

MODULE 1**CHAPTER 1****Introduction to Information Systems****University Prescribed Syllabus**

Introduction To Information Systems : Computer based Information Systems, Impact of IT on Organizations, Impact of IS to Society, Organizational Strategy, Competitive Advantages and IS

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► 1.1 COMPUTER BASED INFORMATION SYSTEMS

UQ. What is information system? Explain the necessary element with neat diagram?

(MU - Q. 1(a), Dec. 19, 5 Marks)

- Today, managing information for organizations has become a very crucial task. Also, dependency of organizations on the information systems that handle this information is even higher.
- In the past decades, organizations were using information systems to manage data processing and record keeping activities associated with maintaining business transactions, payroll, billing, inventory management, etc.
- The focus was mainly on maintaining files and databases related to routine business operations. But today, these information systems are gaining great strategic importance within the business organisations.
- They are helping organizations in making complex decisions, planning strategies to accomplish organizational goals and building a competitive advantage in the market.
- Although owning and maintaining these systems is quite expensive, but the business operations cannot function without the support of these various functional area information systems.
- Information technology (IT) and Information systems (IS) are used by organizations to enhance their performance.
- Also one of the very important types of information systems within modern organisations for managing information resources i.e the Management Information Systems (MIS) play a very significant role.
- These days every modern business organization has a MIS department for managing and sharing of information resources to the end users. These end users could be anyone like the executive or top level managers using the information generated for some strategic planning process.
- So, let us first start with what is information.
- From the point of view of Information Systems it is necessary to understand the difference between data, information and knowledge although they sound quite similar.
 1. **Data** is an unorganized elementary item which alone cannot convey any meaning. Data can be anything like numbers, letters, figures etc. Suppose we consider few numbers like Rs.100000, Rs.50000, Rs.75000 and names such as Arti, Mahesh, and Geeta. This can be said to be some data which is not conveying any meaning.
 2. **Information** refers to an organized and meaningful data. Any information must satisfy characteristics such as completeness, conciseness, correctness and unambiguity. Now suppose we relate the above numbers with the names, we can convey some meaningful information. Say, Rs.100000 is the monthly sales target achieved by Arti, Rs.50000 by Mahesh and Rs. 75000 by Geeta who is working in a particular firm.

- 3. **Knowledge** is processed and well structured information that can be used for analysis, accumulated learning, expertise and decision making to solve any business problem. Continuing with the same example, based on the accumulated knowledge of monthly sales target achieved by its employees the firm may take up a decision on the percentage of incentives to be given to Arti, Mahesh and Geeta.
- An **information system** is a set of organized and interrelated components that work collectively to collect, store, process and disseminate information for a specific purpose, like to support decision making, coordination, control, analysis, and visualization in an organization.

1.1.1 Role of Information Systems in Organizations

- As already stated that every organization wants to be a market leader and to achieve this they are adopting various strategies.
- One such strategy is the adoption of information systems that could enable them to make adequate use of organizational information and improve the efficiency of business processes.

The three primary roles that information systems play in an organization are:

- | | |
|--------------------------------------|-------------------------------|
| (1) Information Storage and Analysis | (2) Assist in Decision Making |
| (3) Assist with Business Processes | |

- (1) **Information Storage and Analysis** : Modern information systems can integrate data from various internal and external sources and keep the user updated with the most relevant information. By adopting information systems such as database management systems, organizations can make use of databases that store all the organizations data at one place. Such systems provide timely and updated information to the user.
- (2) **Assist in Decision Making** : The most important role of information systems is the assistance that they provide in analysing and evaluating information for decision making process and for further formulating strategic plans for the business organization.
- (3) **Assist with Business Processes** : Information systems can be used in developing various value added systems. Integrating the information system with the various business processes simplifies and helps reduce the number of activities and invariably the time spent on these activities. Repetitive tasks are totally eliminated from the system and greater accuracy is provided. Also, information systems ensure that access is provided to only authorised employees. These systems play a very critical role in project management as they facilitate effective monitoring and control as well as comparison with standards. However, the entire capacity of such systems needs to be harnessed to gain maximum benefits from the company's information systems.

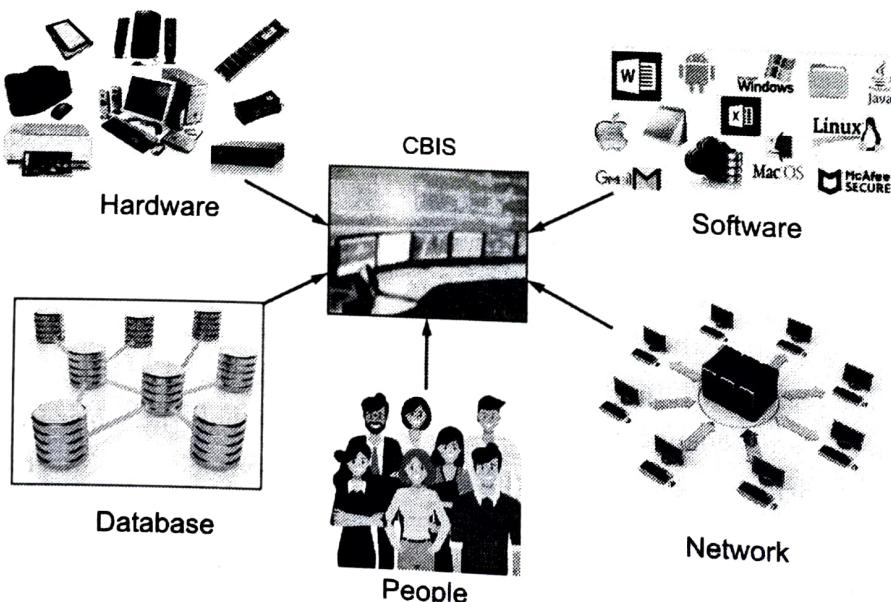
1.1.2 Computer Based Information Systems (CBIS)

CBIS are those that make use of computer technology to perform some dedicated task.

The essential elements / components of a CBIS are:

- (a) **Hardware** : All the physical components including devices such as monitors, CPUs, printers etc. which handle information in one way or the other belong to this category. These hardware components enable input, processing and output of information.
- (b) **Software** : These are not physical but logical components that facilitate the processing of information with the help of hardware components. It can be a simple program to calculate leaves availed by an employee in a month or a complex software application to generate payroll of all employees within an organization.
- (c) **Database** : This component deals with the storage of information. The information can be stored in any form as in simple files or relational tables.
- (d) **Communication Networks** : The communication network helps to share information between the various hardware and software components of a CBIS. It includes all the communication media either wired e.g. twisted copper wires or wireless e.g. bluetooth, Wi-Fi etc.
- (e) **Business Procedures**: Business procedures define the policies to make efficient use of the information available as aligned to the business objectives. Business procedures could be related to any business process within an organization like manufacturing, inventory, human resources etc.
- (f) **People** : They are the ones playing various roles, performing different responsibilities for producing, maintaining and consuming the information.

Fig. 1.1.2 illustrates how these basic components interact to form an organized computer based information system.



(1A1)Fig. 1.1.2 : Elements of Computer based Information Systems

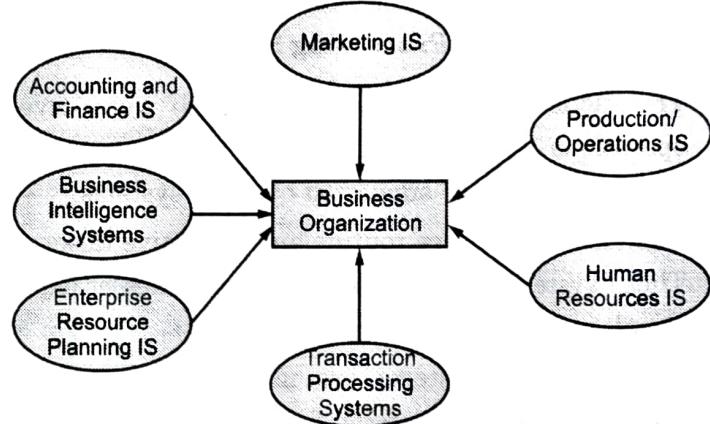
Information systems need not always be computer based but with reference to the subject, Information system and Computer based Information systems have been used interchangeably.

