3.0.

Chances are that you are pretty familiar with the concept of Web 3.0 already. Every time you buy something on Amazon, the website's algorithm will look at the other items that people who have purchased your product went on to buy and then recommends that to you. So, think about what is going on here. The website is learning from other users what your preferred choices can be and then use it to recommend to you what you may like. In essence, the website itself is learning and becoming more intelligent.

### 5.4.1 Features that can help us understand Web 3.0

- **Semantic web:** The evolution of the Web 3.0 involves the Semantic Web. The semantic web improves web technologies to create, share and connect contents through search and analysis based on the capability to comprehend the meaning of words, rather than on keywords or numbers.
- **Artificial Intelligence(AI):** Combining artificial intelligence capability with natural language processing in Web 3.0, computers can distinguish information human being wants in order to provide faster and more relevant results. They become more intelligent to fulfill the requirements of users.
- **3D graphics:** The three-dimensional design is being used widely in websites and services in Web 3.0. Museum guides, computer games, e-commerce, geospatial contexts, etc. are all examples that use 3D graphics.
- **Connectivity:** With Web 3.0, information is more connected thanks to semantic metadata. As a result, the user experience evolves to another level of connectivity that leverages all the available information.
- **Ubiquity:** On the web, content is accessible by multiple applications that every device is using. The services can be used everywhere using these devices and applications.

## 5.5 Social Computing in Shopping

Social computing in shopping is the combination of social media and e-commerce. It uses all of the key aspects of the social web like friends, groups, voting, comments and discussions and focuses them on the world's favorite activity which is shopping to create social shopping.

Social shopping attempts to use technology to replicate the social interactions found in physical mall and stores. It is like bringing your friends with you on the web while you shop.

Social shopping can take many forms like This Next, a social network devoted to shopping, or Product Wiki, a wiki devoted to product reviews and price comparisons.

Social shopping beats old-fashioned web shopping because it brings all types of products into one place. No more skipping around from site to site searching for that hard-to-find item.

Social shopping also has advantages over going to an actual store to shop. With social shopping, you are one click away from comparing prices, and you can easily find out what other people are saying about that Fossil watch or that Alexis Bittar necklace. And above all, it's fun. If you like shopping, you will love social shopping.

### 5.5.1 Major Categories of Social Shopping

Social shopping can have a wide range of categories but can largely be divided into five categories:

#### 1. Group buying

Companies like Group on and Living social encourage group of people to buy together at wholesale prices or at special deal of the day.

#### 2. Shopping communities

It brings like-minded together to discuss, share, shop and help communities. Many sites allow users to create custom shopping lists and share them with friends.

#### 3. Recommendations

Recommendations engines allow buyers provide advice to fellow buyers and friends through conversations.

#### 4. Social shopping markets places

They bring sellers and buyers together to connect and transact. This way it performs the role of e-commerce facilitator.

#### 5. Shared shopping mechanism for catalog-based sites : These allow shoppers to form ad hoc collaborative shopping groups in which one person can drive an online shopping experience for one or more other people.

### 5.5.2 Components of a Social Shopping Website

1. Visual sharing
2. Online discussions
3. How to use product
4. Guides

### 5.5.3 Benefits for Buyers

1. They can get good deals via group buying, daily specials and more.
2. They can socialize while shopping and receive social support and rewards too.
3. They can know about products/services which never existed for them.

4. They can interact directly with brand representatives easily and quickly.

#### 5.5.4 Benefits for Sellers

1. It improves the overall sales unit productivity.
2. It also increases revenue growth per customer.
3. Sellers can gain feedback from new customers, which is very important.
4. The sellers learn from customers through varying experience
5. It increases customer loyalty and trust.
6. It has the capacity to quickly liquidate overstocked or obsolete merchandise.

### 5.6 Social Computing in Marketing

Social computing often called social networking or social media is used to describe the way people share their thoughts, opinions and insights online using interactive technologies.

Social marketing is an application of social media. It is the way companies tap into social media to build brand awareness, customer loyalty and sales.

Social marketing aims to develop and integrate marketing concepts with social media to influence behavior of the people and communities for the greater social good.

#### Significance of Social Marketing

According to Forrester, the three tenets of Social Computing make its collaboration with marketing relevant. The three tenets are:

Communities driving innovation

Institutions facilitating experiences shaped and owned by communities

Communities taking power from institutions

#### 5.6.1 Business Benefits of Social Marketing

##### 1. Consistent audience growth

Every day, thousands of new users join social media sites around the world. One of the most important considerations for any business is how to reach and sell to its target customer audience. For companies that use social marketing, their followings are continuously growing and accessible.

##### 2. Higher search engine ranking

Engagement on social media can lead to more than just direct transactions. It has been proven that social media commerce actually increases traffic to your website which will eventually influence your ranking on search engine results.

##### 3. More authentic engagement and traffic

As already stated, actively working to grow your social media audience is a great first step in eventually making conversions. One of the most significant benefits of social marketing is the engagement and reach that businesses can

get whenever they share content. By showing up in a follower's updates feed on a regular basis, you're participating in a powerful branding opportunity. People who have regular contact with a company are more likely to recommend that company.

#### 4. Customer loyalty and retention

In using social marketing for your business, you are aiming to sell and promote your products/services, but you are also aiming to build good relationships with people. By using this opportunity to engage with prospects, a company can build and maintain relationships that deepen trust and loyalty. This in turn creates customers that are happy and satisfied with your service, who will likely remain clients who make repeat purchases.

#### 5. Business metrics from social media marketing

With your social marketing, you should analyze your efforts, and see if the results provide a positive ROI. Social media marketing makes it easy to measure and evaluate performances. Facebook pages, Instagram business accounts and tweets on Twitter have built-in metrics for impressions, engagements and reach.

#### 5.6.2 Marketing Benefits of Social Media

Social media present great marketing opportunities for businesses of all sizes. You can use social media to:

- Promote the name of your brand and business
- Tell customers about your goods and services
- Find out what customers think of your business
- Attract new customers
- Build stronger relationships with existing customers.

#### Social media marketing advantages

- Social media can reach millions of people all around the world
- Many forms of social media (e.g. Facebook, Twitter, Instagram) allow businesses to target specific groups, often in particular locations
- Many forms of social media are free for business, and paid options are usually low-cost
- Social media allow you to communicate on a personal basis with individual customers and groups
- You can quickly distribute information to many people
- You don't need high-level skills or computer equipment to participate in social media. The average person with a standard computer should have no difficulty.

#### Risks of using social media

Marketing through social media also has its risks. These include:

- Wastage of time and money for little or no tangible return
- The rapid spread of the wrong kind of information about your business (e.g. incorrect information accidentally posted by you, negative reviews posted by others)

- You may have to face legal problems if you don't follow privacy legislation and the laws regarding spam, copyright and other online issues.

### Key social media services

Different types of social media are good for different marketing activities. The key social media services are:

- **Facebook** - a social networking site that allows you to have conversations with customers, post photos and videos, promote special offers, and more
- **Twitter** - a 'micro-blogging' service that allows you to send and receive short messages from customers and potential customers
- **YouTube** - an online video-hosting service that lets people share their videos
- **Blogs** - internet sites that contain a series of entries or 'posts' about topics of interest to the author, much like an online 'diary'
- **Coupon sites** - websites that offer discount coupons for goods, services and events
- **Online photo-sharing services** - websites that allow users to store, organize and share their photo collections
- **Location-based marketing sites** - websites that deliver targeted marketing messages to customers in particular locations, through mobile devices such as smart phones and tablets
- **Customer review sites** - websites that feature customer reviews of goods and services.

## 5.7 Customer Relationship Management (CRM)

CRM is an approach for managing an organization's relationships and interactions with current and potential customers. It uses data analysis about customer's history with the organization to improve business relationship. A CRM system helps companies stay connected to customers, streamline processes, and improve profitability. CRM helps users focus on their organization's relationships with individual people including customers, service users, colleagues, or suppliers.

### CRM is used as

#### Technology

CRM is used as a technology product that teams use to record, report and analyse interactions between the company and customers. This is also called a CRM system or solution.

#### Strategy

CRM is also used as a business' strategy to formulate how relationships with customers and potential customers should be developed and maintained.

#### Process

As a process CRM helps businesses nurture and manage relationships.

#### CRM Software

CRM software is used to record customer contact information such as email, telephone, website social media profile, and more. It can store details such as a client's personal preferences on communications. The software then organizes this information to give you a complete record of individuals and companies, so you can better understand your relationship over time.

CRM software improves customer relationship management by creating a 360° view of the customer, capturing their interactions with the business, and by surfacing the information needed to have better conversations with customers.

### Why is CRM important?

CRM helps a business to strengthen its relationships with customers, service users, colleagues, partners and suppliers and also keep track of prospects and customers. It is important for customer acquisition and retention. CRM puts everything in one place — a simple, customizable dashboard that can tell you a customer's previous history with you, the status of their orders, any outstanding customer service issues, and more.

Gartner predicts that by 2021, CRM technology will be the single largest revenue area of spending in enterprise software. For forward-thinking businesses, CRM is the framework for that strategy.

### 5.7.1 Types of CRM

- (1) Operational CRM
- (2) Analytical CRMs
- (3) Collaborative CRMs

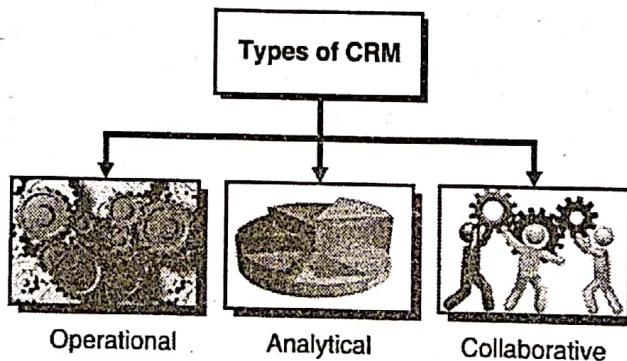


Fig. 5.7.1 : Types of CRM

#### Operational CRM

An operational CRM assists businesses in managing their day-to-day activities such as marketing, sales, and customer service operations. This is the most common type of CRM and is popular among businesses in a wide range of industries. Some of the operational areas it takes care of are

- **Marketing automation** tools allow you to automate your marketing, so that you can more effectively target customers at various stages of the sales process. For instance, an operational CRM initiates a predictable task like initiating an email campaign whenever a new prospect enters the system.
- **Sales force automation** is a major component of many CRM systems. This feature help an organization manage its pipelines, develop leads and acquire new customers. This might involve automatically tracking a contact and updating its status from prospect to qualified lead once he has completed certain actions or met specific criteria.
- **Service automation** is designed to provide a higher level of customer service. A CRM with service automation can provide helpful information via email, text message, or a phone helpline depending on customer preferences. This not only creates a more consistent customer experience, but it also frees up your team members to focus on more pressing tasks.

## Analytical CRM

The function of analytical CRM is to manage the processes of customer acquisition and retention, as well as keep track of customer details. This is helpful for companies that want to collect and analyze a large amount of data.

The three main functions of an analytical CRM system are:

### Customer acquisition

Here, the aim is to turn prospects into customers.

### Customer retention

It helps in keeping current customers happy and coming back for more.

### Managing data

It tracks customer interactions and other information that can improve your bottom line.

The more data your business gathers on consumer behavior and patterns the better you can tailor your marketing and sales strategies to new and existing customers.

## Collaborative CRM

This CRM system is designed to improve the customer experience. Collaborative CRM features **streamline communication** for all parties, between the customer and your company and between various departments and stakeholders. It enables companies to **track and share customer data** with everyone from vendors and suppliers to tech support and marketing managers.

Making this information available internally not only strengthens the relationships but also keeps customers happy.

### 5.7.2 Benefits of CRM

The benefits and advantages of CRM include:

1. **Enhanced contact management** : Every call, question or negotiation from prospects and clients is recorded and made accessible to the entire team with a centralized contact management system. This gives both sales, marketing, and customer service teams a boost in terms of tracking, pipe progression and client history.
2. **Cross-team collaboration** : A CRM system helps people from different parts of a business to work together. A sales team can collaborate with a product team to produce quotations, while a marketing campaign that generates a lead can help a salesperson to have a more informed, tailored conversation with the prospect.
3. **Increased productivity** : With a CRM, follow-up emails can be auto-generated and tested for effectiveness, management can easily access the most recent details of a customer meeting, and customer service administrators can learn the background of a customer without leaving the call.
4. **Effective sales management** : CRM empowers sales managers with data to analyze customer relationships, track sales-related activity, assess deal viability, mobilize extra help when needed, and provide teams with real-time updates. All this improves sales effectiveness.
5. **Accurate sales forecasting** : A single source of right information makes it much easier for sales managers to make accurate forecasts. Sales teams are able to learn from the past and forecast the future through historical data, while predictive analytics makes use of insights from big data to anticipate future customer behavior.

6. **Reliable reporting :** CRM helps get an at-a-glance view of its sales pipeline making it simple to spot potential problems and sort them out in the initial stage. Reports improve team productivity by saving on time that would once have been spent pulling data manually or laboriously creating pivot tables in spreadsheets.
7. **Improved sales metrics :** If you nurture the right prospects in a timely and efficient way by that really matter. CRM data and reporting systems provide insights into conversion effectiveness at various points in the sales process. Once a business better understands its customers, up selling and cross-selling opportunities arise
8. **Increased customer satisfaction and retention :** Having an easily accessible view of a customer's interactions makes it easier to anticipate issues and deal with complaints. This creates a more positive experience for customers who no longer have to move around between departments.
9. **Boosted marketing ROI :** Effective tracking of customers helps businesses to understand what marketing activities and campaigns are effective making it easier for marketers to maximize their budgets and deliver greater ROI.
10. **Better products and services :** A CRM system gathers information from a huge variety of sources. This gives insight into how customers feel and what they are saying about an organization. So businesses can improve what they offer, spot problems early, and identify gaps.

### 5.7.3 Benefits of CRM to Business Functions

- **Sales teams** can use CRM to understand their sales pipeline better by gaining access to reliable information about the progress of individual team members in achieving their sales targets and see how well individual sales teams, products and campaigns are performing too.
- **Marketing teams** can use CRM to make forecasting simpler and more accurate. They can clearly see every opportunity or lead, and map out the whole customer journey from enquiry to sale giving them a better understanding of the sales pipeline or prospective work coming in.
- **Customer service teams** can effectively track conversations across channels. Without a common platform for customer interactions, communications can be missed or lost in the flood of information – leading to an unsatisfactory response to a valued customer.
- **Supply-chain, procurement and partner management teams** can manage relationships better. They can track meetings with suppliers and partners, record requests made, add useful notes, schedule follow-ups and stay on top of expected next steps.
- **The HR team** can use CRM to accelerate the recruitment process and track employee performance. CRM can help the HR function by speeding up the process of managing candidates, analyzing resourcing needs and identifying skills gaps, and supporting the pursuit of staff retention targets.

Just imagine, how convenient it would be to consolidate all the streams of data coming from sales teams, customer service staff, marketers and social media—and translate them into actionable business information. A CRM platform lets you manage these streams of information across channels without losing track, and gives sales, service, marketing, and beyond an integrated view.

## 5.8 E-business

E-business is a buzzword today. It is also called online business. E-business is a kind of business transactions that take place online with the help of the internet. E-business is an abbreviation for electronic business. So there are buyers and sellers doing business transactions without actually meeting personally.

In today's world, we are exposed to various forms of e-business. Since its emergence in 1996, it has grown by leaps and bounds. Some predict that it may very soon overtake brick and mortar stores completely. While that remains to be seen, we cannot ignore the immense role it plays in the current global economy.

Since the late 90s, or even earlier, the development of digitalization not only led to major structural changes in society but also in the economy. Since then, the focus has shifted to the information sector. The systematic use of technology to collect and utilize information laid the foundations of a so-called "information economy," in which competitiveness is achieved through knowledge superiority.

### 5.8.1 Components of E-business

The core components of e-business are information, communication and transaction. Business partners use digital networks to go through business processes. They use innovative technologies to improve business efficiency. Three key areas are particularly important for e-business:

#### E-procurement

It is concerned with the electronic sourcing of products and services by companies which help them in reducing costs and efforts.

#### Online stores

The most visible part of e-business is online stores. The electronic sale of products and services takes place via appropriate platforms, such as online stores.

#### Online marketplaces

This includes electronic commerce which is done using digital networks to connect the buyers and suppliers of products and services.

There are also two further areas of e-business:

#### Online communities

This consists of large number of individuals who are prospective customers in this business. An electronic communication network supported by data and knowledge sharing connects these individuals and organizations.

#### Online companies

They are electronic business corporations which offer goods and services to the consumers. They are like any other traditional organization and store but present online on internet.

### 5.8.2 Market Participants in E-business

E-business can take place between a large number of market participants: Between businesses and consumers, various private individuals, public administrations, and other organizations such as NGOs.

Generally, these various market participants can be divided into three distinct categories:

- Business (B)
- Consumer (C)
- Administration (A)

All three categories can play the role of either buyer or service provider within the market.