1.1.3 Types of Information Systems or Types of Computer based Information Systems

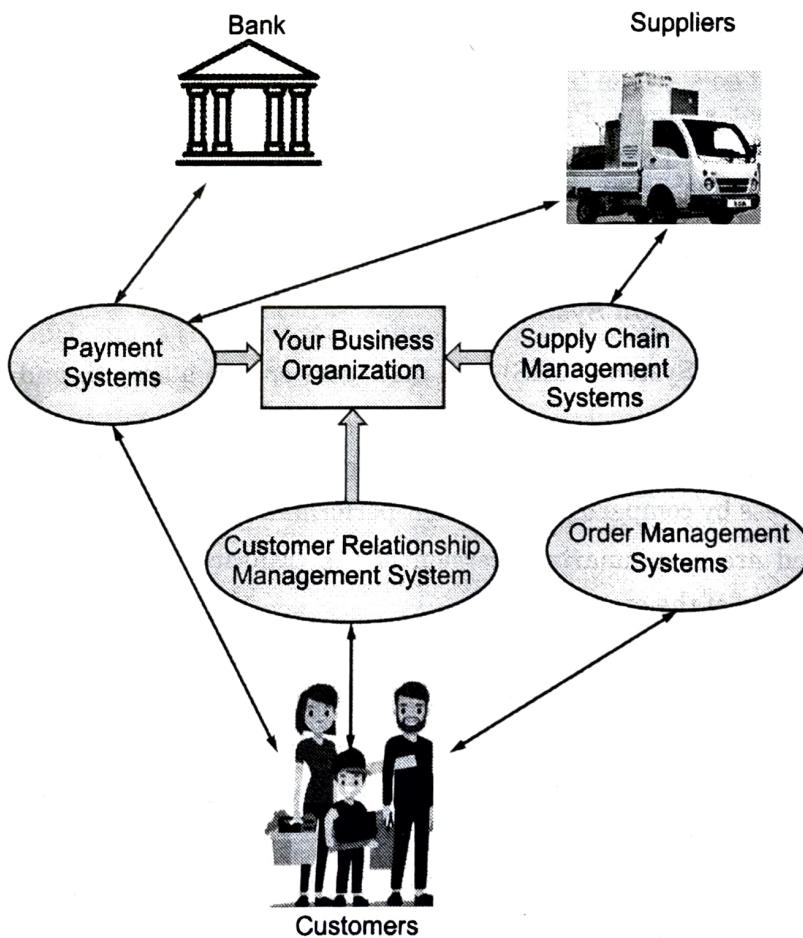
- UQ.** List the types of Information system? Explain in brief. **(MU - Q. 2(a), Dec. 19, 10 Marks)**
- UQ.** With a neat diagram explain the various types of Information Systems. **(MU - Q.2(c) Jan. 21, 5 Marks)**

Information systems have been designed to serve various functional areas. Business organizations deploy various types of Information Systems.

There can be information systems that operate *within* an organization or those which function among multiple organizations. Both the types of Information systems are illustrated in Fig. 1.1.3(a) and 1.1.3(b) respectively.



(1A2)Fig. 1.1.3(a) : Information Systems within a business organization



(1A3)Fig. 1.1.3(b) : Information Systems among different business organizations

The very common and important types of Information systems are listed below.

- | | |
|---|--|
| 1. Transaction Processing Systems (TPS) | 2. Management Information Systems (MIS) |
| 3. Decision Support Systems (DSS) | 4. Executive's Information Systems (EIS) |
| 5. Enterprise Resource Planning (ERP) Systems | |

We will study the important information systems in the next section.

► **1. Transaction Processing Systems**

- Transaction processing systems (TPS) were developed to gather, process and store the daily operations within an organization. They are very important to the organization because all the core operations are supported by these systems.
- The transactions are routine and repetitive tasks which are handled in large volumes by the TPS. These systems manage very large volumes of transactions without any errors, even if they occur simultaneously.
- Usually these systems are used by managers or supervisors at the operational level. The operations are well defined for any particular business process may it be an order processing task or a ticket booking activity or for that matter any other routine job.
- These systems require very complete and thorough information for processing the transactions accurately.
- Inventory management systems, Payroll systems, Airline reservation systems, Online shopping systems are all examples of Transaction Processing System.
- These systems are very essential to keep the regular business operations going on. But such systems cannot support any decision making.

► **2. Management Information Systems**

- Management Information Systems (MIS) help managers ensure a smooth and efficient running of the organization.
- These systems collect information and generate reports regularly which help managers to evaluate the company's progress by comparing the current performance with previous performances.
- The reports created are a summarized version of the transactional data generated in different functional departments of the organization.
- Stating clearly, MIS gather information from transaction processing systems and also from various other external sources such as competitor sales information for similar products.
- Say for example reports such as daily, monthly or annual regionwise sales report for a particular product sold can be generated by such systems based on which managers can evaluate and decide whether the desired sales was achieved or not.
- Thus, MIS are the base for data analysis and further decision making. Such systems are mainly used at tactical level of decision making for management.

- MIS generally provide answers to routine questions that have been specified in advance and have a predefined procedure for answering them.
- These systems have very little analytical ability but can very well provide answers to routine queries which can be solved by comparison procedures predefined in these systems.
- Almost all MIS provide functions to perform comparisons and generate summarized reports in contrast to systems that implement complex statistical and analytical techniques.

► 3. Decision Support Systems

- Decision Support Systems (DSS) also commonly known as Business Intelligence Systems because they emphasize on helping managers make intelligent business decisions.
- DSS have the capability to perform complex analysis on organizational information that no other type of information system can perform.
- The main purpose of these systems is to support decisions to problems that are rapidly changing, and cannot be pre specified. DSS support decision making for managers at both tactical and strategic management level.
- The DSS are user friendly softwares that take input as data from different sources such as the transactional systems, from management information systems and from other external sources such as competitor prices of similar products or stock prices from stock markets etc.
- And then they perform various statistical and mathematical analysis on this input data or at least convert them into a form that will make decision maker's task easier.

The basic components of a decision support system are:

1. **User interface** through which users interact with the system (for entering inputs or displaying analysis results),
 2. **Database** which stores the necessary values of variables/parameters required for analysis (for e.g.: value of sales figures for a particular product),
 3. **DSS/Knowledge model** which specifies relationships between variables and/or parameters, performs what-if analysis, provides alternate solutions and stores the predictions.
- What-If Analysis is a technique to analyse different parameters and their values to determine various possible outcomes, make predictions and take decisions.
 - For example, suppose a bank loan manager wants to take up a decision whether to sanction loan to a loan applicant. After verifying various parameters like applicant's credit history, income level, assets possessed ,the manager can decide whether to offer him loan or not.DSS play a very important role in making such decisions
 - Another example, where DSS (Decision Support System) are used is Amazon where customers are given a chance to choose products from a best selling product list which is displayed on the home page.

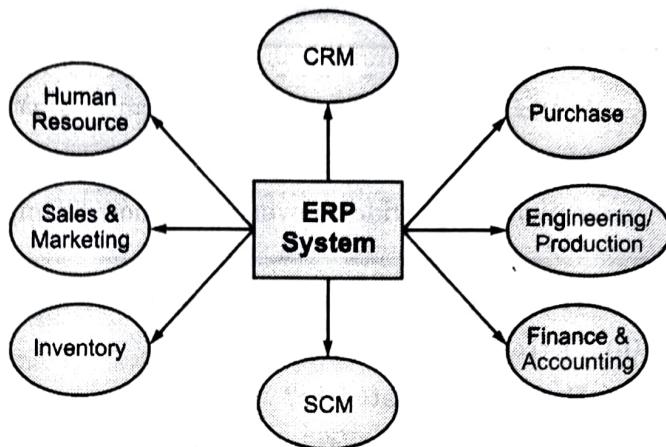
► **4. Executive's Information Systems**

- Executive's Information Systems (EIS) sometimes also called as Executive's Support System (ESS).
- They are specialized form of Decision Support Systems or they are integrated along with DSS and are specially designed for senior managers at strategic levels for decision making.
- These systems consist of interactive graphical display, easy-to-use interfaces with menus to access historical data from internal as well as external sources.
- ESS is basically a reporting tool that has well-built reporting and drill-down capabilities to convert an organization's data into meaningful summarized reports.
- These reports are used by top level managers for quick access to information coming from all company levels and departments such as billing, cost accounting, staffing, scheduling, and sometimes even from external sources.
- Apart from fast access to organized data from different functional departments there are some systems that also provide analysis for predicting performance outcomes and quick access to statistics required for decision-making.
- Say for example, an ESS is a portal which uses a Web interface that can present to a senior manager a timely view of the organisation's financial performance as calculated by working capital, accounts receivable, accounts payable, cash flow, and inventory.
- These systems track critical data, sort and filter, compress, expand and display the data of utmost significance to senior managers.

► **5. Enterprise Resource Planning Systems**

- Enterprise Resource Planning (ERP) software integrates the various business functions into one complete system to streamline processes and information across the entire organization.
- A central repository or a database shared by different business units is an important feature of ERP systems. ERP systems and TPS both function within an organization. Almost all ERPs are TPSs but it is not necessary that all TPSs are ERPs.
- These are business softwares that are used to manage all the resources of the entire enterprise. Everything from a small IC brought into the company to the employee payments, everything can be managed and tracked by using ERP Systems.
- By employing such systems, employees from different departments who require same information—for example, accounting department and sales department – can easily access it from a central place. Or suppose both Sales and Marketing department as well as Customer relationship department need customer information. In that case both can access the same central database of customers to get the required information.
- Many vendors in the market provide packaged ERP solutions where technologies used may be different but the basic modules within every ERP system remain the same.
- And further based on the organization's requirements the systems can also be customized. The basic modules found in an ERP system are as depicted in **Fig. 1.1.4.**

- (a) Human Resource
- (b) Sales & Marketing
- (c) Inventory
- (d) Purchase
- (e) Engineering / Production
- (f) Finance & Accounting
- (g) Customer Relationship Management (CRM)
- (h) Supply Chain Management (SCM)



(14)Fig. 1.1.4 : ERP Systems

- Every component within an ERP software supports a dedicated business process within the business organization. Thus the major objectives of an ERP system are to improve the overall efficiency and accuracy of all business processes by integrating them together into a single package.
- All the business processes are streamlined thereby increasing the productivity. Also, such systems lead to reduction of operational and administrative costs and increased profits.

Few other systems that support the employees within an organization are discussed below

1. **Office automation systems** support the lower and middle level managers in creating documents, scheduling meetings, communication between employees etc. Systems which support these tasks include word processing systems, electronic calendars, e-mails, videoconferencing systems, instant messaging systems etc.
 2. **Functional area information systems** support middle level managers within a specific department for collecting data and generating regular reports.
 3. **Business intelligence (BI) systems** support data analysis and knowledge discovery through data warehousing and mining techniques, to support more effective strategic, tactical, and operational decisions.
 4. **Expert systems (ESs)** provide expert advice and assist in the decision making process by providing valuable insight into the specific area. Say for example navigation systems provide expert advice in the best route to be selected while travelling.
- **Interorganizational systems** include systems such as **Supply Chain Management systems** that manage and control the entire supply chain of an organization right from procurement of raw materials to delivery of finished products. The supply of digital content could be through the internet and physical products through physical medium.
 - Another type of interorganizational information systems are the **Electronic commerce (e-commerce) systems** which make use of electronic medium such as the internet to perform commerce i.e. buying and selling of goods and services.

► 1.2 IMPACT OF INFORMATION TECHNOLOGY (IT) ON ORGANIZATION

UQ. What is the impact of information system on organization and society. (MU - Q. 2(d), Jan. 21, 5 Marks)

In this section, we provide an overview of how IT impacts the business organizations.

- (a) IT reduces number of middle managers and experts
- (b) IT transforms the manager's job
- (c) Does IT eliminate jobs?
- (d) IT impacts the lifestyle of employees at work

► (a) IT reduces number of middle managers and experts

With the advent of Information Technology and most of the tasks within a business organization being automated using various types of Information systems, it increases the work efficiency and productivity of one single manager thereby reducing the need and number of middle level managers to handle the same amount of workload.

► (b) IT transforms the manager's job

- Decision making being one of the important tasks of managers, increased use of information systems such as Management Information systems and Decision Support Systems has made the decision making process more easy, faster and accurate.
- With so much of real time information available from different sources, analyzing and evaluating this information and taking decision is a very difficult task. But managers take up support of such IT tools to make their tasks simpler.

► (c) Does IT eliminate jobs?

- To achieve competitive advantage, the use of IT by organizations is increasing rapidly which is resulting in replacement of people by machines. Nevertheless, it is giving scope to opening of new job opportunities.
- New classes of jobs such as data scientists and analysts are introduced where people with enhanced IT skills are required.

► (d) IT impacts the lifestyle of employees at work

- IT has a negative impact on employees' health as the employee is continuously under job stress. He needs to be constantly updated with new technologies in market. The prolonged use of computer screens, keyboards and mouse also affect the vision and muscles of hands and finger and also leads to back problems.

- On the other side, IT has developed various capabilities for people with disabilities such as speech recognition systems for employees who are physically impaired and cannot type on their own, for employees who are visually impaired there are audible screen tips made available.

In this way IT impacts both positively and negatively to employees at work within an organization.

► 1.3 IMPACT OF IS TO SOCIETY

Here we discuss how IT affects the society as a whole.

☞ (A) IT affects our Quality of Life

- IT has drastically changed the way we think, live and work. The boundaries between work time and free time are overlapping.
- The use of portable devices such as Laptops and Smartphones makes it easier to access text, email and voice communications from anywhere at any time.
- Employees carry their laptops and smartphones at home or even when on vacation to keep the office work undisturbed.
- It has become a 24×7 job rather than traditional 9 to 5 job but with flexibility and convenience of work time and work place. Many employees avail work from home facility rather than physically travelling to the workplace wasting long hours in traffic.

☞ (B) Robotic Revolution

- With the advent of IT, machines in the form of robots are performing the routine tasks of humans. Robots are used in Industry in performing different tasks like manufacturing, farming, healthcare and also at homes for cleaning homes and pools, washing clothes and utensils etc. Self-driven cars, drones are few other examples where robotic techniques are used.
- Mitra, the first humanoid robot is launched by Prime Minister Narendra Modi and Ivanka Trump, First Daughter of the President of the United States Donald Trump, at the Global Entrepreneurship Summit (GES) conference in 2018. It can be found floating in the corridors of the Canara Bank and PVR Cinemas in Bengaluru, chatting with the customers.
- Genrobotics a Kerala based startup company in joint venture with the Kerala Government deployed a **spider-shaped robot named “Bandicoot”** to clean sewers and manholes in the city.
- INDRO robot built in India is an autonomous and the tallest robot that was made inside a house with easily available low-cost material like aluminium, wood, cardboard, plastic etc. It can be used to perform simple tasks like entertainment, education and a few household works.

☞ (C) Improvements in Healthcare Industry

- IT has brought in much advancement in Healthcare Industry as well. There are different expert systems which have been developed using artificial intelligence and machine learning techniques for faster and better diagnosis of diseases.

- ICUs and NICUs in hospitals have specialised automated equipments such as pulse oximetry, temperature and blood pressure monitoring systems, heart rate monitoring systems etc. to observe conditions of critically ill patients.
- Radiologists are using machine vision techniques to improve their work.
- Different modern laboratory equipments are used for enhancing process of research and development of new advanced drugs.
- Even robots can be used to perform complex surgeries (Robotic Surgeries). Videoconferencing can be used by doctors for discussing complex cases.

► 1.4 ORGANIZATIONAL STRATEGY, COMPETITIVE ADVANTAGES AND IS

UQ. Discuss competitive advantage achieved in information systems.

(MU - Q. 2(a), Dec. 19, 10 Marks)

☛ 1.4.1 Concepts

1. **Competitive advantage** refers to the assets of an organization which make it strong enough to compete with its competitor in terms of cost, quality or speed. Information Systems can be strategic as they can provide competitive advantage if used in the right way.
2. The **Strategic information systems** make use of conventional information systems in an innovative way. They can be defined as information systems that create or enhance the company's competitive advantage or change the industry structure by fundamentally changing how business is conducted. Strategic Information systems can be any kind of information systems (such as TPS, MIS, DSS, EIS, ERP, etc.) that help an organization either gain a competitive advantage or reduce a competitive disadvantage or atleast meet the other strategic organizational objectives. Thus, any IS that has the capability to change the goals, business processes, organizational products, or environmental relationships to help an organization gain a competitive advantage or reduce a competitive disadvantage is a strategic IS (SIS). These SIS make use of information technology to build up products and services that provide an organization with strategic advantages over the competitors in the global market.
3. Organisations try to align their IS or IT strategies with their business strategies to achieve competitive benefits. **Organizational strategies** could include reducing overall transactional and operational costs, minimizing the errors in the work carried out and greater accuracy while carrying out business operations, developing high quality products and services, speeding up the data communications and information sharing, improving performance and productivity, and making the management tasks more efficient and effective.
4. **Business process reengineering (BPR)**, is an organizational strategy for redesigning and restructuring the business processes to make them more productive and profitable. Moreover, the support of such SIS enhances the manager's decision-making skills.

Strategic information systems must be built in such a way that they stand different from the competitors, are built on the strengths of the company and that cannot be easily copied. To satisfy these needs an organization faces lots of pressures that affect its functioning.

An intelligent organizational strategy should help the organization withstand those pressures and still make a position in the market. An effective strategy will be the one that combines both implementation of information systems and hardwork of employees to achieve competitive advantage.

❖ 1.4.2 Business Pressures Faced by Organizations

The environment surrounding a business is an integration of social, legal, political and economic factors within which the businesses conduct their operations. Any drastic change in these environmental factors tends to create business pressures on organizations.

The three major types of business pressures are (i) market, (ii) technology and (iii) societal pressures.

☞ Market Pressures

Market pressures are caused due to competitors, global economy and demanding customers.