### 5.8.3 Features of E-business

Some of the features of e-business are as follows:

- It is easy to set up.
- There are no geographical boundaries.
- Running the business is much cheaper than traditional business.
- There are flexible business hours.
- Implementing marketing strategies cost less to the organization.
- Online business receives benefits also from the government.
- A comprehensive IT infrastructure takes care of security and integrity issues.
- There is no personal touch and therefore no personal biases.
- Buyer and seller don't meet personally, which saves time.
- Delivery of products takes time although the logistics have vastly improved.
- There is a transaction risk involved although security system is continuously being improved.
- Anyone can buy anything from anywhere at anytime and for anyone. A person can buy something for other and can get it delivered at his address.

### 5.8.4 Function of Electronic Business

The most important function of electronic business is to create electronic value. The forms of electronic added value are usually distinguished in the following way:

- **Structuring** : It means making available an overview of a large quantity of information online.
- **Selection** : It means providing specific database information upon request by the users/customers
- **Matching** : This function makes it possible to match the inquiries done by the customers with the product offers given by supplier so that buyers make up their mind.
- **Transaction** : This function takes care of the transaction that takes place when the customer places the order by choosing the appropriate payment methods.
- **Coordination** : This function adds value to the product by offers that different providers combine with their product/services

- **Communication:** This is an important function that has the aim of improving communication between different consumers and suppliers.

Depending on which type of value a company decides to pursue, they can choose one or more value activities – for example the collection, structuring, pre-selection, summary, or distribution of information.

The electronic value creation process involves the following steps:

- **Collecting large quantities of information** to identify data relevant to the product
- **Processing the information** and transforming it into a product
- **Transferring the final information product** to the customer
- **Repeating this process** whenever new information becomes available. Information products are not static and must be kept up to date.

### Examples of e-business

There are countless examples of different e-business activities, but here is a brief selection.

The **e-procurement** sector is an important part of e-business. It includes the following activities:

- Implementation of a computerized (application-based) **purchasing system** that supports the whole procurement process, such as checking stock availability and handling the order and payment
- Constructing and operating an **online marketplace** for products and services
- Integrating various electronic supplier catalogs into its own **Enterprise Resource Planning (ERP)** system to support procurement, warehouse management, order processing, production management, and logistics

The **e-commerce** sector includes the following activities:

- **Designing and maintaining an internet presence** and an **online store** which includes products or services accessible from anywhere at all times, multiple payment options, automatic e-mail notifications on orders, and customer support (live chat, hotlines, or help centres)
  - **Developing and provisioning additional content**, such as an informational blog or comparison portal
- Expanding online marketing and targeting advertising to customers, for example by using big data from cookies, purchase behaviour, and customer data

## 5.9 E-Commerce or Electronic Commerce

E-commerce is a popular term for electronic commerce or even internet commerce. The name is self-explanatory. E-commerce is the meeting of buyers and sellers on the internet. This involves the transaction of goods and services, the transfer of funds and the exchange of data.

### Examples of e-commerce

- Amazon
- Flipkart
- eBay
- Fiverr

- Upwork
- Olx
- Quikr

Logging into your Amazon app and purchasing a book is a classic example of an e-commerce transaction. Here you interact with the seller (Amazon), exchange data in the form of pictures, text, address for delivery etc. and then you make the payment.

As of now, e-commerce is one of the fastest growing industries in the global economy. As per one estimate, it grows nearly 23% every year. And it is projected to be a \$27 trillion industry by the end of this decade.

### 5.9.1 Advantages of E-commerce

- E-commerce provides the sellers with a global reach. They remove the geographical barrier. Now sellers and buyers can meet in the virtual world, without the hindrance of location.
- Electronic commerce substantially lowers the transaction cost. It eliminates many fixed costs that are required in maintaining brick and mortar shops. This allows the companies to enjoy a much higher margin of profit.
- It provides quick delivery of goods with very little effort on part of the customer. Customer complaints are also addressed quickly. It also saves time, energy and effort for both - the consumers and the company.
- One other great advantage is the convenience it offers. A customer can shop 24x7. The website is functional at all times, it does not have working hours like a shop.
- Electronic commerce also allows the customer and the business to be in touch directly without any intermediaries. This allows for quick communication and transactions. It also gives a valuable personal touch.

### 5.9.2 Types of E-commerce Models

Electronic commerce can be classified into six major categories. The basis for this simple classification is the parties that are involved in the transactions. Here, the two most basic electronic commerce models given:

#### 1. Business To Business (B2B)

Business to business model is more popularly known as B2B model. It is the largest e-commerce model based on revenue and involves transactions of trillions of dollars. In this model both - the buyers and sellers - are business organizations. B2B describes commerce transactions between businesses, such as between a manufacturer and a wholesaler, or between a wholesaler and a retailer or between two manufacturers. The main aim of this model is to increase business efficiency and revenue of the retailers.

The volume of B2B transactions is much higher than the volume of transactions of any other model. The primary reason for this is that in a typical supply chain there will be many B2B transactions involving sub components or raw materials, and only one B2C transaction, specifically sale of the finished product to the end customer.

#### Advantages of B2B model

- **Better market prediction :** Compared to other business strategies, this model has more market stability. This helps to strengthen the online presence and business opportunities.

- **Better sales :** An improved supply chain management process along with collaborative approach increases customer loyalty which in turn leads to improved sales.
- **Lower cost :** Due to an effective supply chain management process, this model leads to lower cost of business.
- **Data-centric model :** Another advantage is that it relies on effective and factual data to streamline the whole process. In this way, errors can be avoided and proper forecasts can be done.

#### Disadvantages of B2B model

- **Limited market :** Compared to B2C model, this business model has limited market base as it deals in goods that suit other organizations.
- **Lengthy decision :** Here, majority of the purchase decisions take a lengthy process. The process is lengthy generally because of the involvement of multiple stakeholders and decision makers.
- **Inverted structure :** Compared to other models, here, the buyer has more bargaining and decision making power than sellers. This may demand customizations and lower price rates
- **Marketing challenges :** B2B companies face significant marketing challenges in comparison to B2C as digital marketing is specially challenging. Social media is mostly used to promote B2C.

## 2. Business to Consumer (B2C)

Business to consumer e-commerce also known as B2C model is the most popular e-commerce model. In this model, goods and services are directly sold to individual customers over the internet. The internet users can use the shopping cart for everything they need. Payment is mostly done through online payment options.

Most internet users are familiar with the B2C model. The model offers easy steps to the consumers to buy just anything. Customers these days prefer this model as they get a lot of products in varying ranges at one place along with different kinds of offers. Apart from that, the consumers don't have to physically visit the stores.

For business organizations, this model offers a lot of advantages and allows them to cater to a huge market where customers are available with varying needs and demands.

#### Advantages of B2C model

- This model provides the sellers with a huge market in the form of global reach.
- Electronic commerce substantially lowers the transaction cost which allows the companies to enjoy a much higher margin of profit.
- It provides quick delivery of goods with very little effort on part of the customer.
- It saves time, energy and effort for both the consumers and the company.
- A customer can shop 24x7; the website is functional at all times.
- Electronic commerce also allows quick communication and transactions between buyers and sellers.

#### Challenges of B2C

- High consumer traffic often becomes a big problem as it slows down the searching process.
- A lot of consumers are hesitant to submit their personal data to websites due to safety reasons.



- Customer retention is a big challenge as there is no customer loyalty in general. Customers shift to a different online store quickly.
- The promotional offers and discounts have developed a habit in the customers to buy only when such offers are present. This puts pressure on the companies to maintain profitability. As of now, most of the B2C companies are suffering losses.

## 5.10 Mobile Commerce (M-commerce)

M-commerce is a kind of e-commerce transaction done with a mobile phone. So M-commerce is the use of mobile phones to conduct any type of business transaction. It takes the help of the e-commerce background and WAP technology.

The use of wireless technology (WAP) to conduct sales of goods, provide services, make payments and other financial transactions, the exchange of information, etc. is the basis of mobile commerce.

M-commerce is actually a rapidly growing sector of e-commerce. Nearly 70% of the online transactions that occur in India happen from mobile phones. Globally, it is a 700 billion dollar industry.

M-commerce is about exploiting new opportunities made available to us thanks to e-commerce. So it involves the advent of new technologies, services, business models and marketing strategies. It differentiates itself in many ways from e-commerce. This is because mobile phones have different characteristics than desktop computers. It has opened so many windows of opportunities for businesses to exploit.

### 5.10.1 Applications of M-commerce

Other than the straightforward m-commerce transactions of buying and selling of goods and services, they have so many applications. Let us take a look at a few examples.

- **Mobile banking** : Using a mobile application you can perform all your banking functions. It is one step ahead of online banking and has become commonplace these days. For example, in India, there is substantial increase in banking transactions happening on mobile phones.
- **Mobile ticketing and booking** : Making bookings and receiving your tickets on the mobile has become very common today. The digital ticket or boarding pass is sent directly to your phone after you make the payment. Even in India, IRCTC and other services provide m-ticketing services.
- **E-bills** : This includes mobile recharge, electricity, water, gas and many more bills which are easily paid today using mobile phones.
- **Auctions** : Online auctions have now been developed to be made available via mobile phones as well.
- Stock market reports and even stock market trading takes place over mobile applications.

### 5.10.2 Advantages of M-commerce

- It provides a very convenient and easy-to-use system to conduct business transactions.
- Mobile commerce has a very wide reach. A huge part of the world's population has a mobile phone in their pocket. So the sheer size of the market is tremendous.
- M-commerce also helps businesses target customers according to their location, service provider, the type of device they use and various other criteria. This can be a good marketing tool.

- The costs of the company are also reduced. This is due to the streamlined processes, low transaction cost, low carrying cost and low order processing cost as well.

#### **Disadvantages of M-commerce**

- The existing technology to set up an m-commerce business is very expensive. It has great start-up costs and many complications arise.
- In many countries, the networks and service providers are not reliable. It is not the most suitable for data transfer.
- There is also the issue of security. There are many concerns about the safety of the customer's private information, and the possibility of a data leak is very daunting.

#### **Exercises**

##### **Answer the following questions in short**

- Q. What is social computing? (Refer section 5.1.1)
- Q. Give some examples of SC. (Refer section 5.1.1)
- Q. State the benefits of social computing. (Refer section 5.1.2)
- Q. What is WWW? (Refer section 5.2)
- Q. Define web 2.0 (Refer section 5.3)
- Q. What are the key aspects/components of web 2.0? (Refer section 5.3.1)
- Q. What is blog? (Refer section 5.3.1)
- Q. What are the features of web 2.0? (Refer section 5.3)
- Q. Define web 3.0 (Refer section 5.4)
- Q. What is semantic web? (Refer section 5.4.1)
- Q. What is the use of social computing in shopping? (Refer section 5.5)
- Q. Describe the major categories of social shopping. (Refer section 5.5.1)
- Q. What are the benefits of social shopping? (Refer section 5.5.3)
- Q. What is social marketing? (Refer section 5.6)
- Q. Name some key social media service providers along with their contents. (Refer section 5.6)
- Q. Define CRM. (Refer section 5.7)
- Q. What is CRM software? (Refer section 5.7)
- Q. Describe e-business (Refer section 5.8)
- Q. Describe e-commerce (Refer section 5.9)
- Q. Describe mobile commerce. (Refer section 5.10)

##### **Answer the following questions in detail**

- Q. Describe how social computing is beneficial to organizations. (Refer section 5.1.3)
- Q. Write the core principles and advantages of Web 2.0 (Refer sections 5.3.2 and 5.3.4)

- Q. Describe web 3.0 with its features (Refer section 5.4.1)
- Q. What is the significance of social computing in marketing? Explain. (Refer section 5.6.2)
- Q. Describe the benefits of CRM. (Refer section 5.7.2)
- Q. Explain different types of CRM with examples. (Refer section 5.7)
- Q. Describe the features and functions of e-business. (Refer sections 5.8.3 and 5.8.4)
- Q. Describe the advantages and disadvantages of e-commerce (Refer section 5.9)
- Q. Describe B2B and B2C models with their respective advantages. (Refer section 5.9)
- Q. What are the applications and advantages of mobile commerce? (Refer sections 5.10.1 and 5.10.2)

# Computer Networks

## Syllabus

Wired and Wireless Technology, Pervasive Computing, Cloud Computing Model

### 6.1 Introduction

Information technology has made a huge impact everywhere be it the life of a person, society, organization or a nation. IT began with the development of computers. Till 1990, computer was mainly used in industries to control different industrial processes. With the advent of micro computer, it started making an impact everywhere. After 1990, the growth picked up pace and microprocessor started changing the whole computer industry. Then came the biggest revolution in the form of computer network particularly of micro computers.

The rest is an impactful history. The growth and development in computer network, computer hardware and software have been phenomenal. We are living in an era where we cannot imagine our life without these networks. We are part of this network on 24x7 basis. There is hardly any area of our life where IT doesn't have a role to play. You have already learnt about it in the previous chapters. Businesses around the world not only use IT systems but also are constantly upgrading the entire IT infrastructure to make more impact in the business world.

This chapter is about computer network and its basics. Your understanding of information system is not complete without adequate understanding of this IT system that provides the backbone to IS.

#### 6.1.1 What is Computer Network?

A computer network is simply an interconnection of two or more computers. The purpose is to exchange information with each other electronically and within no time. A computer network is now easy to set up just anywhere whether it is your home, office or a factory.

The development of computer network has erased distance between two places. One of the most important factors behind globalization has been computer network. Millions of computer networks exist today in this world. They exist everywhere- on land across the world, in water, in space.

Businesses have become dependent on computer network for improving their effectiveness and efficiency. An organization better equipped with IT Infrastructure has taken edge in this highly competitive business world.

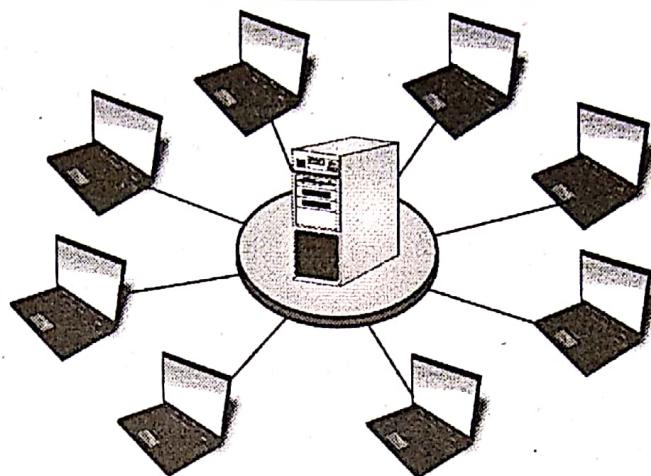


Fig. 6.1.1 : Computer Network

### 6.1.2 How does a Network Work?

A computer network is first set up by bringing two or more computers together. The computers use some networking devices and a physical medium to get connected with each other. The networking devices could be network interface cards, modems, routers, switches, etc. and the physical medium may be wired or wireless. Then a special software called protocol is used to ensure communication between two computers. The computers then get connected and exchange of messages and information takes place.

## 6.2 Advantages and Disadvantages of a Computer Network

### Advantages

1. Computer network helps people exchange and share messages and information at a fast speed and at a fraction of the cost.
2. It provides a medium of communication to the people in different forms such as text, graphics, voice and video.
3. It acts like a centralized information system that people and organizations use to access information of all kinds from anywhere and anytime.
4. It provides security and confidentiality to the information stored in it which otherwise is very difficult on a stand-alone machine.
5. It helps users across the world to share and develop software and applications.
6. It also provides sharing of files and hardware devices by different users. It saves cost of using multiple devices. For example, a printer in an office is shared by many computers.
7. It connects people and organizations located anywhere in the world.

### Disadvantages

1. A computer network may break down causing all the work activities to stop.
2. There is always a security threat. Hackers are active and always try to steal information or take control of a network or computer.
3. Destructive programs like virus and malware put the data and information in danger.

4. The initial cost of setting up a computer network is high and there is continuous upgradation required which further adds to the cost.
5. It provides a platform for people to also spread wrong news and rumors easily causing a trouble for the society and the governments

### **6.3 Applications of Computer Network**

Computer network is nowadays used almost everywhere. It has numerous applications. Some of them can be categorized in the following ways:

1. **Business** : It has many applications in business such as
  - (a) Sharing information, programs, files, software and resources like hardware by employees and branches located at distant places.
  - (b) The employees can access the organization's remote database during their day-to-day operations. This benefits them in taking right decisions, handling a problematic situation or availing an opportunity.
  - (c) Organizations promote e-business and e-commerce with the help of computer networks.
  - (d) Organizations are able to integrate all their operations with the help of computer network, which improves their overall effectiveness and efficiency.
  - (e) IT-enabled services have prospered very fast during last two decades mainly to better communication systems and computer networks.
2. **Education** : Because of computer network, today education system has changed a lot. A student can search for the right institution for admission, apply for admission and then take admission even without actually visiting the campus personally. Online course allow students to attend classes from their homes and appear in online tests too. A computer network offers them vast amount of reading material for studies.
3. **Online banking** : People today don't require to visit their bank branches every now and then or carry cash in their pockets all the time. Online banking allows people to pay bills, book tickets and transfer money at the click of a mouse. It not only saves time for people but also promotes cashless transactions which boost the economy.
4. **Social media** has been a great revolution and the credit goes to computer networks.
5. **Communication** : Computer network has brought a huge change in the way we communicate with others. Today, we can communicate with others present anywhere in the world using text, voice calls or video conferencing.