- 1) **Globalization** : Globalization means the increasing interdependence of the world's economies, cultures, and populations, made possible due to cross-border trade in goods and services, technology, and flows of investment, people, and information. Some examples of globalization like Outsourcing, Insourcing, Off shoring facilitate organizations to connect, compute, communicate, collaborate, and compete anywhere in the global world.
- 2) **Powerful Customers** : As customers have wide variety of choices in the market and they have become very knowledgeable about the options available in the outside world, retaining the customers has become a major challenge. Customer relationship management is a key to maintaining the customer loyalty.
- 3) **Changing nature of workforce** : Information technology is giving opportunity for women, single parent, physically challenged to work and also work from home facility for employees, all which is making the nature of work quiet diversified.

☞ Technology Pressures

The next type of pressure is related to advancement in technology.

- 1) **Technological innovation** : There is continuous and faster deployment of competitive products in the market with upgraded features. So, a company has to always be on its toes to meet those technological changes.
- 2) **Information overload** : Due to Internet, vast amount of information on any particular topic, product or service is available. For the managers to make effective decisions they need to make use of search engines and advanced data mining tools to extract knowledge from the huge pools of information.

Societal / Political / Legal Pressures

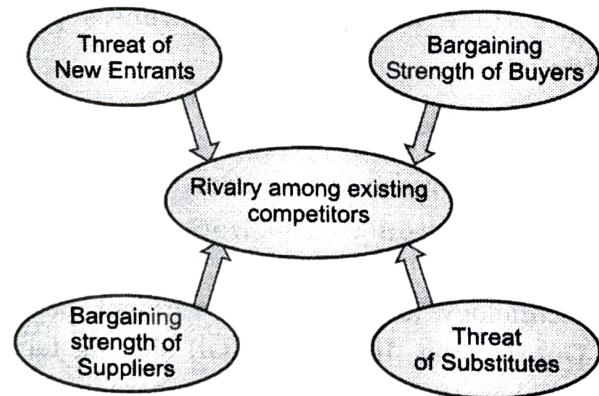
The third category of pressure includes government rules and regulations, society related issues etc.

- 1) **Social responsibilities :** As a responsibility organizations need to also spend time and/or money to tackle various social problems. Green IT revolution, ways to conserve energy, computer power management, use of solar energy to operate the equipments, carbon management are all initiatives taken by organizations as a social responsibility.
- 2) **Compliance with Government Regulations :** Organizations find abiding government laws as a major constraint because not following rules and regulations completely ,say by escaping from paying taxes, somehow intensifies competition. There are also many laws which the IT companies need to abide to, while buying IT products to disposing them off.

1.4.3 Porter's Five Forces Model

As shown in Fig. 1.4.3. Porter's five forces model is a strategic model put forward by Michael Porter.

This model provides an outline for evaluating the strengths and weaknesses as well as competitive position of a company in the market.



(1A5)Fig. 1.4.3 : Porter's Five Forces Model

1. **The threat of new entrants.** The fear that new competitors will enter the market is high when making the entry is effortless whereas it is low when there are considerable barriers to the entry. We can consider entry barriers as the outstanding characteristics of products or services owned by the organization and which is difficult for the competitor to achieve.
2. **The bargaining strength of suppliers.** The strength of suppliers is high when the buyers have very limited options from whom to buy and it is low when buyers have various alternative options of sellers. Therefore, having more number of suppliers will make the position of the organisation powerful when negotiating on prices, quality, and delivery terms.
3. **The bargaining strength of customers or buyers.** In the same way as suppliers have bargaining power even the buyer position can be stronger if buyers have several choices from whom to buy and low when buyers have very little choices.
4. **The threat of substitute products or services.** If there are many substitute products or services available in market to an organization's products or services, then the threat of substitutes is high. If there are few alternatives in the market, then the threat is low.

- 5. The rivalry among existing firms in the industry.** The threat from rivals to an organisation is high when there is powerful competition among many firms within the same type of industry. Whereas the threat is less when there are fewer powerful firms to compete.

1.4.4 Strategies for Competitive Advantage

Organizations constantly try to build up strategies to counteract the Porter's five forces. They must select a strategy intelligently and follow it properly to achieve success. Based on this selection an organization will employ its information systems. Below are explained these strategies for achieving competitive advantage.

- | | |
|------------------------------|--|
| 1. Cost leadership strategy. | 2. Differentiation strategy. |
| 3. Innovation strategy. | 4. Operational effectiveness strategy. |

- ▶ **1. Cost leadership strategy:** This strategy states that an organization will develop a product and/or service at the lowest cost than all its competing organizations in the same type of industry. For example, McDonald's implements a cost leadership strategy by offering the basic fast-food meals at considerable low prices.
- ▶ **2. Differentiation strategy:** According to differentiation strategy, an organization should offer products and/or services that have some unique features which no other organization within the same industry can provide. For example, Apple has been a giant in selling variety of products such as the Iphone, the Ipad and the Ipod. It makes use of differentiation strategy for pricing and marketing i.e. they make superior quality products which none of their competitors can provide at a lower cost with same paybacks.
- ▶ **3. Innovation strategy:** Innovation strategy is the one where an organization continuously works to introduce new ways to improve quality of existing products and/or services, or incorporate new ways to produce them. For example, Samsung follows an innovative strategy where it is into continues R&D for improving its variety of products. One such example is the curved mobile phone screens first developed by Samsung.
- ▶ **4. Operational effectiveness strategy:** Under this strategy, the business organization tries to improvise the internal business processes and operations so that it performs better than its rivals. The organization can work on reducing delivery times, improving productivity, increasing employee satisfaction etc. Here we can take an example of Fortis group of Healthcare Systems which strives to achieve Operational effectiveness. They have tried to employ and continuously track clinical outcomes in India. Clinical Outcomes are the globally agreed upon, evidence-based measurable changes in health or quality of life resulting from patient care. The monitoring of outcomes provides a feedback to these healthcare organizations for both assessing and improving the quality of clinical excellence, patient health and care.

► **5. Customer-orientation strategy:** This strategy aims at maintaining customer loyalty and keeping them satisfied. The organization should try to build better customer relationships and keep them happy. A very rightful example of customer orientation strategy is products by Apple. Apple is always into launching new products that satisfy customer's requirements and needs before they even express them.

► 1.5 MULTIPLE CHOICE QUESTIONS

- Q.1** For any information to be useful, it must be _____. (Jan 2021)
 (a) Efficient (b) Safe (c) Complete (d) Optimized ✓ Ans. : (c)
- Q.2** Types of information systems include _____. (Jan 2021)
 (a) Management support system (b) Hardware processing system
 (c) Output handling systems (d) Storage processing systems ✓ Ans. : (a)
- Q.3** The most fundamental information systems in an organization are _____. (Jan 2021)
 (a) Office automation systems (b) Decision support systems
 (c) Functional area information systems (d) Transaction processing systems ✓ Ans. : (d)
- Q.4** The term Field in a data represents _____.
 (a) Integrated collection of logically related data (b) A group of related records
 (c) logical structure (d) Data attribute ✓ Ans. : (d)
- Q.5** _____ refer(s) to an elementary description of things, events, activities, and transactions that are recorded, classified, and stored but are not organized to convey any specific meaning.
 (a) Data items (b) Knowledge (c) Information (d) Wisdom ✓ Ans. : (a)
- Q.6** _____ are/is organized so that they have meaning and value to the recipient.
 (a) Data items (b) Knowledge (c) Information (d) Wisdom ✓ Ans. : (c)
- Q.7** _____ are/is organized and processed to convey understanding, experience, accumulated learning, and expertise as they apply to a current business problem.
 (a) Data items (b) Knowledge (c) Information (d) Wisdom ✓ Ans. : (b)
- Q.8** You take orders at a local fast food restaurant. A customer approaches the counter and says "I would like 3 please." This is example of _____.
 (a) A data item (b) Knowledge (c) Information (d) Wisdom ✓ Ans. : (a)
- Q.9** You take orders at a local fast food restaurant. A customer approaches the counter and says "I would like 3 hamburgers please." This is example of _____.
 (a) A data item (b) Knowledge (c) Information (d) Wisdom ✓ Ans. : (c)

- Q.10** You take orders at a local fast food restaurant. A customer approaches the counter and says "I would like 3 hamburgers please." Since this customer comes in every day, you know he also wants 3 small fries to go with it. This is example of _____.
(a) A data item (b) Knowledge (c) Information (d) Wisdom ✓ **Ans. : (b)**

Q.11 _____ is a program or collection of programs that enable the hardware to process data.
(a) A database (b) A network (c) A procedure (d) Software ✓ **Ans. : (d)**

Q.12 _____ is a connecting system that permits different computers to share resources.
(a) A database (b) A network (c) Hardware (d) Software ✓ **Ans. : (b)**