### **6.4 Network Components**

1. **Hardware devices**
  - (a) **Server** : A server is the most powerful computer in a network. It performs many functions such as –
    - (i) Acts as a medium to interconnect two users. Receives message from one and then forwards it to the other
    - (ii) Acts as a centralized database system and stores user's data and information and lets a user access data of his choice by giving the required authority.
    - (iii) Provides data security and confidentiality by not allowing unauthorized users to get access to the data and information. Also recovers data in case of loss or damage.

- (iv) Allows many users to share the same piece of information and make changes also if required and being done by an authorized user.
- (b) **Client/Node:** It is a general purpose computer used by a user to perform different tasks. A user may or may not choose to store his data on his node.
- (c) **Network devices:** Network devices are various hardware devices used by computers to transfer data and programs to each other. Some of these devices are Hub, Switches, Router, Modems, Ethernet, etc. We will discuss them in the next section.
- (d) **Communication media:** These are the physical medium through which a data signal transfers from one computer to another. These media mainly fall in two categories – wired and wireless. The wired medium wires for interconnection while wireless medium uses air as the medium of communication. We will discuss them in the following sections.

## 2. Software

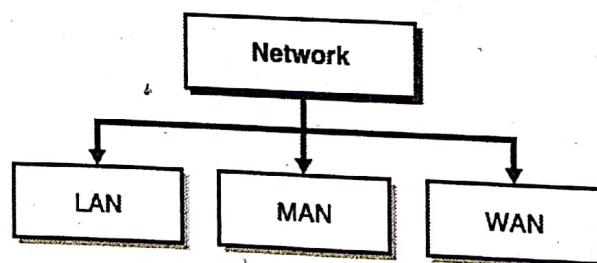
Software, as you know, is an essential component of each computer.

- (a) **Network operating system :** A network operating system like Windows 10 server is used on the server. It controls all the functions of a server.
- (b) **Local operating system :** On every node, there is an operating system installed.
- (c) **Protocol :** For a network, a separate software called *protocol* is required. The protocol defines the network architecture. It describes the steps of data transmission between two computers. There are many protocols in different computer networks but the most common is called TCP/IP. It is based on a standard network architecture model called OSI, which describes the structure of a network.

## 6.5 Types of Network

On the basis of distance, computer network has been divided into three types

1. Local Area Network (LAN)
2. Metropolitan Area Network (MAN)
3. Wide Area Network (WAN)



**Fig. 6.5.1 : Types of Network**

### 1. Local Area Network (LAN)

A **Local Area Network** is a privately owned computer network covering a small geographical area, like a home, office, or groups of buildings, e.g. a school network. A LAN is used to connect the computers and other network devices so that the devices can communicate with each other to share the resources. The resources to be shared can be a

hardware device like printer, software like an application program, or data. The size of LAN is usually small. The various devices in LAN are connected to central devices called hub or switch using a cable.

Nowadays LANs are being installed using wireless technologies. Such a system makes use of access point or APs to transmit and receive data. One of the computers in a network can become a server serving all the remaining computers called *clients*.

For example, a library can have a wired or wireless LAN network for users to interconnect local networking devices e.g., printers and servers to connect to the internet.

LAN offers high speed communication of data rates up to 100 megabits per second (Mbps). IEEE, which creates LAN standards, is working on Standardization of 100 Giga bit/s. LANs Network may have connections with other LANs Network via leased lines, leased services.

### Types of LAN

There are basically two types of local area networks namely: ARCnet and Ethernet.

**ARCNET** is one of the oldest, simplest, and least expensive types of local-area network protocol, similar in purpose to Ethernet or Token Ring. ARCNET was the first widely available networking system for microcomputers and became popular in the 1980s for office automation tasks. ARCnet was introduced by Datapoint Corporation in 1977. The specification is ANSI 878.1. It can have up to 255 nodes per network.

**Ethernet** is a family of computer networking technologies for local area networks commercially introduced in 1980. Standardized in IEEE 802.3, Ethernet has largely replaced competing wired local area network technologies. Ethernet uses a bus or star topology network and supports data transfer rates of 10 Mbps.

Ethernet network uses the CSMA/CD access method to handle simultaneous demands. It is one of the most widely implemented LAN standards. A newer version of Ethernet network, called 100Base-T (or Fast Ethernet), supports data transfer rates of 100 Mbps. Ethernet is a physical and data link layer technology for local area networks (LANs).

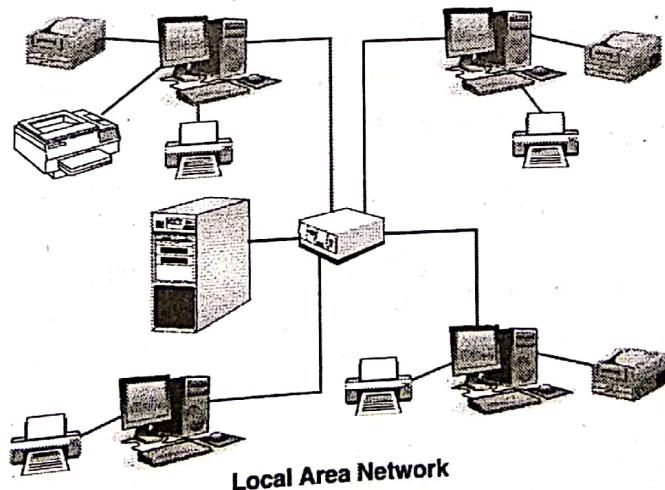


Fig. : 6.5.2 : LAN

### 2. MAN (Metropolitan Area Networks)

**MAN** stands for Metropolitan Area Networks. It is one of the types of network. MAN is larger than a local area network and as its name implies, covers the area of a single city. MANs rarely extend beyond 100 KM and frequently comprise of a combination of different hardware and transmission media. It can be a single network such as a cable

TV network, or it is a means of connecting a number of LANs into a larger network so that resources can be shared LAN to LAN as well as device to device.

A MAN can be created as a single network such as cable TV network, covering the entire city or a group of several Local Area Networks (LANs). In this way, resource can be shared from LAN to LAN and from computer to computer also. MANs are usually owned by large organizations to interconnect its various branches across a city.

MAN is based on IEEE 802.6 standard known as DQDB (Distributed Queue Dual Bus). DQDB uses two unidirectional cables (buses) and all the computers are connected to these two buses. Each bus has a specialized device that initiates the transmission activity. This device is called head end. Data that is to be sent to the computer on the right hand side of the sender is transmitted on upper bus. Data that is to be sent to the left hand side of the sender is transmitted on lower bus.

The two most important components of MANs are security and standardization. Security is important because information is being shared between dissimilar systems. Standardization is necessary to ensure reliable data communication.

A MAN usually interconnects a number of local area networks using a high-capacity backbone technology, such as fiber-optical links, and provides up-link services to wide area networks and the internet.

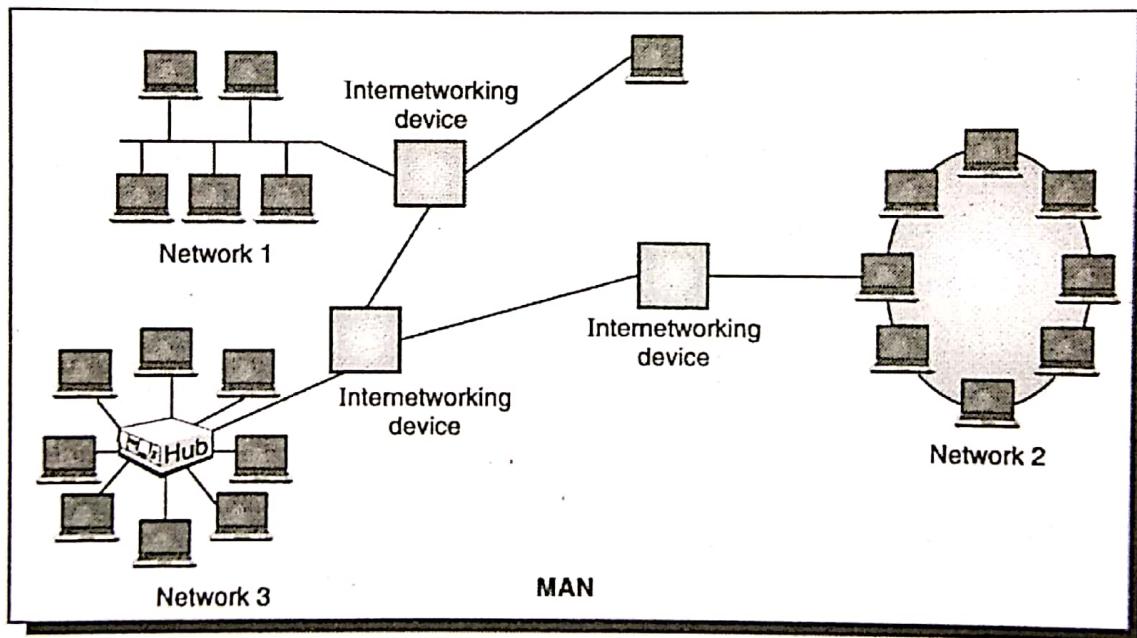


Fig. 6.5.3 : MAN

### Wide Area Networks (WAN)

A wide area network (WAN) is a telecommunication network. A wide area network is simply a LAN of LANs or network of networks. WANs connect LANs that may be on opposite sides of a building, across the country or around the world. WANs are characterized by the slowest data communication rates and the largest distances. WANs can be of two types: an enterprise WAN and global WAN.

Computers connected to wide area networks are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites. The largest WAN in existence is the internet. Some segments of the Internet, like VPN based extranets, are also WANs in themselves. Finally, many WANs are corporate or research networks that utilize leased lines.

Numerous WANs have been constructed, including public packet networks, large corporate networks, military networks, banking networks, stock brokerage networks, and airline reservation networks.

Organizations supporting WANs using the internet protocol are known as Network Service Providers (NSPs). These form the core of the internet.

By connecting the NSP WANs together using links at Internet Packet Interchanges (sometimes called "peering points") a global communication infrastructure is formed.

WANs (wide area networks) generally utilize different and much more expensive networking equipment than do LANs (Local Area Networks). Key technologies often found in WANs (wide area networks) include SONET, Frame Relay, and ATM.

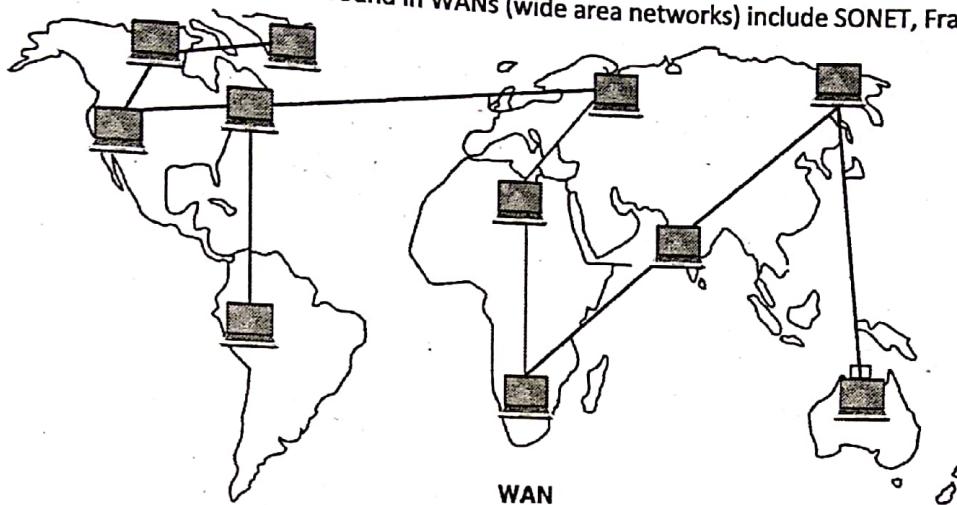


Fig. 6.5.4

## 6.6 Computer Network Architecture

Computer network architecture is defined as the physical and logical design of the software, hardware, protocols, and media of the transmission of data. Simply, we can say, that is how computers are organized and how tasks are allocated to the computer

**The two types of network architectures are used**

- Peer-To-Peer network
- Client/Server network

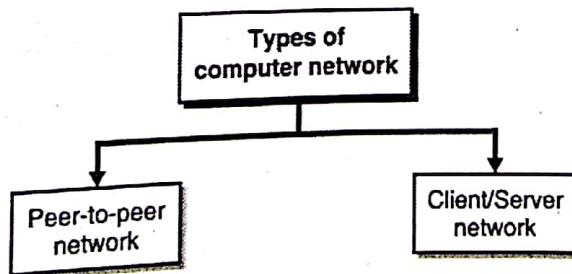


Fig. 6.6.1 : Network architecture types

### 6.6.1 Peer-To-Peer Network

- Peer-to-peer network is a network in which all the computers are linked together with equal privilege and responsibilities for processing the data.
- Peer-to-peer network is useful for small environments, usually up to 10 computers.

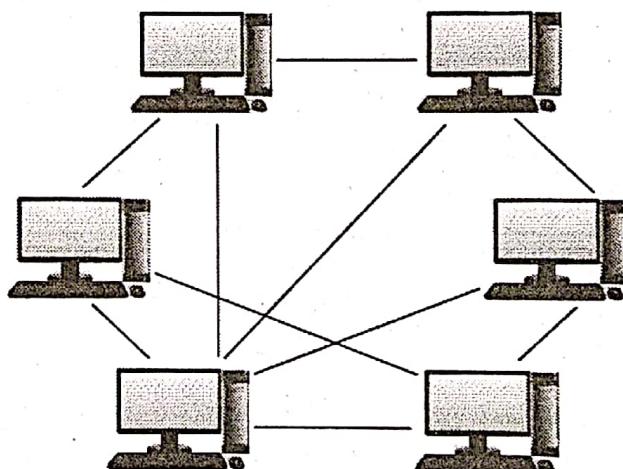
- Peer-To-Peer network has no dedicated server.
- Special permissions are assigned to each computer for sharing the resources, but this can lead to a problem if the computer with the resource is down.

### **Advantages of peer-to-peer network**

- It is less costly as it does not contain any dedicated server.
- If one computer stops working other computers will not stop working.
- It is easy to set up and maintain as each computer manages itself.

### **Disadvantages of peer-to-peer network**

- In the case of Peer-To-Peer network, it does not contain the centralized system. Therefore, it cannot back up the data as the data is different in different locations.
- It has a security issue as the device is managed itself.



**Fig. 6.6.2 : Peer-to-peer network**

### **6.6.2 Client/Server Network**

- Client/Server network is a network model designed for the end users called clients, to access the resources such as songs, videos, etc. from a central computer known as server.
- The central controller is known as a **server** while all other computers in the network are called **clients**.
- A server performs all the major operations such as security and network management.
- A server is responsible for managing all the resources such as files, directories, printer, etc.
- All the clients communicate with each other through a server. For example, if client 1 wants to send some data to client 2, then it first sends the request to the server for the permission. The server sends the response to the client 1 to initiate its communication with the client 2.

### **Advantages of client/server network**

- A client/server network contains the centralized system. Therefore, we can back up the data easily.
- A client/server network has a dedicated server that improves the overall performance of the whole system.
- Security is better in client/server network as a single server administers the shared resources.

- It also increases the speed of the sharing resources.

### Disadvantages of client/server network

- Client/Server network is expensive as it requires a server with large memory.
- A server has a Network Operating System (NOS) to provide the resources to the clients, but the cost of NOS is very high.
- It requires a dedicated network administrator to manage all the resources.

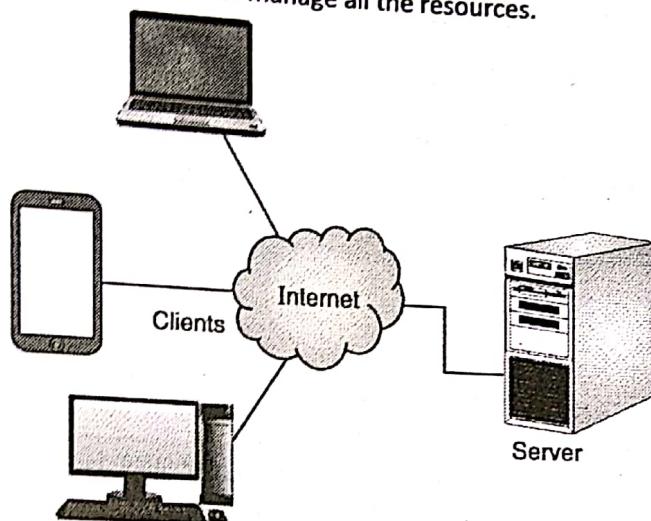


Fig. 6.6.3 : Client/Server network

## 6.7 Network Topology

Network Topology is the way in which computer systems or network devices are connected with each other. Topologies may define both physical and logical aspect of the network. Both logical and physical topologies could be same or different in a same network.

There are many topologies. Some are discussed below:

### 6.7.1 Point-to-Point

Point-to-point networks contain exactly two hosts such as computer, switches or routers, servers connected back to back using a single piece of cable. Often, the receiving end of one host is connected to sending end of the other and vice-versa.

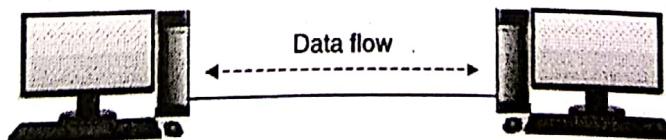


Fig. 6.7.1

### 6.7.2 Bus Topology

In case of bus topology, all devices share single communication line or cable. Bus topology may have problem while multiple hosts sending data at the same time. Therefore, bus topology either uses CSMA/CD technology or recognizes one host as bus master to solve the issue. It is one of the simple forms of networking where a failure of a device does not affect the other devices. But failure of the shared communication line can make all other devices stop functioning.

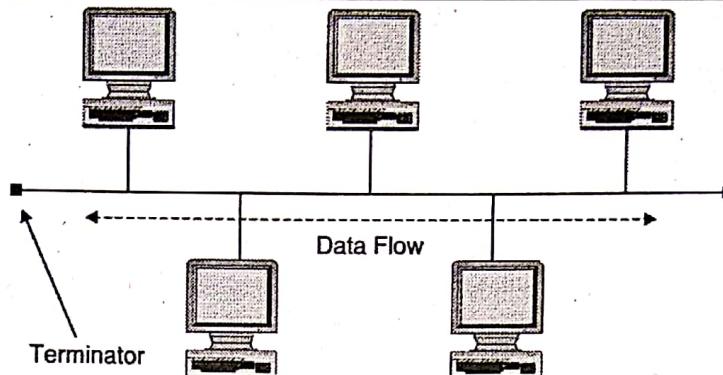


Fig. 6.7.2 : Bus Topology

Both ends of the shared channel have line terminator. The data is sent in only one direction and as soon as it reaches the extreme end, the terminator removes the data from the line.

### 6.7.3 Star Topology

All hosts in star topology are connected to a central device, known as hub device, using a point-to-point connection. That is, there exists a point-to-point connection between hosts and hub. The hub device can be any of the following:

- Layer-1 device such as hub or repeater
- Layer-2 device such as switch or bridge
- Layer-3 device such as router or gateway

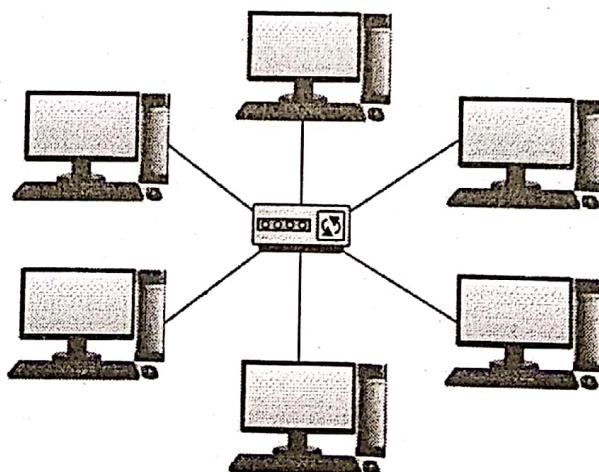
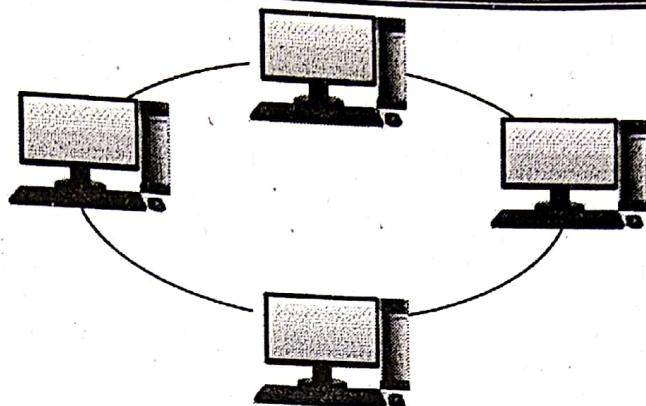


Fig. 6.7.3 : Star Topology

As in bus topology, hub acts as single point of failure. If hub fails, connectivity of all hosts to all other hosts fails. Every communication between hosts, takes place through the hub only. Star topology is not expensive as to connect one more host, only one cable is required and configuration is simple.

### 6.7.4 Ring Topology

In ring topology, each host machine connects to exactly two other machines, creating a circular network structure. When one host tries to communicate or send message to a host which is not adjacent to it, the data travels through all intermediate hosts. To connect one more host in the existing structure, the administrator may need only one more extra cable.



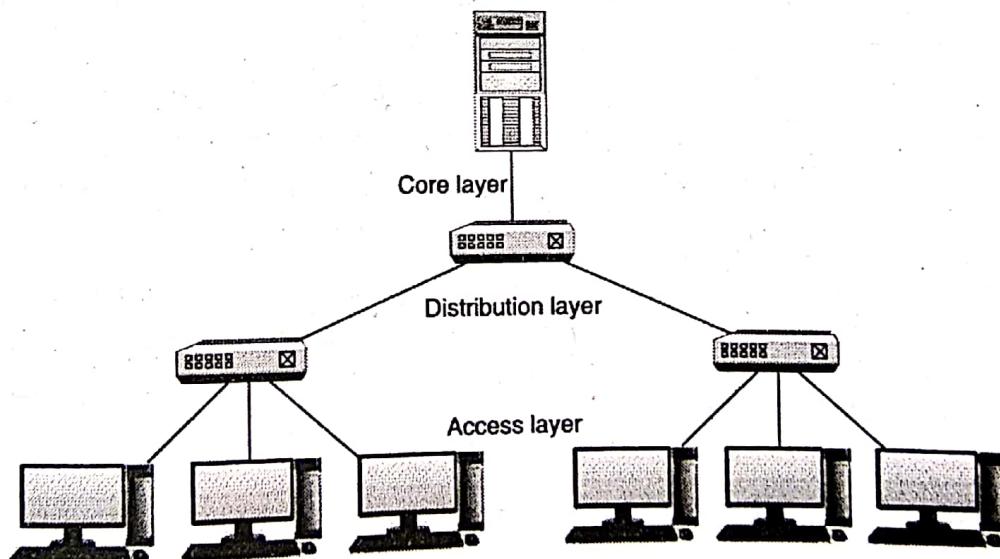
**Fig. 6.7.4 : Ring Topology**

Failure of any host results in failure of the whole ring. Thus, every connection in the ring is a point of failure. There are methods which employ one more backup ring.

### 6.7.5 Tree Topology

Also known as hierarchical topology, this is the most common form of network topology in use presently. This topology imitates as extended star topology and inherits properties of bus topology.

This topology divides the network into multiple levels/layers of networks. Mainly in LANs, a network is bifurcated into three types of network devices. The lowermost is access layer where computers are attached. The middle layer is known as distribution layer, which works as mediator between upper layer and lower layer. The highest layer is known as core layer, and is the central point of the network, i.e. root of the tree from which all nodes fork.



**Fig. 6.7.5 : Tree Topology**

### 6.7.6 Hybrid Topology

A network structure whose design contains more than one topology is said to be hybrid topology. Hybrid topology inherits merits and demerits of all the incorporating topologies.

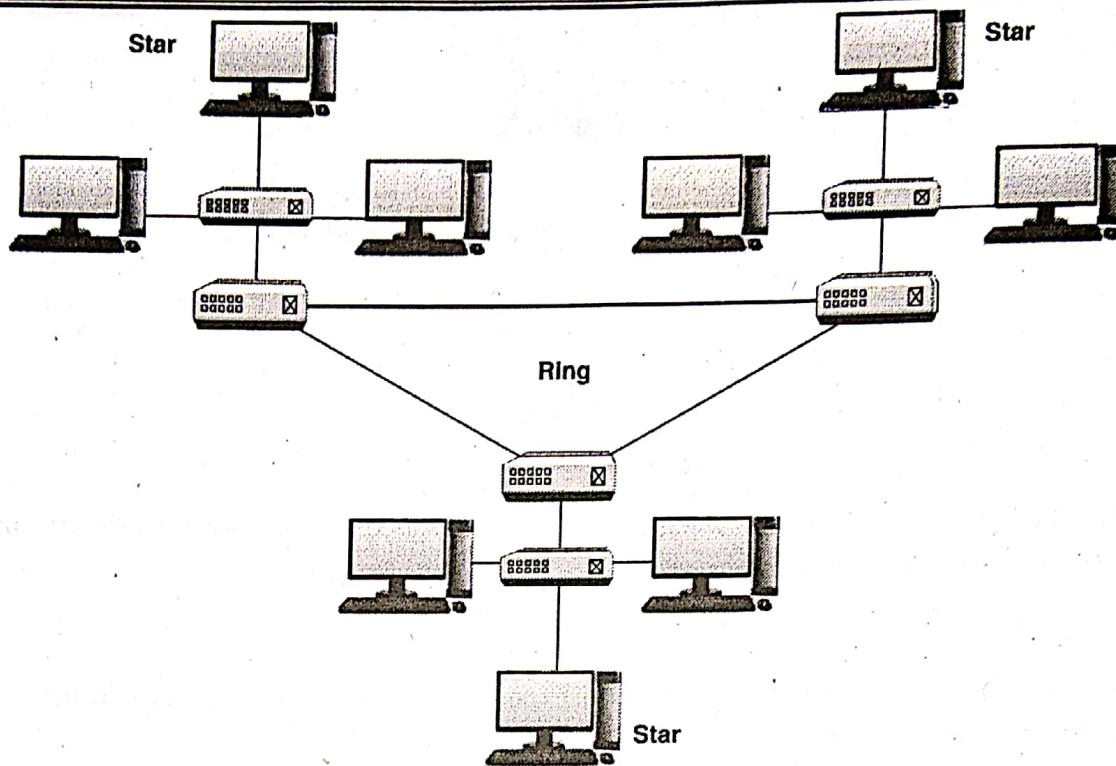


Fig. 6.7.6 : Hybrid Topology

The above picture represents a hybrid topology. The combining topologies may contain attributes of star, ring and bus topologies. Most WANs are connected by means of dual-ring topology and networks connected to them are mostly star topology networks. Internet is the best example of largest hybrid topology.

## 6.8 Network Devices

In a network, many devices other than computers are used. They play significant roles in network communication. Following are the common devices:

- Repeater :** A repeater operates at the physical layer. Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network. An important point to be noted about repeaters is that they do not amplify the signal. When the signal becomes weak, they copy the signal bit by bit and regenerate it at the original strength. It is a 2 port device.
- Hub :** A hub is basically a multiport repeater. A hub connects multiple wires coming from different branches, for example, the connector in star topology which connects different stations. Hubs cannot filter data, so data packets are sent to all connected devices. Also, they do not have intelligence to find out best path for data packets which leads to inefficiencies and wastage.
- Bridge :** A bridge operates at data-link layer. A bridge is a repeater with add-on functionality of filtering content by reading the addresses of source and destination. It is also used for interconnecting two LANs working on the same protocol. It has a single input and single output port, thus making it a 2-port device.
- Switch :** A switch is a multi port bridge with a buffer and a design that can boost its efficiency (large number of ports imply less traffic) and performance. Switch can perform error checking before forwarding data that makes it very efficient as it does not forward packets that have errors and forwards good packets selectively to correct port only.

5. **Routers :** A router is a device like a switch that routes data packets based on their IP addresses. Router is mainly a network layer device. Routers normally connect LANs and WANs together and have a dynamically updating routing table based on which they make decisions on routing the data packets. Router divides broadcast domains of hosts connected through it.
6. **Gateway :** A gateway, as the name suggests, is a passage to connect two networks together that may work upon different networking models. They basically work as the messenger agents that take data from one system, interpret it, and transfer it to another system. Gateways are also called protocol converters and can operate at any network layer. Gateways are generally more complex than switch or router.

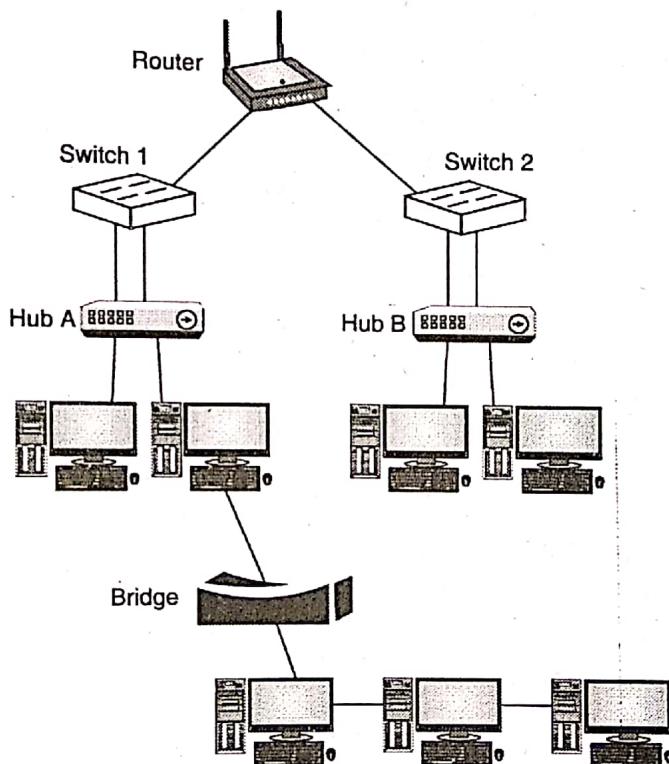


Fig. 6.8.1 : Network devices

7. **Modem :** Modems (modulators-demodulators) are used to transmit digital signals over analog telephone lines. Thus, digital signals are converted by the modem into analog signals of different frequencies and transmitted to a modem at the receiving location. The receiving modem performs the reverse transformation and provides a digital output to a device connected to a modem, usually a computer. The digital data is usually transferred to or from the modem over a serial line. Many telephone companies offer DSL services, and many cable operators use modems as end terminals for identification and recognition of home and personal users.
8. **Access point :** An Access Point (AP) is a wireless device involved in either a wired or wireless connection. An AP operates either as a bridge connecting a standard wired network to wireless devices or as a router passing data transmissions from one access point to another.

Wireless Access Points (WAPs) consist of a transmitter and receiver (transceiver) device used to create a Wireless LAN (WLAN). Access points typically are separate network devices with a built-in antenna, transmitter and adapter. APs use the wireless infrastructure network mode to provide a connection point between WLANs and a wired Ethernet LAN. They also have several ports, giving you a way to expand the network to support additional clients. Depending on

the size of the network, one or more APs might be required to provide full coverage. Additional APs are used to allow access to more wireless clients and to expand the range of the wireless network. Each AP is limited by its transmission range. The actual distance depends on the wireless standard, the obstructions and environmental conditions between the client and the AP.

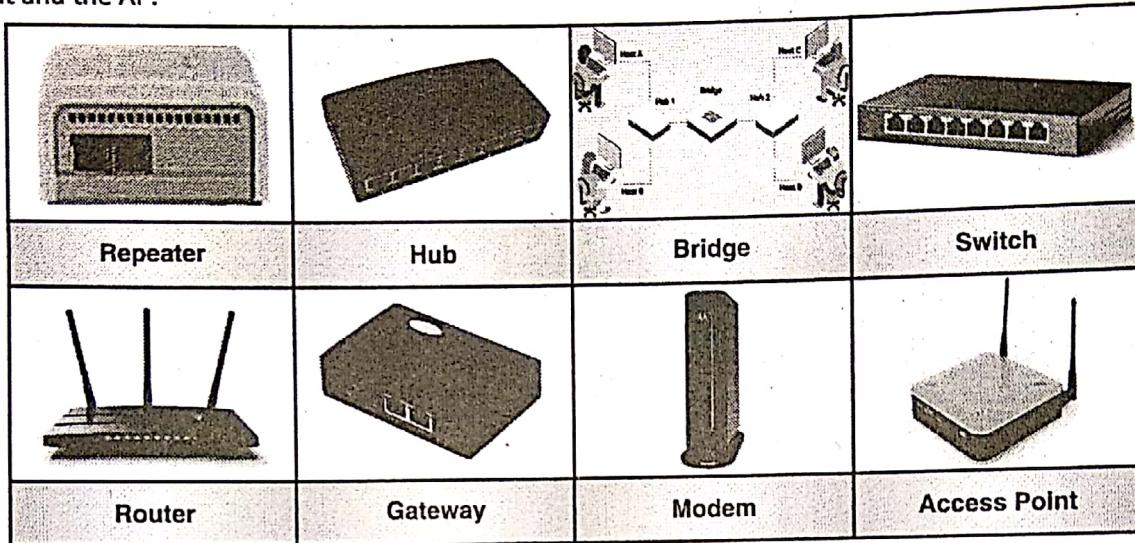


Fig. 6.8.2 : Shows different network devices

## 6.9 Wired and Wireless Network

### 6.9.1 Wired Network

A wired computer network is a traditional network of computer and other devices connected with each other through cables of one or another kind such as co-axial, twisted pair or optical fiber. Though in computing terminology, the term "wired" is used to differentiate between wireless connections and those that involve cables.