Q.13 Information systems that connect two or more organizations are referred to as _____ organizational information systems
(a) infra (b) infer (c) inter (d) intra ✓ **Ans. : (c)**

Q.14 When thinking about how IT eliminates jobs, which of the following is FALSE?
(a) Many companies have responded to difficult economic times by increasing their IT investments.
(b) Employees need to find a way to show they add value beyond IT and ensure their managers are aware of this value.
(c) IT creates entirely new categories of jobs.
(d) Organizations are finding ways to do less with more IT resources. ✓ **Ans. : (d)**

Q.15 Which of the following statements is TRUE?
(a) IT decreases the number of executives (b) IT eliminates all jobs eventually
(c) IT does not affect health (d) IT reduces job stress ✓ **Ans. : (a)**

Q.16 Which of the following is NOT a way that IT affects our lives?
(a) Businesses can offer 24/7/365 service (b) Employees are constantly on call
(c) It improves the quantity of leisure time (d) It is easier to work from any location ✓ **Ans. : (c)**

Q.17 The IS function can be strategic within organizations.
(a) True (b) False ✓ **Ans. : (True)**

Q.18 The traditional functions of the MIS department tend to be technology-focused while the consultative functions of the MIS department tend to be strategic or inter-disciplinary in nature.
(a) True (b) False ✓ **Ans. : (True)**

Q.19 Information and knowledge are the same things because both depend on data in context.
(a) True (b) False ✓ **Ans. : (False)**

- Q.20** An _____ collects, processes, stores, analyzes, and disseminates information for a specific purpose.
- (a) Information technology (b) Information system
 (c) Machine (d) Algorithm
- ✓ Ans. : (b)
- Q.21** _____ define the policies to make efficient use of the information available as aligned to the business objectives.
- (a) Software (b) Program (c) Business procedures (d) Contract
- ✓ Ans. : (c)
- Q.22** Which type of systems involves what-if analysis?
- (a) Transaction Processing Systems (b) Decision Support Systems
 (c) Operational Systems (d) ERP systems
- ✓ Ans. : (b)
- Q.23** _____ is positive impact of IS on Healthcare Industry
- (a) Excessive dependency on machines (b) Robotic Surgeries
 (c) Elimination of jobs (d) 24 X 7 working hours
- ✓ Ans. : (b)
- Q.24** Strategic Information systems are those information systems
- (a) that help an organization either gain a competitive advantage
 (b) that help in overcoming the competitive threats in market
 (c) reduce a competitive disadvantage
 (d) all of above
- ✓ Ans. : (d)
- Q.25** _____ is an organizational strategy for redesigning and restructuring the business processes to make them more productive and profitable.
- (a) Business process restructuring (b) Business process redesigning
 (c) Business process reengineering (d) Business procedure reengineering
- ✓ Ans. : (c)
- Q.26** The full analytical capability and statistical evaluation is a highlighting feature of
- (a) Decision Support Systems (b) Management Information Systems
 (c) Transaction Processing Systems (d) None of above
- ✓ Ans. : (a)
- Q.27** _____ strategy aims at maintaining customer loyalty and keeping them satisfied.
- (a) Marketing orientation (b) User orientation
 (c) People orientation (d) Customer orientation
- ✓ Ans. : (d)
- Q.28** Innovation strategy is the one where
- (a) maintaining customer loyalty and keeping them satisfied is necessary.
 (b) working continuously to introduce novel ways to improve quality of existing products and/or services.
 (c) developing products that are higher in cost than similar products.
 (d) none of above
- ✓ Ans. : (b)

Q.29 Operational effectiveness strategy is the one where

- (a) a business organization tries to improvise the internal business processes and operations so that it performs better than its rivals.
- (b) that an organization will develop a product and/or service at the lowest cost.
- (c) an organization should offer products that are different from other products developed by the same firm.
- (d) All of above

✓ Ans. : (a)

Q.30 Which strategy states that an organization will develop a product and/or service at the lowest cost than all its competing organizations in the same type of industry?

- (a) Differentiation strategy
- (b) Cost leadership strategy
- (c) Operational strategy
- (d) Customer orientation

✓ Ans. : (b)

Q.31 According to differentiation strategy

- (a) an organization should offer products that have some unique features which no other organization within the same industry can provide.
- (b) an organization should offer products that have highest cost which no other organization within the same industry can provide.
- (c) an organization should offer products that are different from other products developed by the same firm.
- (d) an organization should offer products that have a higher cost from other products developed by the same firm.

✓ Ans. : (a)

Q.32 A firm restructuring the business processes in effort to reduce delivery times is an example of _____ strategy.

- (a) Differentiation strategy
- (b) Leadership strategy
- (c) Operational effectiveness strategy
- (d) Marketing strategy

✓ Ans. : (c)

Q.33 McDonald's implements a _____ strategy by offering the basic fast-food meals at considerable low prices.

- (a) Differentiation
- (b) Operational effectiveness
- (c) Cost leadership
- (d) Innovative

✓ Ans. : (c)

Q.34 The strength of suppliers is ____ when the buyers have very limited options from whom to buy.

- (a) high
- (b) low

✓ Ans. : (a)

Q.35 Which out of the following is not a negative impact of IT on lifestyle of employees at work?

- (a) no clear boundaries between work time and leisure time
- (b) flexibility of work hours due to work from home facility
- (c) health issues such as vision and back problems
- (d) elimination of jobs

✓ Ans. : (b)

- Q.36** _____ system support creation and dissemination of knowledge to its employees and managers.
- (a) data management (b) information management
 (c) operation management (d) knowledge management
- ✓ Ans. : (d)
- Q.37** Which of these is not an Office automation system?
- (a) electronic calender (b) email
 (c) word processing system (d) knowledge management
- ✓ Ans. : (d)
- Q.38** _____ systems make use of electronic medium such as the internet to perform buying and selling of goods and services.
- (a) Ebusiness (b) ECommerce
 (c) Enterprise Application System (d) Etransaction
- ✓ Ans. : (b)
- Q.39** _____ systems that manage and control the entire supply chain of an organization right from procurement of raw materials to delivery of finished products.
- (a) Supply Chain Management (b) Customer Relationship Management
 (c) Operation management (d) Knowledge management
- ✓ Ans. : (a)
- Q.40** Which of these is an Interorganizational system?
- (a) transaction Processing system (b) supply chain management
 (c) operation management (d) knowledge management
- ✓ Ans. : (b)
- Q.41** Which of the following is a Strategic Information system?
- (a) TPS (b) EIS (c) DSS (d) all of above
- ✓ Ans. : (d)
- Q.42** Which of these are core modules of an ERP package?
- (a) Human Resource (b) Sales & Marketing
 (c) Inventory (d) all of above
- ✓ Ans. : (d)
- Q.43** Which of these is an example of expert system?
- (a) navigation system (b) word processing system
 (c) email system (d) videoconferencing system
- ✓ Ans. : (a)
- Q.44** _____ techniques facilitate organizations to connect, compute, communicate, collaborate, and compete anywhere in the global world.
- (a) globalization (b) technological innovation
 (c) competitive (d) none of above
- ✓ Ans. : (a)
- Q.45** Which among these is not among Porter's five forces
- (a) Threat of new entrant (b) Bargaining power of buyer
 (c) Bargaining power of supplier (d) Threat of customer
- ✓ Ans. : (d)

Q.46 _____ systems support knowledge discovery through data analysis using data warehousing and mining techniques.

- (a) business intelligence
- (b) knowledge management
- (c) expert management
- (d) data management

✓ Ans. : (a)

Q.47 _____ support the lower and middle level managers in creating documents, scheduling meetings and communication between employees

- (a) Office automation systems
- (b) Expert Systems
- (c) Business Intelligence systems
- (d) Knowledge management systems

✓ Ans. : (a)

Q.48 _____ support middle level managers within a specific department for collecting data and generating regular reports.

- (a) Expert Systems
- (b) Functional area information systems
- (c) Transaction processing system
- (d) Knowledge management systems

✓ Ans. : (b)

Q.49 Societal pressures that impact organizations to handle certain social responsibilities are

- (a) Green IT revolution
- (b) Conservation of energy
- (c) Carbon management
- (d) All of above

✓ Ans. : (d)

Q.50 Various globalization techniques that facilitate organizations to connect, compute, communicate, collaborate, and compete anywhere in the global world include

- (a) Outsourcing,
- (b) Insourcing
- (c) Offshoring
- (d) all of above

✓ Ans. : (d)

Q.51 Managing information systems in modern organizations is _____ because _____.

- (a) difficult; organizations are dependent on them and they are expensive to acquire, operate, and maintain
- (b) difficult; while people are accustomed to using technology in their daily lives, they don't adjust so easily to using them at work
- (c) easy; organizations are dependent on them but they don't cost that much to acquire, operate, and maintain
- (d) easy; people are so accustomed to using technology in their daily lives that they easily adjust to using them at work

✓ Ans. : (a)

Chapter Ends...