A wired network is a common type of wired configuration. Most wired networks use Ethernet cables to transfer data between connected PCs. In a small wired network, a single router may be used to connect all the computers. Larger networks often involve multiple routers or switches that connect to each other. One of these devices typically connects to a cable modem or other type of internet connection that provides internet access to all devices connected to the network.

While most of the networks are now wireless, some users still prefer wired devices, since they have a few benefits over their wireless networks. For example, a wired connection is not prone to signal interference that can slow down Wi-Fi connections. Additionally, wired network connections are often faster than wireless ones, which allows for faster data transfer rates.

Setting up a wired network requires network components and architecture that we have already discussed in above sections. So, here our focus will be more on learning about wireless network.

### 6.9.2 Wireless Network

Wireless network is a computer network set up using electromagnetic waves working at radio signal frequency to communicate among computers and other network devices. Sometimes it's also referred to as **Wi-Fi network** or **WLAN**. A wireless local-area network connects devices such as laptops and mobile phones to the internet and to your business network and its applications. When you connect to a Wi-Fi hotspot at a cafe, a hotel, an airport lounge, or another public place, you're connecting to a wireless network.

This network has become very popular nowadays due to easy setup features and no cabling involved. You can connect computers anywhere in your home without the need for wires.

The two main components are **wireless router or access point** and **wireless clients**.

If you want to set up any wired network, you just need to get a wireless router and attach it to cable or DSL modem. You then set up wireless client by adding wireless card to each computer and form a simple wireless network. Wireless router or access points should be installed in a way that maximizes coverage as well as throughput. Large areas usually require more than one access point in order to have adequate coverage. You can also add an access point to your existing wireless router to improve coverage.

### Wireless operating mode

The IEEE 802.11 standards specify two operating modes: **infrastructure mode** and **ad hoc mode**.

**Infrastructure mode** is used to connect computers with wireless network adapters, also known as wireless clients, to an existing wired network with help from the wireless router or access point.

**Ad hoc mode** is used to connect wireless clients directly together, without the need for a wireless router or access point. An ad hoc network consists of up to 9 wireless clients, which send their data directly to each other.

### Benefits of a wireless network

- **Convenient to use** : You can access your network resources from any location within your wireless network's coverage area or from any Wi-Fi hotspot.
- **Improves mobility** : When you have a wired connection you're not tied to your desk. You and your employees can go online in conference room meetings. You can perform every job while you are on the move.
- **Increases productivity** : Wireless access to the internet and to your company's key applications and resources helps your staff get the job done and encourages collaboration.
- **Easy to set up** : You don't have to use cables, so installation can be quick and cost effective. It's like plug and play.
- **Expandability** : You can easily expand wireless networks with existing equipment, whereas a wired network might require additional wiring.
- **Security** : Advances in wireless networks provide robust security protections.
- **Cost** : Because wireless networks eliminate or reduce wiring expenses, they can cost less to operate than wired networks.

## 6.10 Transmission Media

In network communications, a **transmission medium** is a physical connection between two computers.

There are two major categories of transmission media:

- **Guided or wired**
- **Unguided or wireless**

### 6.10.1 Guided Transmission Media

This medium uses cables to connect devices with each other. It is mainly of three types:

#### 1. Twisted pair cables

Twisted pair cables have been around for a long time. They were mainly invented for voice transmissions using telephones. Twisted pair is a widely used medium in networking, particularly in LAN as it is lighter, cheaper, more flexible, easy to install and provides greater speeds than coaxial cables.

#### Types of twisted pair cables

Unshielded Twisted Pair (UTP)

Shielded Twisted Pair (STP)

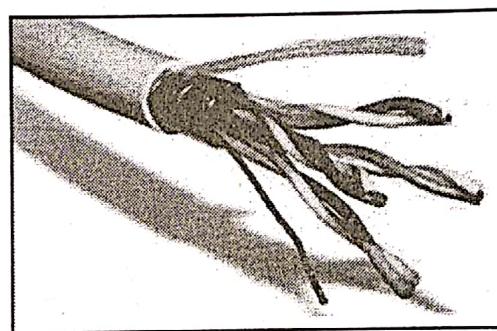


Fig. 6.10.1 : Twisted pair

#### 2. Coaxial cables

The coaxial cables have a central copper conductor, surrounded by an insulating layer, a conducting shield and the outermost plastic sheath. Thus, there are 3 insulation layers for the inner copper cable. There are two basic modes of data transmission in coaxial cables: baseband mode that has dedicated bandwidth, and broadband mode that has distributed cable bandwidth.

Cable TV and analog televisions mainly use coaxial cables. Coaxial cables have better resistance to cross talk than twisted pair cables. The coaxial cables are used for long distance communication. It was used in computer network in early days.

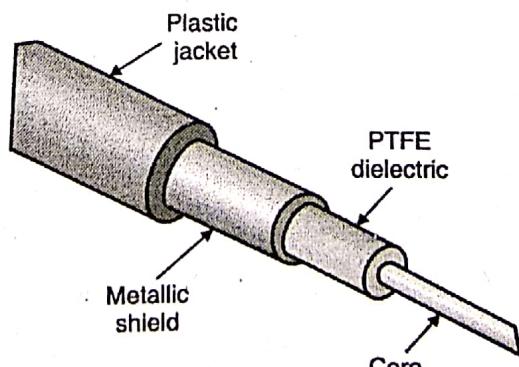


Fig. 6.10.2 : Co-axial cable

### 3. Optical fibres

Optical fibre transmits signals in the form of light waves. These cables are well-suited for voice, data and video transmissions. Optical fibre is the most secure of all the cable media. Installation and maintenance are difficult and costly. Fibre optic cables have greater transmission speed, high bandwidth, and the signal can travel longer distances, when compared to coaxial and twisted pair cables.

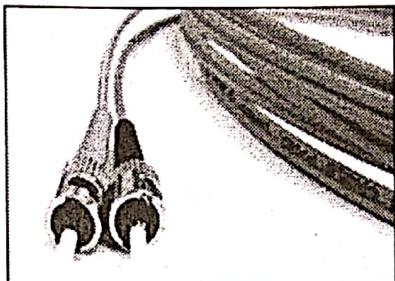


Fig. 6.10.3 : Optical fiber

## 6.10.2 Unguided Transmission

An unguided transmission transmits the electromagnetic waves without using any physical medium. Therefore it is also known as **wireless transmission**. In unguided media, air is the media through which the electromagnetic energy can flow easily.

Unguided transmission is broadly classified into three categories:

### (a) Radio waves

- Radio waves are the electromagnetic waves that are transmitted in all the directions of free space.
- Radio waves are omni directional, i.e. the signals are propagated in all the directions.
- An example of the radio wave is FM radio.

#### Advantages of radio transmission

- Radio transmission is mainly used for wide area networks and mobile cellular phones.
- Radio waves cover a large area, and they can penetrate the walls.
- Radio transmission provides a higher transmission rate.

### (b) Microwaves

#### Microwaves are of two types

1. Terrestrial microwave transmission
2. Satellite microwave communication

### 1. Terrestrial microwave transmission

- Terrestrial microwave transmission is a technology that transmits the focused beam of a radio signal from one ground-based microwave transmission antenna to another.
- Microwaves are unidirectional as the sending and receiving antennae are to be aligned, i.e. the waves sent by the sending antenna are narrowly focused.

- It works on the line-of-sight transmission, i.e. the antennae mounted on the towers are in direct sight of each other.

### Advantages

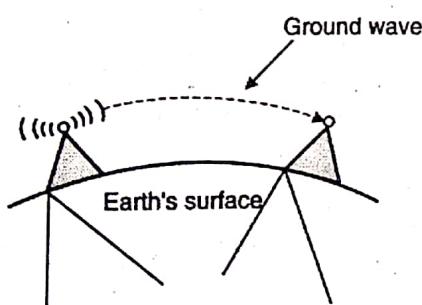
- Terrestrial transmission is cheaper than using cables.
- It is free from land acquisition as it does not require any land for the installation of cables.
- Terrestrial transmission provides easy communication in terrains as the installation of cables in terrain is quite a difficult task.

## 2. Satellite Microwave Communication

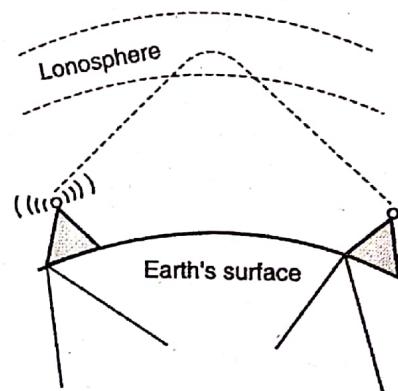
- A satellite is a physical object that revolves around the earth at a known height.
- Satellite communication is more reliable nowadays as it offers more flexibility than cable and fibre optic systems.
- We can communicate with any point on the globe by using satellite communication.

### Advantages

- The coverage area of a satellite microwave is more than the terrestrial microwave.
- The transmission cost of the satellite is independent of the distance from the centre of the coverage area.
- Satellite communication is used in mobile and wireless communication applications.



Terrestrial microwave transmission



Satellite Microwave Transmission

Fig. 6.10.4 : Microwaves

## 6.11 Pervasive Computing

It is a computing environment that proposes a proactive interaction between devices and environment with the goal of making technologies transparent to the user. It goes beyond the realm of personal computers. It is a kind of embedded technology where any device can be imbedded with chips and get connected to an infinite network of other devices.

The goal of pervasive computing, which combines current network technologies with wireless computing, voice recognition, internet capability and artificial intelligence, is to create an environment where the connectivity of devices is embedded in such a way that the connectivity is unobtrusive and always available.

It is also known as ubiquitous computing, which is the study of how computing can be integrated into the environment in a way that makes it easily accessible to users. It includes an emphasis on ease and naturalness of use.

**Features**

- Pervasive computing consists of inexpensive microprocessors embedded in everyday objects and environments. It creates an environment where computers have the capability to obtain information from the environment in which it is embedded and utilize it dynamically.
- Pervasive computing devices are not personal computers as we tend to think of them, but rather small electronic mobile embedded devices in almost any type of real world object, including cars, tools, watches, household appliances, clothes, and so forth—all communicating through increasingly interconnected networks.
- This is a new dimension of personal computing that integrates mobile communication, ubiquitous embedded computer systems, consumer electronics, and the power of the internet. Camera phones are sometimes seen as a step toward “smart” phones becoming successful pervasive computing devices that allow users to communicate via audio, video, still images, e-mail, and the internet without having to stop and deal with issues such as connectivity and technical issues.
- In pervasive computing environment, all these devices communicate with each other over wireless networks without any interaction required by the user.

**6.11.1 Application Areas****Health**

The application of pervasive computing in health is called *u-Health* or pervasive health. The applications are commonly centered in hospital routine management, patients' monitoring or well-being. For example, the treatment of non-communicable diseases (NCDs) can benefit from *u-Health* technologies. The treatment of these diseases is continuous, so the patients must always be aware of their condition, following the treatment planned by the doctor. Furthermore, patients of NCDs should be engaged in the treatment, because some activities are performed daily by themselves and depend on their habits and lifestyle.

**Accessibility**

The term *pervasive accessibility* indicates a new technology approach to support accessibility. Since the computing is shifting from personal workstations to pervasive computing, accessibility should be thought accordingly with this new computational paradigm. In this sense, the *u-Accessibility* has emerged as a way to improve the quality of life of people with disabilities and the elderly.

**Learning**

The application of mobile and pervasive computing in the improvement of learning strategies has created two research fronts called *mobile learning* and *pervasive learning*. *Mobile learning* is fundamentally about increasing learners' capability to carry their own learning environment along with them. M-learning is the natural evolution of e-learning, and has the potential to make learning even more widely accessible. In m-learning model, mobile computers are still not embedded in the learners' surrounding environment, and as such they cannot seamlessly obtain information about learner context.

On the other hand, *pervasive learning* refers to learning supported by the use of mobile and wireless communication technologies, sensors and location/tracking mechanisms, which work together to integrate learners with their environments. Pervasive learning systems connect virtual and real objects, people and events, in order to support a continuous, contextual and meaningful learning.

While the learner is moving with mobile device, the system dynamically supports the learning process by communicating with embedded computers in the environment. The essence of pervasive learning is to realize which information can be presented throughout the learners' daily tasks, in different forms and places, and to link this data with the learners' educational process.

### **Logistics :**

Transport is strategic in the supply chain integration, because it can be used to control flows of resources, goods and products. In addition, transport is a significant part of the logistics costs, thus; its management is relevant to enhance efficiency and flexibility in fleet operation. In this sense, companies have used current technologies to obtain precise information to support this management among which stands out the Global Positioning System and its use to implement location systems and monitoring/tracking systems.

Several research works have addressed the use of pervasive technologies to improve the transport logistics. This enables the users to identify whether a vehicle is following a planned route or deviating from the original path.

### **Commerce :**

The use of mobile devices and pervasive technologies to support commerce is commonly classified as *context-aware commerce* or *ubiquitous commerce* (so called *u-commerce*). There are three prerequisites for the success of u-commerce: (1) always be connected with the clients; (2) always be aware of clients' contexts (where they are, what they are doing and what is available around them); and (3) always be proactive, identifying real-time opportunities to meet client needs.

Pervasive computing technologies are used to identify business opportunities for users as clients or suppliers. In addition, it offers a generic approach to support trade in goods and services without domain restrictions.

## **6.12 Cloud Computing**

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Cloud computing is the delivery of computing services such as servers, storage, database, networking, software, analytics, etc. over the internet. Using cloud computing services users are able to access software and applications from wherever they are; the computer programs are hosted by an outside party and reside in the cloud. This means that users do not have to worry about things such as storage and power. Moreover, you pay only for the services you use, thus lowering your operating costs.

### **6.12.1 Advantages of Cloud Computing**

Cloud computing is a big shift from the traditional way of using IT resources. Following are the advantages organizations get out of cloud computing:

- **Cost saving :** Cloud computing eliminates the capital expense of buying hardware and software and setting up and running IT infrastructure such as data centres, servers, electricity for power and cooling, the IT experts for managing the infrastructure. All this result in cost cutting.
- **High speed :** Most cloud computing services are offered on demand, so even vast amounts of computing resources can be made available in minutes giving businesses a lot of flexibility and taking the pressure off.

- **Greater scalability :** The benefits of cloud computing services include the ability to scale up fast. It means delivering the right amount of IT resource when it is needed and from the right geographic location.
- **Improves productivity :** On-site data centres typically require a lot of infrastructural requirements like hardware, software, and other time-consuming IT management chores. Cloud computing removes the need for many of these tasks, so IT teams can spend time on achieving more important business goals.
- **Better performance :** The biggest cloud computing services run on a worldwide network of secure data centres, which are regularly upgraded to the latest generation of fast and efficient computing hardware. This offers several benefits over a single corporate data centre
- **Reliability :** Cloud computing makes data backup, disaster recovery and business continuity easier and less expensive because data can be mirrored at multiple redundant sites on the cloud provider's network.
- **Security:** Many cloud providers offer a broad set of policies, technologies and controls that strengthen your security posture overall, helping protect your data, apps and infrastructure from potential threats.

### 6.12.2 Types of Cloud Computing

Clouds of several different models, types and services have evolved to offer the right solution for your needs. There are three different ways to deploy cloud services: on a public cloud, private cloud or hybrid cloud.

- **Public cloud:** These clouds are owned and operated by a third party cloud service provider to deliver the services over the internet. All the supporting hardware, software and other infrastructure is owned and managed by the cloud provider. You access these services using your browser.
- **Private cloud:** It refers to the cloud services owned by a single organization for its own use. It may be located at the organization's data centre.
- **Hybrid cloud:** Hybrid clouds combine public and private clouds, bound together by technology that allows data and applications to be shared between them. By allowing data and applications to move between private and public clouds, a hybrid cloud gives your business greater flexibility, more deployment options and helps optimise your existing infrastructure, security and compliance.

### 6.12.3 Types of Cloud Services

Most cloud computing services fall into four broad categories: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Serverless and Software as a Service (SaaS).

- **Infrastructure as a Service (IaaS):** This is the most basic category of cloud computing services. With IaaS, you take on rent IT infrastructure like servers and virtual machines (VMs), storage, networks, operating systems from a cloud provider on payment basis
- **Platform as a Service (PaaS):** Platform as a service refers to cloud computing services that supply an on-demand environment for developing, testing, delivering and managing software applications. PaaS is designed to make it easier for developers to quickly create web or mobile apps, without worrying about setting up or managing the underlying infrastructure of servers, storage, network and databases needed for development.
- **Serverless computing:** Serverless computing focuses on building app functionality without spending time on managing the servers and infrastructure required to do so. The cloud provider handles the setup, capacity planning and server

management for you. Serverless architectures are highly scalable and event-driven, only using resources when a specific function or trigger occurs.

- **Software as a Service (SaaS):** Software as a service is a method for delivering software applications over the internet, on demand and typically on a subscription basis. With SaaS, cloud providers host and manage the software application and underlying infrastructure and handle maintenance, like software upgrades and security patching. Users connect to the application over the internet, usually with a web browser on their phone, tablet or PC.

#### 6.12.4 Usage of Cloud Computing

You are probably using cloud computing right now, even if you don't realise it. If you use an online service to send email, edit documents, watch movies or TV, listen to music, play games or store pictures and other files, it is likely that cloud computing is making it all possible behind the scenes.

Here are a few examples of what is possible today with cloud services from a cloud provider:

- **Create new apps and services:** Quickly build, deploy and scale applications for web, mobile and API on any platform. Access the resources you need to help meet performance, security and compliance requirements.
- **Test and build applications:** Use of cloud services reduce application development cost and time by using cloud infrastructures.
- **Store, back up and recover data:** Protect your data more cost-efficiently—and at massive scale—by transferring your data over the internet to an offsite cloud storage system that is accessible from any location and any device.
- **Analyse data:** Unify your data across teams, divisions and locations in the cloud. Then use cloud services, such as machine learning and artificial intelligence to uncover insights for more informed decisions.
- **Stream audio and video:** Connect with your audience anywhere, anytime, on any device with high-definition video and audio with global distribution.

#### Exercises

**Answer the following questions in short**

- Define computer network. (Refer section 6.1)
- How does a computer network work? (Refer section 6.1.1)
- Write any four advantages of computer network. (Refer section 6.2)
- What is online banking? (Refer section 6.3)
- What is server? State two of its functions. (Refer section 6.4)
- What is protocol? Give an example. (Refer section 6.4)
- Define LAN. Write its advantages. (Refer section 6.5)
- Define WAN. (Refer section 6.5)
- What is Ethernet? (Refer section 6.5)
- Describe client/server network. (Refer section 6.6.2)
- What is network topology? (Refer section 6.7)

- Q. Differentiate bus and star topology. (Refer section 6.7.2 and 6.7.3)
- Q. What is hub? How is different from switches? (Refer section 6.8)
- Q. Differentiate bridge and gateway. (Refer section 6.8)
- Q. What is router? (Refer section 6.8)
- Q. What is an access point? (Refer section 6.8)
- Q. Differentiate between guided and unguided media. (Refer section 6.10)
- Q. What is optical fibre? Write its advantages. (Refer section 6.10)
- Q. What is pervasive computing? (Refer section 6.11)
- Q. What is cloud computing? (Refer section 6.12)

**Answer the following questions in long**

- Q. Describe the applications of computer network. (Refer section 6.3)
- Q. Describe the hardware and software component of a computer network. (Refer section 6.4)
- Q. Describe and differentiate LAN, MAN and WAN. (Refer section 6.5)
- Q. Describe the types of network architecture. (Refer section 6.6)
- Q. Describe any four network topologies. (Refer section 6.7)
- Q. Describe and differentiate between wired and wireless network technology (Refer section 6.9)
- Q. Describe wireless/unguided transmission media, their usage and advantages. (Refer section 6.10)
- Q. Describe the applications of pervasive computing. (Refer section 6.11)
- Q. Explain different types of cloud computing services. (Refer section 6.12)
- Q. Describe the advantages of cloud computing. (Refer section 6.12.1)

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# Information System within Organization

## Syllabus

Transaction Processing Systems, Functional Area Information System, ERP and ERP Support of Business Process  
Acquiring Information Systems and Applications: Various System Development Life Cycle Models

## 7.1 Introduction

This chapter introduces the fast-changing world of information system applications used within the organizations. Many companies today are using information technology to develop integrated cross-functional enterprise systems that cross the boundaries of traditional business functions in order to reengineer and improve vital business processes all across the enterprise. These cross-functional enterprise systems are used as a strategic way to use IT to share information resources and improve the efficiency and effectiveness of business processes, and develop strategic relationships with customers, suppliers, and business partners. Companies first moved from functional mainframe-based systems to integrated cross-functional applications. These changes introduced applications based on transaction processing which later gave way to *enterprise resource planning, supply chain management, and customer relationship management* software. Such enterprise software focuses on supporting integrated business processes involved in the operations of a business.

Behind the development of all these enterprise-based application development there lies a careful and complex development system. Such a system is called system development lifecycle. You are going to learn the steps of system/application development.

### 7.1.1 Transaction Processing System

Many companies today are using information technology to develop integrated cross-functional enterprise systems in order to reengineer and improve vital business processes all across the enterprise. These organizations view cross-functional enterprise systems as a strategic way to use IT to share information resources and improve the efficiency and effectiveness of business processes, and develop strategic relationships with customers, suppliers, and business partners.

Companies all across the globe are using the World Wide Web and their intranets and extranets as a technology platform for their cross-functional and enterprise information systems. **Transaction processing systems (TPS)** are cross-functional information systems that process data resulting from the occurrence of business transactions.

Transactions are events that occur as part of doing business, such as sales, purchases, deposits, withdrawals, refunds, and payments. Think, for example, of the data generated whenever a business sells something to a customer on credit, whether in a retail store or at an e-commerce site on the web. Data about the customer, product, salesperson, store, and so on, is captured and processed. This need prompts additional transactions, such as credit checks, customer billing, inventory changes, and increases in accounts receivable balances, which generate even more data.

Thus, transaction processing activities are needed to capture and process such data, or the operations of a business would grind to a halt. Transactions ensure that data-oriented resources are not permanently updated unless all operations within the transactional unit complete successfully. By combining a set of related operations into a unit that either completely succeeds or completely fails, you can simplify error recovery and make your application more reliable. Therefore, transaction processing systems play a vital role in supporting the operations of most companies today.

Transaction processing systems capture and process data describing business transactions, update organizational databases, and produce a variety of information products. They consist of computer hardware and software hosting a transaction-oriented application that performs the routine transactions necessary to conduct business.

To ensure predictable behaviour, all transactions must possess the basic ACID properties. The following list contains a definition and a description of each ACID property:

- **Atomic:** A transaction must execute exactly once and must be atomic—either all of the work is done or none of it is. Operations within a transaction usually share a common intent and are interdependent. By performing only a subset of these operations, the system could compromise the overall intent of the transaction. Atomicity eliminates the chance of processing only a subset of operations.
- **Consistent:** A transaction must preserve the consistency of data, transforming one consistent state of data into another consistent state of data. Much of the responsibility for maintaining consistency falls to the application developer.
- **Isolated:** A transaction must be a unit of isolation, which means that concurrent transactions should behave as if each were the only transaction running in the system. Because a high degree of isolation can limit the number of concurrent transactions, some applications reduce the isolation level in exchange for better throughput.
- **Durable:** A transaction must be recoverable and therefore must have durability. If a transaction commits, the system guarantees that its updates can persist even if the computer crashes immediately after the commit. Specialized logging allows the system's restart procedure to complete unfinished operations required by the transaction, making the transaction durable.

## 7.1.2 Transaction Processing Cycle

### 1. Data entry

The first step of the transaction processing cycle is the capture of business data. For example, transaction data may be collected by point-of-sale terminals using optical scanning of bar codes and credit card readers at a retail store or other business. Transaction data can also be captured at an e-commerce website on the Internet.

### 2. Transaction processing

Transaction processing systems process data in two basic ways:

(a) **Batch processing:** Here transaction data are accumulated over a period of time and processed periodically. Examples are

#### Cheque clearance

- Written order asking a bank to transfer an amount of money to an account
- People deposit them into their account
- Involves checking whether the person has the correct funds(takes up to 3 days)
- Money is withdrawn when cheque has been cleared

#### Bill generation

- Invoice is given to a customer for supplied goods or service
- Generated at a scheduled time so the user can effectively manage their time
- Done as a group

(b) **Real-time processing** (also called online processing): Here data are processed immediately after a transaction occurs. All online transaction processing systems incorporate real-time processing capabilities. Many online systems also depend on the capabilities of *fault tolerant* computer systems that can continue to operate even if parts of the system fail. Examples are

#### Reservation systems

- Used in any type of business involved in setting aside a product or server for a customer(Ex. train tickets)
- Requires an acceptable response time

#### Point of sale terminals

- Used by retail stores to sell goods and services
- Minimizes the cost of batch handling by converting the data to a form that can be easily transmitted through a communication system
- Correct price of the product is received once the product number is entered

### 3. Database maintenance

An organization's databases must be updated by its transaction processing systems so that they are always correct and up-to-date. Therefore, transaction processing systems serve to assist in maintaining the corporate databases of an organization to reflect changes resulting from day-to-day business transactions. For example, credit sales made to customers will cause customer account balances to be increased and the amount of inventory on hand to be decreased. Database maintenance ensures that these and other changes are reflected in the data records stored in the company's databases.

### 4. Document and report generation

Transaction processing systems produce a variety of documents and reports. Examples of transaction documents include purchase orders, paychecks, sales receipts, invoices, and customer statements. Transaction reports might take the form of a transaction listing such as a payroll register, or edit reports that describe errors detected during processing.

## 5. Inquiry processing

Many transaction processing systems allow you to use the internet, intranets, extranets, 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. For example, you might check on the status of a sales order, the balance in an account, or the amount of stock in inventory and receive immediate responses at your PC.

### 7.1.3 Features

- **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.
- **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.
- **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.
- **Controlled processing:** The TPS must be able to allow authorized employees to be able to access it at any time.

### 7.1.4 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.

Transaction processing is supported by programs that are called transaction processing systems. Transaction processing systems provide the following functions:

#### - System runtime functions

Transaction processing systems provide an execution environment that ensures the integrity, availability, and security of data. They also ensure fast response time and high transaction throughput.

#### - System administration functions

Transaction processing systems provide administrative support that lets users configure, monitor, and manage their transaction systems.

#### - Application development functions

Transaction processing systems provide functions for use in custom business applications, including functions to access data, to perform inter-computer communications, and to design and manage the user interface.

## 7.2 Information System for Business Functional Areas

Business managers are moving from a tradition where they could avoid, delegate, or ignore decisions about IT to one where they cannot create a marketing, product, international, organization, or financial plan without IT. There are as many ways to use information technology in business as there are business activities to be performed, business problems to be solved, and business opportunities to be pursued.

As a business professional, you should have a basic understanding of the major ways information systems are used to support each of the functions of business accomplished in any company. Thus, in this section, we will discuss functional business systems.

**Information systems** (transaction processing, management information, decision support, and so on) support the business functions of accounting, finance, marketing, operations management, and human resource management. As a business professional, it is also important that you have a specific understanding of how information systems affect a particular business function or a particular industry. For example, someone whose career objective is a marketing position in banking should have a basic understanding of how information systems are used in banking and how they support the marketing activities of banks and other firms.

Thus, information systems in this section will be analyzed according to the business function they support by looking at a few key examples in each functional area.

### 7.3 Marketing Information System

The business function of marketing is concerned with the planning, promotion, and sale of existing products in existing markets, and the development of new products and new markets to better attract and serve present and potential customers. Thus, marketing performs an essential function in the operation of a business enterprise. Business firms have increasingly turned to information technology to help them perform vital marketing functions in the face of the rapid changes of today's environment.

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.

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.

#### 7.3.1 Components of Marketing Information System

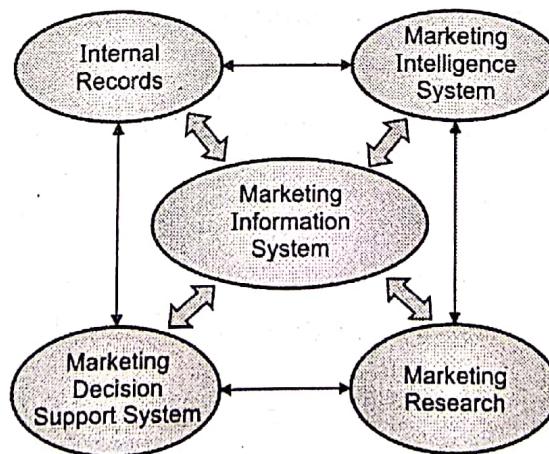


Fig. 7.3.1 Components of marketing IS

- **Internal records :** The company can collect information through its internal records comprising of sales data, customer database, product database, financial data, operations data, etc.

- **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.
- **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.
- **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 marketing 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.

### 7.3.2 Advantages of Marketing Information Systems

1. **Organized data collection :** Lots of data can be collected from the market. But the main word here is "organized". Organizing data is very important else the data is meaningless. Thus MIS helps you to organize your database thereby improving productivity.
2. **Storage of important data :** Several times in pharmaceuticals, when one drug is being produced they may need data of another drug which was produced years back. Similarly in media, photographs are stored in archives. This storage of important data plays a crucial role in execution and thus proves again that MIS is not important only for information but also for execution.
3. **Avoidance of crisis :** The best way to analyse a stock (share market) is to see its past performance. Top websites like moneycontrol thrive on MIS. Similarly MIS helps you keep track of margins and profits. With an amazing information system established, you can know where your organization is moving and probably avert a crisis long before it has taken place. Ignoring hints received from MIS reports is foolhardy.
4. **Co-ordination :** Consumer durables and FMCG companies have a huge number of processes which needs to be co-ordinated. These companies depend completely on MIS for the proper running of the organization. There are dedicated people for marketing information systems in such organizations. This is mainly because of the speed required to access information and implement it.
5. **Analysis and planning :** MIS is critical for planning. You cannot do planning without information. For planning, the first thing which is needed is the organization's capabilities, then the business environment and finally competitor analysis. In a proper MIS, all these are present by default and are continuously updated. Thus MIS is very important for planning and analysis.
6. **Control :** Just like MIS can help in a crisis, in normal times it provides control as you have information of the various processes going on and what is happening across the company. Thus, it provides you with a sense of control.

## 7.4 Manufacturing System

There was a time when manufacturers operated on a simple build-to-stock model. They built 100 or 100,000 of an item and sold them via distribution networks. They kept track of the stock of inventory and made more of the item once inventory levels dipped below a threshold. Rush jobs were both rare and expensive, and configuration options limited. Now, things have changed for the better. Concepts like just-in-time inventory, build-to-order (BTO) manufacturing, end-to-end supply chain visibility, the explosion in contract manufacturing, and the development of web-based e-business tools for collaborative manufacturing have revolutionized plant management.

**Manufacturing Information Systems (MIS)** support the *production/operations* function of an organization that includes all activities concerned with the planning and control of the processes producing goods or services. Thus, the production/operations function is concerned with the management of the operational processes and systems of all business firms.

Information systems used for operations management and transaction processing support firms plan, monitor, and control inventories, purchases, and the flow of goods and services. Therefore, firms such as transportation companies, wholesalers, retailers, financial institutions, and service companies must use production/operations information systems to plan and control their operations.

A variety of manufacturing information systems, many of them web-enabled, today support Computer-Integrated Manufacturing (CIM). The objectives of computer-based systems in manufacturing are to:

- Simplify production processes, product designs, and factory organization creating a vital foundation for automation and integration.
- Automate production processes and the business functions that support them with computers, machines, and robots.
- Integrate all production and support processes using computer networks, cross-functional business software, and other information technologies.

### 7.4.1 Benefits of Manufacturing Information Systems

1. It streamlines the product production system.
2. It reduces costs, waste, and re-work which results in savings.
3. Increased efficiency in set-up times helps avoid delays.
4. Assessment of correct order priority helps in delivering products on time.
5. Assignment and reassignment of inventory are done as per the necessity.
6. It helps evaluate the optimal times to turn machines on and off.
7. Scheduling and rescheduling of equipment is done better.
8. It improves the reaction time within the supply chain management process.
9. It helps in the timely movement of inventory from one workstation to another.
10. It helps in managing suppliers on the right time and at the right price.
11. It Improves operational efficiency.
12. It increases transparency in record-keeping processes.

## 7.4.2 Applications

The overall goal of manufacturing information systems is to create flexible, agile, manufacturing processes that efficiently produce products of the highest quality. Implementing such manufacturing concepts prepares a company to respond to and fulfill customer requirements quickly with high-quality products and services.

Manufacturing information systems help companies simplify, automate, and integrate many of the activities needed to produce products of all kinds. For example, computers are used to help engineers design better products using both *computer-aided engineering (CAE)* and *computer-aided design (CAD)* systems, and better production processes with *computer-aided process planning*.

They are also used to help plan the types of material needed in the production process, which is called *material requirements planning (MRP)*, and to integrate MRP with production scheduling and shop floor operations, which is known as *manufacturing resource planning*.

Many of the processes within manufacturing resource planning systems are included in the manufacturing module of enterprise resource planning (ERP) software.

Computer-aided manufacturing (CAM) systems automate the production process. For example, this could be accomplished by monitoring and controlling the production process in a factory or by directly controlling a physical process, a machine tool, or robots.