MODULE 2

CHAPTER 2

Data and Knowledge Management

University Prescribed Syllabus

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

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► 2.1 INTRODUCTION

UQ. Explain the importance of data in today's environment with an example.

MU - Q. 2(b), Jan 21, 5 Marks

- Information systems play a very vital role in managing data within organizations. Managing data involves accessing, processing and storing huge amounts and variety of data generated within organizations due to the daily transactions.
- These transactions could be anything from financial transactions, maintaining confidential information, reviews and feedback on social media, intellectual property.
- Data is plain facts and values that are generated during these day to day transactions.
- The data generated due to these transactions is really huge and cost involved to manage this data is even higher.
- But managing and maintaining this data is very critical for the business organization as data analysts will analyze and use this data as per their requirements to generate useful information.
- Senior managers can then apply their experience to use this information to solve critical business problems. This activity of addressing business problems will further lead to generation of knowledge.
- This knowledge will be captured and stored by knowledge management systems and can be accessed by anyone within the organization who is authorized to do so thereby creating flexible and powerful learning organizations.
- Hence this implies that data and knowledge management is very vital to modern business organizations.
- Managing data means maintaining the quality of data at high levels. The data should be accurate, complete, timely, consistent, accessible, relevant and concise.
- Say for example, Customer data would be the values or facts that are generated due to customer interactions like placing an order, making a booking or giving feedback etc. As this data generated is raw, it can be put up into a meaningful context to convert it into information.
- As a result of which proper interpretations can be made and will help the business organizations and management in making informed decisions.
- In the context of above examples related to customer data, useful metrics like negative customer reviews would help in making decisions on how to devise better ways to satisfy the customer.
- The value of the information lies in the actions that arise from the information. For example, if the information alerts you to poor customer satisfaction, it is useful only if this creates a change in the way the business deals with customers. Hence the information process should form part of a wider review process within the business to gain the best outcomes.
- But managing and maintaining the quality of data is not an easy task. The process is becoming really challenging with such high volumes and variety of data being generated.

- Few of the difficulties in managing data are discussed below:
 - o Most of the data needs to be kept for a long time as historical records for analysis purpose. New data keeps on adding exponentially with time.
 - o The data is collected, processed and distributed from and to different locations within the organization and using different devices and methods .
 - o Different sources of information include internal sources like company documents and corporate databases, external sources like corporate websites or government reports, personal feedbacks and reviews, blogs, digital footprints etc.
 - o Further the data are frequently stored on heterogeneous computing systems, databases and that too in different formats. These days the data that is generated is highly unstructured.
 - o Also data changes or even degrades over time, say for example customers change their names and addresses, new products are added or some products do not exist anymore.
 - o Data duplication and redundancy is another major issue. Like it happens in organizations where same data is maintained at several places like marketing, billing and even customer service function.
 - o Data is subjected to data rot over time due to temperature, humidity, and exposure to light. It can damage the storage media and make it difficult to retrieve the data.
 - o Legal constraints regarding data and information across countries differs which is also a major concern.
 - o Maintaining data integrity, ensuring its security is yet another issue to be considered while managing data.

► 2.2 DATA GOVERNANCE

- To address these numerous problems related to managing data, organizations are turning towards Data Governance.
- **Data Governance** is an approach to managing information across an organization. It involves people, business processes, policies and tools that are designed to ensure that data is handled in a certain well-defined fashion.
- There should be proper well defined procedures within organizations for acquiring, processing ,and storing data. Rules for handling and protecting data should be clearly mentioned and followed within the organization.
- The objective is to make the information available to only those people who are authorized to access it, from the moment it enters an organization until it is outdated and deleted.
- Data governance can be defined as a collection of processes, roles, policies, standards, and metrics that ensure the effective and efficient use of information in enabling an organization to achieve its goals.

- Data governance clearly states who can take what action, upon what data, in what situations, using what methods.
- A well defined Data Governance policy will cover all strategic, tactical and operational level decisions and also justify how your business benefits from consistent business processes and responsibilities.
- One strategy for implementing data governance is Master Data Management.
 - o **Master data management (MDM)** deals with creating a single master record for all business critical data gathered from various sources either internal or external to the organization.
 - o It helps to create and maintain a single version of data which is available throughout all the functional units of the organization.
 - o The data is synchronized and consistent throughout various business processes within the organization.
 - o Master data management involves removing duplicates, standardizing data and incorporating rules to eliminate incorrect data from entering the system.

► 2.3 DATABASE APPROACH

- Until the early seventies, business organizations managed their data using file management environment.
- The applications were developed independently and as a result they maintained their own version of data independently in separate data files. These data files were collection of logically related records.
- This was fine until applications were few. As number of applications started increasing, each application maintaining its own version of data became chaotic. Same data was duplicated at many places. Some places the data was updated and at some places the older version of data was in use.
- Say for example, the sales department, marketing department and the customer support department were maintaining three different copies of the same customer data. Further it could happen that customer support department had new updated address whereas sales department had old postal address in their data file.
- These problems could be very well minimized using a Database Approach.
- In this approach, Database Management systems which are a collection of software programs are used to store, access and manage data.
- These systems minimize the problems of data redundancy, data inconsistency, data security, data integrity, data isolation etc.

2.3.1 The Data Hierarchy

- Data is always organized in an hierarchical fashion.
- To begin with we have the smallest unit of data which is a **binary digit or bit** represented in terms of 0 and 1.
- A group of 8 bits is one **byte**. A byte can be used for symbols, letters or characters.
- Group of characters form words and logical grouping of characters or words forms a **field**. Fields could be text, numbers, images etc. For example roll no, name, address, phone number etc.
- A logical grouping of related fields, such as the student's roll no., name, subject marks, make up a **record**.
- A logical grouping of related records is called a **table**. For example, a grouping of the records of student roll no, name, marks etc. would form a table of student details.
- And at the highest level a logical grouping of related files constitutes a **database**.

2.3.2 Designing the Database

- While designing a database care should be taken that data should be organized properly so that it can be accessed and understood with ease.
- A key tool for designing an effective database is the data model. A **data model** is used to represent entities and their relationships within the database. One such model is **Entity-Relationship diagram**.
- An **entity** is a person, place, thing, or event - such as a customer, an employee, or a product - about which information is maintained in the database. A record generally describes an entity.
- An **instance** of an entity is a specific, unique representation of that entity. For example, an instance of the entity EMPLOYEE would be details of a specific employee.
- Each characteristic or quality of a particular entity is called an **attribute**. For example, for the entity employee, attributes would include employee name, employee code, designation etc .
- Every record in a file must contain at least one field that uniquely identifies that record so that it can be retrieved, updated, and sorted.
- This field is called the **primary key**. For example, employee code is unique for every employee and it can be considered as primary key.
- At times for identifying a record in a database we also need additional fields. A **secondary key** is another field that has some identifying information but typically does not identify the record with complete accuracy always. For example, the employee's address can be considered as secondary key for identifying the employee records.
- As mentioned earlier, A **database management system (DBMS)** is a set of programs that provide users with tools to add, delete, access, modify, and analyze data stored in a database.
- An organization can access the data by using query and reporting tools that are a part of the DBMS.

- There are a number of different database architectures, but most commonly used are relational database model due to ease of use. Popular examples of relational databases are Microsoft Access, Oracle and SQL Server.

2.3.3 The Relational Database Model

- The **relational database model** is based on the concept of two-dimensional tables. Data is organized into simple tables made up of rows and columns. These models help in accessing and retrieving data quickly by finding intersection of rows and columns. Usually, a relational database is a collection of number of related tables. Every row in the table indicates a record and column represents attributes. Each of these tables contains records (listed in rows) and attributes (listed in columns).
- **Structured Query Language** is the most popular language used for requesting, searching or accessing information from the database.
- However, the relational databases have their limitations, like for large-scale enterprise wide databases may have many interrelated tables because of which the overall design can become complex and lead to slow search and access times.
- **Data Dictionary** is another important term used in relational database model. It is like metadata i.e. data about data. The data dictionary provides all information about each attribute, such as its name, its type, whether it is a key etc. Data dictionaries provide names and standard definitions for all attributes.

2.4 BIG DATA

UQ. Define Big Data and discuss its basic characteristics?

(MU - Q.2(B), Dec. 19, 5 Marks)

2.4.1 Concept

- Big Data implies data that is very huge, rather superabundance of data available today is Big Data.
- And it's just not huge but also growing exponentially with time as well as is of diverse types.
- So handling such variety of large data is highly impossible using simple database management tools but requires advanced tools to capture, process, transform and analyse this data.
- Big Data could be best explained with few examples like
 - o The New York Stock Exchange generates about *one terabyte* of new trade data per day.
 - o Around *500 + terabytes* of data in the form of photos, videos, messages, reviews etc. enters into the databases of social media sites like Facebook, every day.
 - o A single Jet engine can generate *so many terabytes* of data in *few minutes* of flight time collected from its various sensors.