Manufacturing Execution Systems (MES) are performance-monitoring information systems for factory floor operations. They monitor, track, and control the five essential components involved in a production process: materials, equipment, personnel, instructions and specifications, and production facilities. MES includes shop floor scheduling and control, machine control, robotics control, and process control systems. These manufacturing systems monitor, report, and adjust the status and performance of production components to help a company achieve a flexible, high-quality manufacturing process.

Process control is the use of computers to control an ongoing physical process. Process control computers control physical processes in petroleum refineries, cement plants, steel mills, chemical plants, food product manufacturing plants, pulp and paper mills, electric power plants, and so on. A process control computer system requires the use of special sensing devices that measure physical phenomena such as temperature or pressure changes, which are then converted to digital forms and relayed to computers for processing.

Machine control is the use of computers to control the actions of machines. This is also popularly called *numerical control*. The computer-based control of machine tools to manufacture products of all kinds is a typical numerical control application used by many factories throughout the world.

## 7.5 HR Information System

The Human Resource Management (HRM) function involves the recruitment, placement, evaluation, compensation, and development of the employees of an organization.

The goal of human resource management is the effective and efficient use of the human resources of a company. Human Resource Information Systems (HRIS) play an important role in achieving this goal. They are designed to support

- HR planning to meet the current and future personnel needs of the business
- Planned employees development to its full potential
- Controlling and shaping of all personnel policies and programs.

Originally, businesses used computer-based information systems for limited and routine functions like

- Producing paychecks and payroll reports
- Maintaining personnel records, and
- Analyzing the use of personnel in business operations.

But, now many firms have gone beyond these traditional *personnel management* functions and have developed human resource information systems that also support

- Recruitment, selection, and hiring
- Job placement
- Performance appraisals
- Employee benefits analysis
- Training and development
- Health, safety, and security

### 7.5.1 HRIS Functions

- **Operational:** A human resources information system functions as a productivity tool for HR operational processes. Increased speed and accuracy result when HR transactions are performed with computer software rather than manually, and routine transactions such as employee headcount, payroll tracking and time and attendance reporting become automated and more cost-effective.
- **Managerial:** An HRIS functions as a managerial information system to gather and provide key data about staffing, turnover, benefits and regulatory compliance issues. Human resources personnel can provide reports on total number of employees, cost to hire, vacant positions, benefits costs, required reports and cost of raises and bonuses. HR managers can more easily present analysis of compensation, recruiting, accidents and injuries.
- **Executive:** A company's HRIS functions as an executive information system to aggregate high-level data for long-range planning such as succession planning. The system provides executive planning information for strategic needs such as forecasting, staffing needs assessment and employee skills assessment.
- **Office automation:** An HRIS also can function as an office automation system to design employee management documents such as applications and job requisitions, to schedule shared resources and schedule and track employee training and recognition. HR reports can be automated and set to run and distribute right from the system, getting information to the people that need it in real time. An HRIS reduces the amount of time the staff spends on daily transaction activities, such as tracking employee status changes, and frees them to work on more planning and strategy aligned with corporate goals.

## 7.5.2 HRIS Advantages

**Recruitment :** HRIS are involved in the recruitment of employees through recruitment sections of corporate websites. Companies these days are also using recruitment services which maintain candidates profile databases on the World Wide Web to invite job seekers, posting messages in selected Internet newsgroups, and communicating with job applicants via e-mail. The internet has a wealth of information and contacts for both employers and job hunters. HRIS allow companies to process most common HRM applications over their corporate intranets.

**Employee services :** HRIS allow the HRM departments to provide around-the-clock services to their employees. They can also disseminate valuable information faster to the concerned employees and departments.

**Training :** Another benefit of the HRIS is that it can serve as a superior training tool. Employees can easily download instructions and processes to get the information or education they need. In addition, employees using new technology can view training videos over the intranet on demand. Thus, the HRIS eliminates the need to loan out and track training videos.

**Talent management :** Employees are the most valuable resources in any organization. However, the process of talent management which is attracting, recruiting, engaging, developing, and retaining employees is a complicated process. Also, employee turnover cost is expensive. An HRIS with an exclusive talent management system will help the organization take better care of their employees.

**Time and absence management :** An HRIS solves the problems associated with leave and time management with a comprehensive set of features such as:

- o Auto-capture and submit timesheet entries
- o Workforce scheduling
- o Leave tracking and management
- o Drill-down and drill-through analytics
- o Integrations with payroll, accounting, etc.

If not handled properly, timesheets and vacation requests have the potential to stir up a lot of trouble. Mishandled time-off requests can leave a bad impression on the quality of life in the organization, and reduce employee satisfaction. So, streamlining the timesheet and time-off process with an HRIS can control the manual errors and prevent possible disasters.

**Employee Self-Service(ESS):** Organizations often find it hard to keep their employee-related data updated. Employee Self-Service is an effective way to manage this problem. Giving employees access to view and manage their personal information (profile, time off, benefits, or payroll) can reduce the time HR staffs spend on mundane clerical tasks.

By extending a self-service option to their employees' organizations can:

- o Empower employees
- o Decrease clerical tasks
- o Cut down admin time
- o Improve employee engagement
- o Reduce HR paperwork

- With a self-service portal, every HR process from employee on boarding to reporting will become more efficient. If the HRIS has multi-channel accessibility, employees can view, edit, and retrieve all work-related information right from their mobile phones.
- **Centralized database:** With an automated database that collects, stores, and displays up-to-date, consistent information about the personnel, policies, and procedures in an organization, HR leaders can finally break up with spreadsheets and paper files. Storing all confidential information in a centralized cloud-based HRIS software will:
  - o Promote data integrity
  - o Reduce process and data redundancy
  - o Improve productivity
  - o Enhance efficiency of HR staff and
  - o Reduce cost

A centralized database that is seamlessly integrated with other HR modules will offer great accessibility to all end users. Any updates or changes made to the master database will reflect immediately across all modules, saving a considerable amount of time and effort HR staff put into matching and duplicating all records manually.

- **Payroll:** Several organizations still use a stand-alone system to manage their payroll process. However, an HRIS software can manage the payroll process end-to-end with its broad range of features that:
  - o Automate payout process
  - o Auto-compute taxes
  - o Ensure statutory compliance
  - o Deliver automated reminders
  - o Extend employee self-service options

## 7.6 Information System for Accounting

Accounting information systems are the oldest and the most widely used information systems in business. They record and report business transactions and other economic events. Computer-based accounting systems record and report the flow of funds through an organization and produce important financial statements such as balance sheets and income statements.

Such systems also produce forecasts of future conditions such as projected financial statements and financial budgets. A firm's financial performance is measured against such forecasts by other analytical accounting reports.

Operational accounting systems emphasize legal and historical record-keeping and the production of accurate financial statements. Typically, these systems include transaction processing systems such as order processing, inventory control, accounts receivable, accounts payable, payroll and general ledger systems.

Management accounting systems focus on the planning and control of business operations. They emphasize cost accounting reports, the development of financial budgets and projected financial statements, and analytical reports comparing actual to forecasted performance.

Many accounting software packages are available for these applications. It should come as no surprise that the accounting information systems are being transformed by internet technologies. Using the internet and other network changes, accounting information systems now monitor and track business activity.

The interactive nature of online accounting systems calls for new forms of transaction documents, procedures, and controls. This particularly applies to systems like order processing, inventory control, accounts receivable, and accounts payable. These systems are directly involved in the processing of transactions between a business and its customers and suppliers. So naturally, many companies are using internet and other network links to these trading partners for such online transaction processing systems.

## 7.7 Financial Management System

Computer-based financial management systems support business managers and professionals in decisions concerning

- The financing of a business
- The allocation and control of financial resources within a business

Major financial management system categories include cash and investment management, capital budgeting, financial forecasting, and financial planning.

### 7.7.1 Applications

- The capital budgeting process involves evaluating the profitability and financial impact of proposed capital expenditures.
- Long-term expenditure proposals for facilities and equipment can be analyzed using a variety of return on investment (ROI) evaluation techniques. This application makes heavy use of spreadsheet models that incorporate present value analysis of expected cash flows and probability analysis of risk to determine the optimum mix of capital projects for a business.
- Financial analysts also typically use electronic spreadsheets and other financial planning software to evaluate the present and projected financial performance of a business. They also help determine the financing needs of a business and analyze alternative methods of financing. Financial analysts use financial forecasts concerning the economic situation, business operations, types of financing available, interest rates, and stock and bond prices to develop an optimal financing plan for the business.
- Electronic spreadsheet packages, DSS software, and web-based groupware can be used to build and manipulate financial models. Answers to what-if and goal-seeking questions can be explored as financial analysts and managers evaluate their financing and investment alternatives.

### 7.7.2 Building Blocks of an FMIS

There are many elements that make up an FMIS, each with its own function. Some of them have to do with the accounting functions of the organization; others are concerned with planning, others analysis, and others reporting. The following are the main elements you will find in most financial management information systems:

- The general ledger.
- The accounts payable.

- The accounts receivable.
- A budgetary accounting module.
- A payroll system.
- A procurement module.
- A project ledger module.
- An asset module.

### 7.7.3 Advantages of a Financial Management Information System

#### Faster decision-making process

The information provided by the financial management information system has some important qualities: It is timely, reliable, accurate, and verifiable. That makes it much easier and faster to make decisions. Because of the financial reporting capabilities of the financial management information system, it helps the management of the business to evaluate the economic advantages and disadvantages of various business strategies they are trying out. This brings about more certainty to the implementation of business strategies and decisions.

#### Helps in planning

Having an FMIS system implemented increases your capacity to schedule and forecast. With that capability, the process of allocating financial resources become much more effective, and the targets set become more realistic. Capacity to plan realistically allows you to achieve your goals much faster.

#### More efficient business

With a financial management information system, your business stands a chance to become much more efficient. The system gives you all the information and control you need to prevent the misuse of the business's financial resources while giving you the ability to mitigate potential risks that you cannot foresee. Because of its reporting capabilities, a financial management information system also allows you to use past performance to inform your current as well as future strategies.

#### Competitive advantage

With a financial management information system, your business will have a competitive advantage over other businesses. An FMIS is simply a way to bring more productivity to the business and more satisfaction to the customer. The business will be able to see everything that is going on in a financial sense and respond in a timely manner to remain a step ahead of its competitors at all times.

#### Integration

With a financial management information system, the process of integration becomes much easier. The functions and resources of the business can all be controlled within a single system. This makes it easier and faster to process transactions and convey financial information. Redundant activities are eliminated, and shared services are centralized to save on operational costs. The end result is a more efficient business with a more robust bottom line.

## 7.8 Enterprise Resource Planning (ERP)

Enterprise Resource Planning (ERP) systems help unleash the true potential of companies by integrating business and management processes. It is an integrated, real-time, cross-functional enterprise application, an enterprise-wide transaction framework that supports all the internal business processes of a company. The central feature of all ERP systems is a shared database that supports multiple functions used by different business units such as sales order processing, inventory management and control, production and distribution planning, and finance. In practice, this means that employees in different divisions—for example, accounting and sales—can rely on the same information for their specific needs.



Fig. 7.8.1 : ERP system

### 7.8.1 History

The term ERP was coined in 1990 by Gartner, but its roots date to the 1960s. Back then, the concept applied to inventory management and control in the manufacturing sector. Software engineers created programs to monitor inventory, reconcile balances, and report on status. By the 1970s, this had evolved into Material Requirements Planning (MRP) systems for scheduling production processes.

In the 1980s, MRP grew to encompass more manufacturing processes, prompting many to call it MRP-II or Manufacturing Resource Planning. By 1990, these systems had expanded beyond inventory control and other operational processes to other back-office functions like accounting and human resources, setting the stage for ERP as we've come to know it.

### 7.8.2 Need 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

### 7.8.3 Features of ERP

The following are the features of ERP –

- Accommodating variety
- Seamless integration
- Resource management
- Integrated management information
- Supply chain management
- Integrated data model

### 7.8.4 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.

### 7.8.5 Advantages and Disadvantages of ERP

#### Advantages

- Reduce your overhead costs by folding a number of business tools and applications into one system
- Cause individual operations/departments (warehouse, accounting, HR, etc.) to work faster
- Automate specific processes that would otherwise require manpower to complete
- Improve business data analytics for better, more accurate and actionable insights
- Positively impact customer relationships by being an overall faster, more efficient company to work with
- Be customized to focus on the aspects of your business that are most aligned with your current goals and needs

#### Disadvantages

- Expensive and time consuming in implementation
- Difficulty in integration with other system

Risk of implementation failure

Difficulty in implementing changes

Risk in using one vendor

## 7.8.6 Benefits of Implementing ERP Software for an Organization

### Organizations become more competitive

It's a fact that ERP software requires a major investment, but there's also an even bigger cost in not making the investment. While some manufacturers choose to stick to the tried and true traditional methods, others seek technological solutions. Manufacturers cannot afford to put off an ERP package implementation while their competition invests in ERP and starts achieving the many benefits we'll touch on below.

### Efficiency improves

An ERP solution eliminates many repetitive processes and greatly reduces the need to manually enter information. This system will also streamline business processes and make it easier and more efficient for companies to collect data, no matter what department they're working in.

### Better forecasting

Enterprise resource planning software gives to users, and especially managers, the tools they need to create more accurate forecasts in business activities. The information within ERP is as accurate as possible. Businesses can make realistic estimates and more effective forecasts.

### Collaboration in the organizational functions

Nobody wants to run a business with each department functioning separate from the other. Collaboration between departments is a crucial task and often necessary part of the business processes. With the data entered into ERP systems being centralized and consistent, there is no reason why departments cannot work together. The ERP package also touches on almost every aspect of a business, thus naturally encouraging collaborative efforts.

### Scalability improves

A structured ERP system allows the addition of new users and functions to grow the initially implemented solution over time. When your business is ready to grow or needs extra resources, enterprise resource planning software should be able to facilitate that growth.

### Integrated information

No more issues with data spread across separate servers; all information will be housed at a single location. We can integrate platforms like CRM software with the ERP system, keeping data consistent, accurate, and unique. ERP facilitates know your customer, their orders, and your inventory, all in one place.

### Cost Savings

With one source of accurate, real-time information, ERP software reduces operational costs. It allows manufacturers to proactively manage its operations, preventing disruptions, delays and breaking up of information.

### 7.8.7 Types of ERP Architecture

Currently ERP systems are divided into two categories: **monolithic** and **postmodern**. Each type has its own characteristics and different levels of flexibility.

#### Monolithic systems

These systems have all the needed business management tools in one suite or application. They are developed with a single tech stack and by a single vendor. This way, users always know whom to contact if there's any performance issue. So despite their implementation cost, traditional systems were able to find their customers, gaining a significant market share.

But nowadays business owners have no interest in monolithic ERP systems that seem complex and are not flexible to business changes. In addition, small companies cannot afford to replace the whole ERP suite with each new process update as the system requires.

#### Postmodern suites

Postmodern suites are more simple and user-friendly, compared to their predecessors. They are agile and do not contain lots of redundant tables and other complex solutions that were required for scalability in monolithic systems. And unlike traditional systems, postmodern ERPs are based on a few applications, not a single suite.

They do have core ERP modules, but they can be easily extended with external solutions. For example, basic modules would cover financial and order management, while additional solutions can help with HR or service quality management. Postmodern suites are moving with the times so they are driven by social media, mobile trends and cloud-based solutions.

### 7.8.8 ERP Software Examples

#### SAP ERP

SAP SE is the largest European software enterprise based in Germany, and its most popular product is SAP ERP software. The system collects and combines data from various modules and ensures accurate enterprise resource planning. Its main modules include financial and asset accounting, QA management, HR management, product planning and many other. It's also possible to customize the ERP suite according to the business needs of a company.

#### Infor LN

Infor is an enterprise software company with headquarters in New York, the USA. Their InforLN ERP solution is designed to automate business processes in companies working with high-tech manufacturing as well as with complex logistics systems.

Main modules include financials, HR management, purchasing management, inventory and manufacturing management, QA management, product technology, etc. Customization is also allowed.

#### Oracle ERP Cloud

Oracle Corporation (USA) is famous for its CRM solutions and flagship Oracle database. But their ERP systems also play an important role in the company's success. Oracle Enterprise Resource Planning Cloud is used for finance, project management, risk management, procurement, and other everyday business activities. The system has cloud ERP architecture and can be easily customized.

## 7.9 System Development Life Cycle (SDLC)

The **systems development life cycle**, also referred to as the **application development life-cycle**, is a term used in systems engineering, information systems and software engineering to describe a process for planning, creating, testing, and deploying an information system. The systems development lifecycle concept applies to a range of hardware and software configurations, as a system can be composed of hardware only, software only, or a combination of both.

### 7.9.1 The Seven Phases of the System-Development Life Cycle

#### 1. Planning

This is the first phase in the systems development process. It identifies whether or not there is a need for a new system to achieve a business's strategic objectives. The purpose of this step is to find out the scope of the problem and determine solutions. Resources, costs, time, benefits and other items should be considered at this stage.

#### 2. Systems analysis and requirements

The second phase is where businesses will work on the source of their problem or the need for a change. In the event of a problem, possible solutions are submitted and analyzed to identify the best fit for the ultimate goal(s) of the project. This is where teams consider the functional requirements of the project or solution. It is also where system analysis takes place. Systems analysis is vital in determining what a business's needs are, as well as how they can be met, who will be responsible for individual pieces of the project, and what sort of timeline should be expected.

#### 3. Systems design

The third phase describes, in detail, the necessary specifications, features and operations that will satisfy the functional requirements of the proposed system which will be in place. This is the step for end users to discuss and determine their specific business information needs for the proposed system. It's during this phase that they will consider the essential components (hardware and/or software) structure (networking capabilities), processing and procedures for the system to accomplish its objectives.

#### 4. Development

The fourth phase is when the real work begins when a programmer, network engineer and/or database developer are brought on to do the major work on the project. This work includes using a flow chart to ensure that the process of the system is properly organized. The development phase marks the end of the initial section of the process. Additionally, this phase signifies the start of production. The development stage is also characterized by instillation and change.

#### 5. Integration and testing

The fifth phase involves systems integration and system testing carried out by a Quality Assurance (QA) professional to determine if the proposed design meets the initial set of business goals. Testing may be repeated, specifically to check for errors, bugs and interoperability. This testing will be performed until the end user finds it acceptable. Another part of this phase is verification and validation, both of which will help ensure the program's successful completion.

## 6. Implementation

The sixth phase is when the majority of the code for the program is written. Additionally, this phase involves the actual installation of the newly-developed system. This step puts the project into production by moving the data and components from the old system and placing them in the new system via a direct cutover. Both system analysts and end-users should now see the realization of the project that has implemented changes.

## 7. Operations and maintenance

The seventh and final phase involves maintenance and regular required updates. This step is when end users can fine-tune the system, if they wish, to boost performance, add new capabilities or meet additional user requirements.

### 7.9.2 SDLC Models

#### Waterfall SDLC Model

Waterfall – is a cascade SDLC model, in which development process looks like the flow, moving step by step through the phases of analysis, projecting, realization, testing, implementation, and support. This SDLC model includes gradual execution of every stage completely. This process is strictly documented and predefined with features expected to every phase of this software development life cycle model.

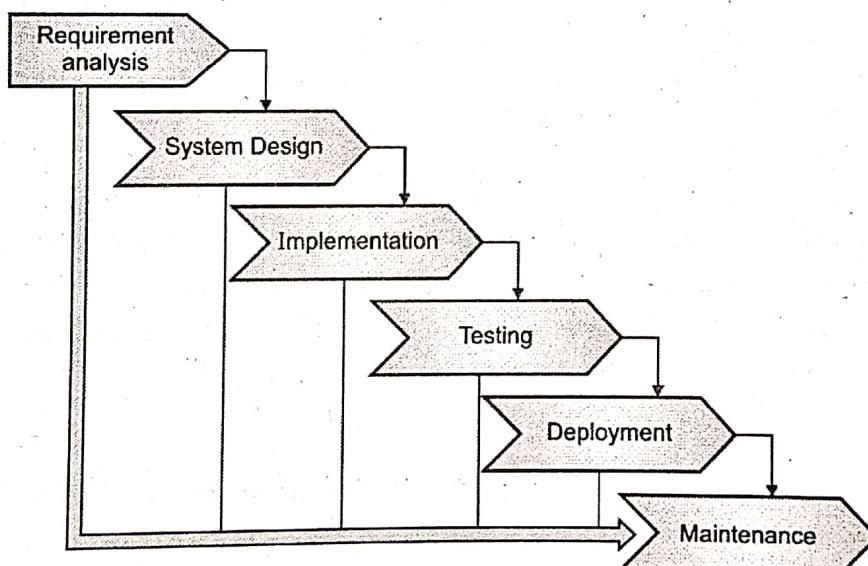


Fig. 7.9.1. : Waterfall SDLC model

#### Advantages

- Simple to use and understand
- Management simplicity thanks to its rigidity: every phase has a defined result and process review
- Development stages go one by one

#### Disadvantages

- The software is ready only after the last stage is over
- High risks and uncertainty
- Not the best choice for complex and object-oriented projects

## Iterative SDLC Model

The Iterative SDLC model does not need the full list of requirements before the project starts. The development process may start with the requirements to the functional part, which can be expanded later. The process is repetitive, allowing to make new versions of the product for every cycle. Every iteration (which last from two to six weeks) includes the development of a separate component of the system, and after that, this component is added to the functional developed earlier. Speaking with math terminology, the iterative model is a realization of the sequential approximation method; that means a gradual closeness to the planned final product shape.

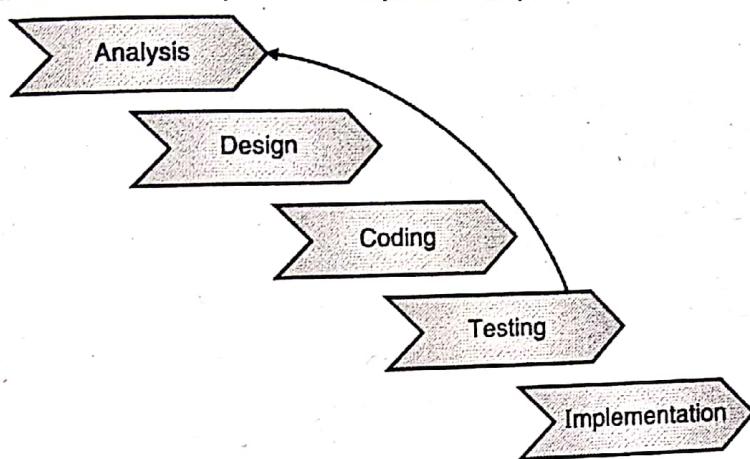


Fig. 7.9.2. : Iterative SDLC model

### Advantages

- Some functions can be quickly developed at the beginning of the development lifecycle
- The paralleled development can be applied
- The progress is easily measurable

### Disadvantages

- Iterative model requires more resources than the waterfall model
- Constant management is required
- Issues with architecture or design may occur because not all the requirements are foreseen during the short planning stage

## Spiral SDLC Model

Spiral model – is SDLC model, which combines architecture and prototyping by stages. It is a combination of the iterative and waterfall SDLC models with the significant accent on the risk analysis. The main issue of the spiral model – is defining the right moment to make a step into the next stage. The preliminary set time frames are recommended as the solution to this issue. The shift to the next stage is done according to the plan, even if the work on the previous stage isn't done yet. The plan is introduced basing on the statistic data, received during the previous projects even from the personal developer's experience.

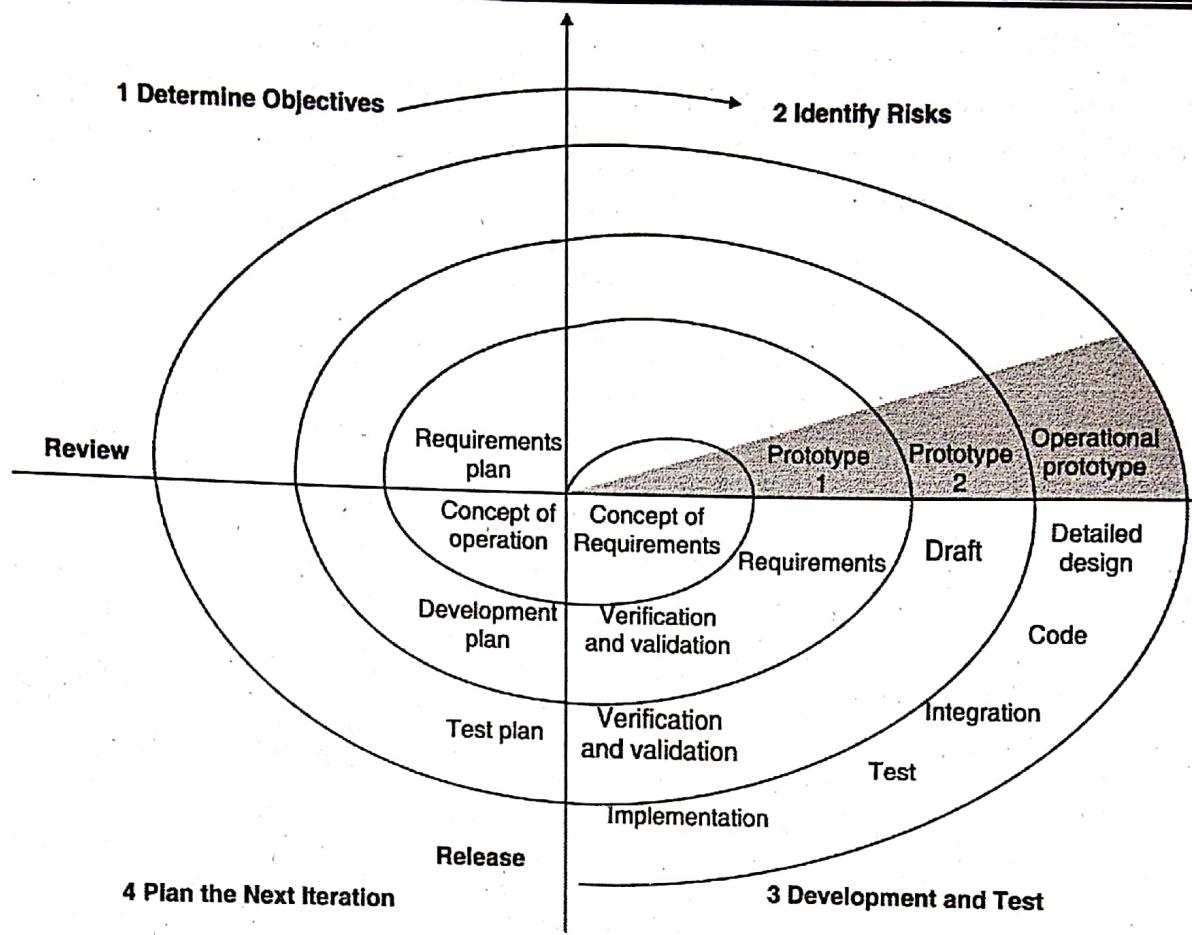


Fig. 7.9.3. : Spiral SDLC model

### Advantages

- Lifecycle is divided into small parts, and if the risk concentration is higher, the phase can be finished earlier to address the treats.
- The development process is precisely documented yet scalable to the changes.
- The scalability allows to make changes and add new functionality even at the relatively late stages.

### Disadvantages

- Can be quite expensive
- The risk control demands involvement of highly-skilled professionals.
- Can be ineffective for small projects

### V-shaped SDLC Model

V-shaped SDLC model is an expansion of classic waterfall model and it's based on associated test stage for every development stage. This is a very strict model and the next stage is started only after the previous phase. This is also called "validation and verification" model. Every stage has the current process control, to make sure that the conversion to the next stage is possible.

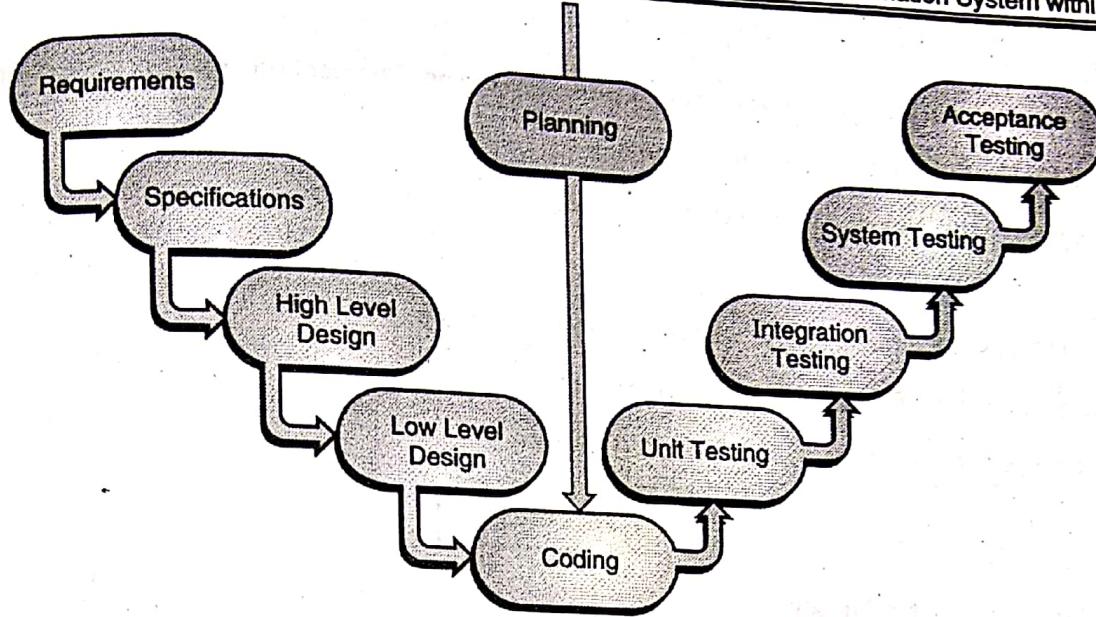


Fig. 7.9.4. : V-shaped SDLC model

#### Advantages

- Every stage of V-shaped model has strict results so it's easy to control
- Testing and verification take place in the early stages
- Good for the small projects, where requirements are static and clear

#### Disadvantages

- Lack of the flexibility
- Bad choice for the small projects
- Relatively big risks

#### Agile SDLC Model

In the agile methodology after every development iteration, the customer is able to see the result and understand if he is satisfied with it or he is not. This is one of the advantages of the agile software development life cycle model. One of its disadvantages is that with the absence of defined requirements it is difficult to estimate the resources and development cost. Extreme programming is one of the practical use of the agile model. The basis of such model consists of short weekly meetings – Sprints which are the part of the Scrum approach.

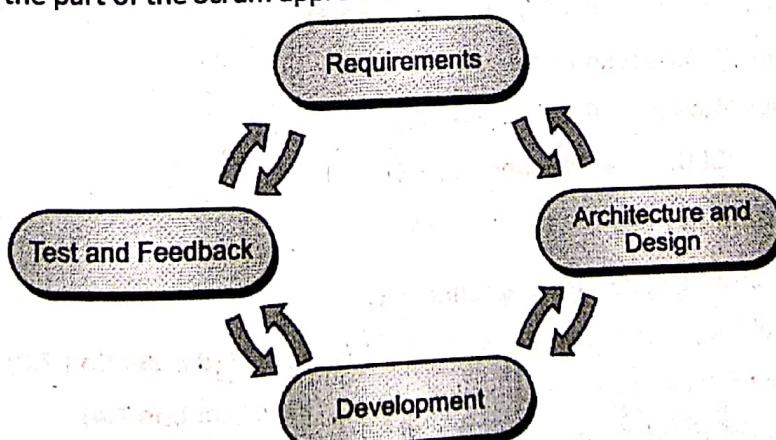


Fig. 7.9.5. : Agile SDLC model

**Advantages**

- Corrections of functional requirements are implemented into the development process to provide competitiveness
- Project is divided by short and transparent iterations
- Risks are minimized thanks to the flexible change process

**Disadvantages**

- Difficulties with measuring the final cost because of permanent changes
- The team should be highly professional and client-oriented.
- New requirements may conflict with the existing architecture.

**Exercises****Answer the following question in short**

- Q. What is a transaction? Give an example. (Refer section 7.1)
- Q. Define a transaction processing system. (Refer section 7.1)
- Q. What is ACID? Explain. (Refer section 7.1)
- Q. What are the functions of Transaction Processing systems? (Refer section 7.1)
- Q. What is marketing information system? (Refer section 7.3)
- Q. What is the use of information system in manufacturing? (Refer section 7.4)
- Q. Define HR information system. (Refer section 7.5)
- Q. How does HRIS help in office automation? (Refer section 7.5)
- Q. Explain the role played by HRIS in training. (Refer section 7.5)
- Q. What is the role of financial management system? (Refer section 7.7)
- Q. What are the building blocks of financial management system? (Refer section 7.17)
- Q. Describe the role of financial management system in bringing competitive advantage. (Refer section 7.7)
- Q. What is ERP? (Refer section 7.8)
- Q. What are the needs of HRP in an organization? (Refer section 7.8)
- Q. State the features of ERP. (Refer section 7.8)
- Q. State any four advantages of ERP. (Refer section 7.8)
- Q. How does ERP save cost of an organization? (Refer section 7.8)
- Q. What is monolithic system? (Refer section 7.8)
- Q. Define system development lifecycle. (Refer section 7.9)
- Q. Describe waterfall model of SDLC. (Refer section 7.9)

**Answer the following question in long**

- Q. Explain the transaction processing cycle. (Refer section 7.1)
- Q. What are the advantages of information system in marketing? Explain. (Refer section 7.3)
- Q. Discuss the applications of information system in manufacturing. (Refer section 7.4)
- Q. What are the advantages of HRIS in HR management? Explain. (Refer section 7.5)

- o Discuss the role of information system in accounting. (Refer section 7.6)
- o Explain the advantages of financial management information system. (Refer section 7.7)
- o What are the benefits of implementing ERP in an organization? (Refer section 7.8)
- o Describe the phases of system development lifecycle. (Refer section 7.9)

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