2.4.2 Characteristics of Big Data

The most common characteristics of Big Data are **Volume, Variety, Velocity and Value**.

- i) **Volume** : Volume implies size of Big Data which is enormous. The size of data helps in deciding the value of data. As just discussed above one terabyte of data per day generated by New York Stock Exchange, many terabytes of data generated on social media daily etc., these are all examples of high volumes of data.
- ii) **Variety** : The next characteristic of Big Data is its Variety. It means that Big data is diverse in nature. It comes from various sources internal and external to the organization and is heterogenous in nature. It can be structured as in case of records stored in relational tables or unstructured as in multimedia data on websites. The data generated can be of any type from PDF documents , emails, to photos and videos,
- iii) **Velocity** : The pace with which Big data is generated is very fast. The speed with which data is generated and processed is termed as Velocity. Velocity can be best explained with example of a single Jet engine that can generate *so many terabytes* of data in *30 minutes* of flight time collected from its various sensors like temperature, pressure, fuel monitoring systems. The data generated on social media sites, from mobile devices and sensors is really extensive and continues. Google alone processes on an average more than 40,000 search queries every second.
- iv) **Value** : The next characteristic of Big data is the actual Value of this enormous data that is collected. Just volume is not sufficient but the data should be meaningful and of help to whichever organization that is collecting it. For example the customer feedback data collected should help in understanding the customers, their needs and grievances and accordingly change business policies to satisfy their needs.

2.4.3 Benefits of Big Data

Below are certain benefits of Big Data.

1. As just explained above the customer feedback data collected can be analyzed to help organizations in understanding the trends in customer needs and thereby build new products. It could also deal with pricing of the product i.e. giving better products at affordable prices.
2. There are certain tools of Big Data like Hadoop that are very cost effective when it comes to storing large amounts of data.
3. Also analysis of data collected from various internal and external sources helps in getting a better understanding of current market conditions.
4. The analysis of data and further decision making becomes very fast with the help of Big Data tools like Hadoop.
5. The organization can work on maintaining their brand image and reputation by considering the feedback and reviews posted by customers and thereby taking necessary actions.

The use of Big Data is becoming common these days by the companies to outperform their peers. In most industries, existing competitors and new entrants alike will use the strategies resulting from the analyzed data to compete, innovate and capture value.

❖ 2.4.4 Issues with Big Data

1. **Veracity** : Big Data comes from various sources of which all may not be trusted sources. Hence the authenticity and reliability of data and analysis performed on such data is questionable. For example, how authentic are the reviews posted on a shopping site by customers. Some negative feedbacks could be posted by competitors only to defame the business organization.
2. **Validity** : Big Data can be dirty and of poor quality. For example incomplete survey forms filled by customers. The data may not be accurate and complete. Such data cannot serve as a base for data analysis.
3. **Security** : Big data breaches are possible and can have disastrous impact. Around 87 million Facebook users had their profiles exposed by Facebook to Cambridge Analytica, a political consulting firm for some election campaign.
4. **Variable** : Big Data also changes due to heterogenous data sources and types. These inconsistencies lead to difficulty in handling and managing data.

► 2.5 DATAWAREHOUSES AND DATAMARTS

❖ 2.5.1 Concept and Definition

- Any organization needs a database to manage its data. Sometimes it could be more than one databases. But the problem with databases is that they process data in real time or near real time. So if any analysis has to be performed it is not advisable to work on real time databases as they would keep changing as new data enters in real time. To avoid this problem, Data warehouses have been developed to allow users to access data for analysis and decision making.
- Consider an example, The profit margin on second hand cars sold by company like Cars21 can be easily found using SQL. But now suppose the trend in profit margin on second hand cars over last 15 years in a particular geographic location say any city needs to be found, then writing the query would be very complex. So, for this reason building Data warehouses and datamarts is becoming essential.
- For accessing, analyzing and processing data efficiently within Data warehouses and datamarts various Online Analytical Processing tools, Data Mining tools are available
- Data warehouses and datamarts are also used to support number of business intelligence applications within organizations for better decision making.
 - o **Business intelligence (BI)** is a broad category of applications, technologies, and processes for gathering, storing, accessing, and analyzing data to help business users make better decisions.

- A **datawarehouse** is a repository of historical data that are organized by business subject/dimension to support decision makers in the organization.
- As maintaining Data warehouses is very expensive, they can be afforded majorly by large companies.
- For smaller organizations or strategic business units a datamart is sufficient
- A **datamart** is a low-cost, scaled-down version of a Data warehouse that is designed for the end-user needs in a strategic business unit (SBU) or an individual department.
- Wherever there are very few BI applications, datamart are sufficient, rather than a Data warehouse.
- The basic characteristics of Data warehouses and datamarts are:
 - In contrast to transactional databases which are organized by business process, Data warehouses and datamarts are organized by business subject or dimension. Usually in business organizations customer, product, vendor, geographic location can be considered as business subjects.
 - As opposed to databases that use Online Transaction Processing (OLTP), Data warehouses and datamarts are designed for Online Analytical Processing (OLAP) that involves analysis of accumulated data for decision making.
 - Data about the business subject is integrated from multiple internal and external sources and accumulated at one place.
 - Unlike transactional databases that contain only recent data(of about days ,weeks or months), Data warehouses and datamarts store very old historical data(of about years)which is used for analysis purpose.
 - The data within Data warehouses and datamarts does not change frequently i.e.it is nonvolatile. Users cannot update the warehouses very often. Whenever they need updation it is done through IT-controlled load processes rather than by users directly.
 - Data warehouses or marts are multidimensional unlike databases which are two dimensional.

2.5.2 Architecture of a Data warehouse

UQ. Explain the architecture of Data mart and Data warehouse in an organization.

(MU - Q. 3(A), Dec. 19, 10 Marks)

The basic block diagram of a Data warehouse and datamart architecture is shown in Fig. 2.5.2. It includes:

- The source systems that provide data to the data warehouse or datamart.
- The data-integration technology and processes that prepare the data for use.
- Different architectures for storing data in an organization's Data warehouse or datamarts.
- Different tools and applications for the variety of users.

- Metadata, data quality and governance processes that ensure that the warehouse or mart meets its purpose.

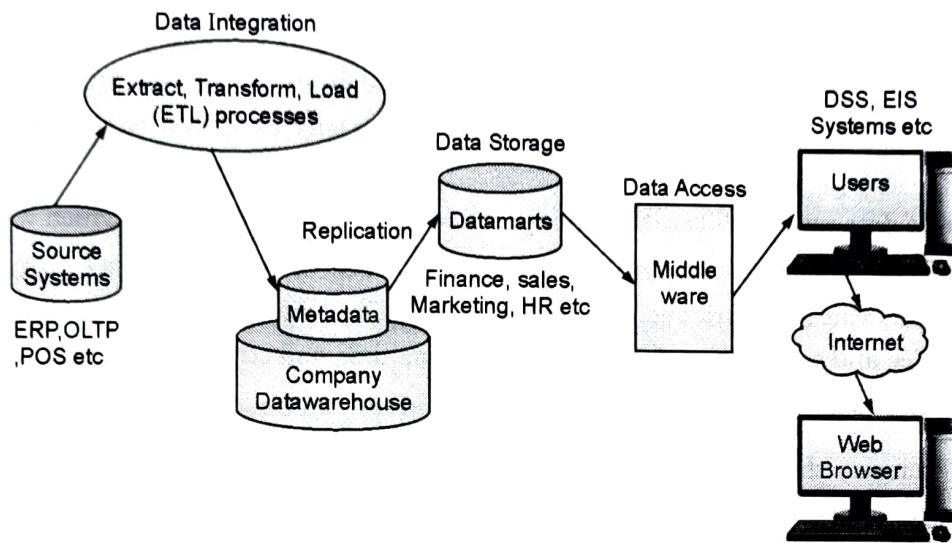


Fig. 2.5.2 : Architecture of a Data warehouse

As shown in the Fig. 2.5.2, let us have a look at the components and their functions in a Data warehouse architecture.

- **Data Extraction :** In this step, data is collected from various heterogenous sources both external and internal to the organization.
- **Data Cleaning :** In data cleaning ,the errors in data are found and simultaneously corrected.
- **Data Transformation :** In this step data is converted into a format to be stored in Data warehouses, which was previously stored in a format suitable for legacy systems.
- **Data Loading :** Data Loading involves various functions performed such as sorting, summarizing, consolidating, checking integrity, and building indices and partitions.
- **Refreshing :** This step deals with updating data from data sources to Data warehouse.

There are different types of datawarehouse applications such as

- **Information Processing :** Various data processing functions like querying, statistical analysis, reporting using tables, charts, or graphs is supported by Data warehouses.
- **Analytical Processing :** The data within warehouses can be analyzed by means of basic OLAP operations, such as slice-and-dice, drill down, drill up, and pivoting.
- **Data Mining :** Data mining can also be performed on Data warehouses. It supports knowledge discovery by finding hidden patterns and associations, constructing analytical models, performing classification and prediction.

2.5.3 Benefits and Drawbacks of Data Warehousing

The benefits of Data warehouses are listed below

- End users can obtain a consolidated view of organizational data.
- The data for analysis can be accessed more faster and easily as it is accumulated at a central location.
- Broad range of data analysis operations are possible with Data warehouses, which was previously not possible.
- These operations can help improve business knowledge, provide competitive advantage, enhance customer service and satisfaction, facilitate decision making, and streamline business processes.

Inspite of their benefits, Data warehouses have few drawbacks

- First and foremost, they are very expensive to build and to maintain hence only very large enterprises where huge amounts of data are generated can afford it.
- Secondly, integrating data from obsolete mainframe systems can be very difficult and expensive.
- Thirdly, different departments within an enterprise might be hesitant to share their data with other departments.

2.6 KNOWLEDGE MANAGEMENT SYSTEMS

2.6.1 Concept

UQ. Describe what is meant by knowledge management. What factors have led to its development.

(MU - Q. 2(A), Jan. 21, 5 Marks)

- **Knowledge Management (KM)** is a process that helps organizations manipulate important knowledge that comprises part of the organization's memory, usually in an unstructured format.
- For an organization to be successful, knowledge must be effectively disseminated among people of different departments. Also knowledge must keep growing for the organization to grow. It should not remain stagnant.
- Knowledge is different from data and information. As explained earlier data are a collection of facts, measurements, and statistics; information is organized or processed data that is timely and accurate.
- Knowledge is information that is contextual, relevant, and useful. Knowledge is also termed as Intellectual asset.
- To understand the concept of knowledge let us take an example. The list of percentage marks is data. When these marks are associated with a particular student (mapped with his roll no. and name), it becomes information. Now when these percentages are used to decide a cutoff on how many students can go for campus placement, say all students scoring above 60% marks are eligible for interview then it becomes knowledge.

- **Knowledge Management Systems** aim to help an organization make the most optimum use of the knowledge that has been aggregated.
- **Knowledge Management Systems (KMSs)** deal with the use of modern information technologies - the Internet, intranets, extranets, databases - to systematize, enhance, and accelerate intrafirm and interfirm knowledge management.

2.6.2 Factors Leading to Development of knowledge Management Systems

Below are few factors that are leading to increased use of knowledge management systems:

- KMSs are designed to help an organization manage rapid changes and turnover by using the information assets available.
- The best practices and methods to improve the overall performance of the business organization is readily available to the employees. For example, sales managers can now make available their knowledge about how to best handle their customers. The organization can then utilize this knowledge when it trains new customer sales representatives.
- Due to the knowledge gathered organizations can improve their customer service drastically.
- At the same time products can be developed in more efficient manner satisfying customer requirements even better.
- Also improved employee retention is motivating increased use of knowledge management systems. The automated business processes are leading to higher employee satisfaction.
- Knowledge management systems encourage the employees by rewarding those who have added their skills to enhance the knowledge base.
- Thus, Knowledge Management Systems help in making most productive use of accumulated knowledge.
- Now let us have a look at the Knowledge Management System(KMS) Cycle.

2.6.3 The KMS Cycle

- The KMS cycle consists of six steps as shown in Fig. 2.6.3. The system is cyclic because the environment and the knowledge is ever changing and growing. It is continuously refined.

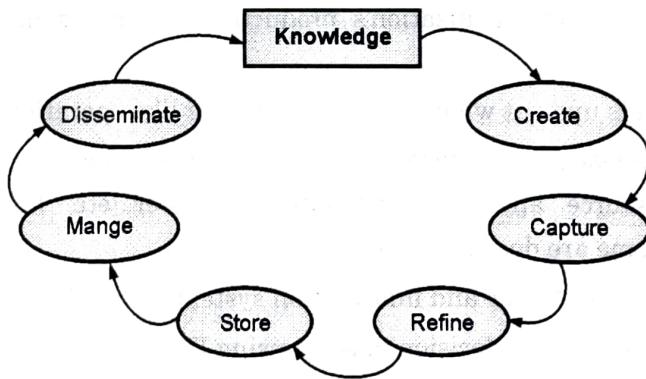


Fig. 2.6.3 : Knowledge Management Systems

- **Create** : Create involves knowledge creation when people discover new things as the data is continuously accumulated from various internal and external sources.
- **Capture** : New knowledge must be identified and gathered and represented in a standard way.
- **Refine** : The new knowledge captured must be refined and brought in a form that is useful and can be put into action.
- **Store** : The useful knowledge captured must then be stored in a proper format in a knowledge repository so that people in the organization can access it.
- **Manage** : The knowledge in the repository must be continuously managed and updated. It must always have current knowledge.
- **Disseminate** : Knowledge must be spread and made available in a useful format to anyone in the organization who needs it, anywhere and anytime.

Some examples of knowledge management systems are:

- The company employees might be working on some project. So, all the files and information related to the project is shared amongst the team members. This will help every member to be updated what the other one is doing.
- The customer and employee feedback can be stored at a single location and can be shared with people who are authenticated to access it. Based on the knowledge shared, necessary actions can be taken.
- A company's research data on developing new products and services can be shared among the employees of research and development team, so that healthy discussions and appropriate decisions for progress of the business can be taken.

2.7 MANAGERS AND DECISION MAKING

UQ. Discuss the Impact of BI on Decision Making.

(MU - Q. 3(B), Dec. 19, 10 Marks)

- **Management** is a process by which an organization achieves its goals through the use of resources (people, money, materials, and information). Managers must strive for optimizing this process. They must try to improve the organization's productivity by using minimum resources to get maximum output.
- The manager's job depends upon at what level he is working like operational, tactical or strategic.
- The manager works as a leader, supervisor, middleman between lower level employees and upper level management, resource allocator, negotiator, analyzer etc. Some of these roles are interpersonal whereas some are decision making.
- The managers take the support of IT and information systems to perform these roles.
- Here, in this section our focus is on decision making using IT.
- A **decision** refers to a choice among two or more alternatives that individuals and groups make.



- Economist Herbert Simon (1977) described decision making as composed of three major phases: *intelligence, design, and choice*. Once the choice is made, the decision is implemented.
- The decision-making process begins with the *intelligence phase*, in which managers scrutinize a situation and identify the problem or opportunity.
- In the *design phase*, decision makers construct a model for the situation. They make assumptions, identify relations between various parameters. The model is validated with test data.
- Finally in the *choice phase* a decision is made i.e. selecting the best solution to solve the problem.
- Computer-based decision support systems assists managers in the decision making process.
- Managers alone cannot take up the decisions. They need IT support to take up decisions because:
 - o The number of alternative solutions is very vast due to innovations in technology, global markets, use of internet to do business etc. Therefore selecting the best from these various options is a great challenge. For this IT support is needed to assist in making optimal searches and comparisons.
 - o The ever increasing information processing to take up decision should be done very fast which is not possible manually but only with the support of IT tools.
 - o Due to uncertainty in the decision environment, taking up decisions is becoming quiet complex. It is usually necessary to conduct a sophisticated analysis in order to make a good decision.
 - o The decision making process should be done rapidly and inexpensively ,which is again a major challenge.
- Here comes into picture the concept of Business Intelligence.

2.8 BUSINESS INTELLIGENCE (BI)

2.8.1 Concept

- To provide users with access to corporate data, many organizations are implementing data warehouses and data marts, which we have seen in the earlier sections. Users analyze the data in warehouses and marts using a wide variety of BI tools.
- Many vendors offer bundled packages of various tools by the name *Business Intelligence* (BI) software.
- Major BI software vendors include SAS, Hyperion, Business Objects, Information Builders, SPSS, and Cognos.
 - o BI is vital to modern decision making and organizational performance. The term *Business Intelligence* was introduced by Business and IT analyst Howard Dresner in 1989 while he was an analyst at Gartner, a market research firm.
 - o BI covers all decision-support applications. It includes both “getting data in” (to a data mart or warehouse) and “getting data out” (through BI applications).

- Previously BI was used by only managers for decision support but these days all other stakeholders like customers, customer support executives, suppliers, etc. are using BI to achieve current updated information.
- BI tools can be as simple as using Excel sheets for analysis by smaller organizations or sophisticated data mining, predictive analysis and data visualization tools for bigger organizations. BI tools are used within organizations for making decisions on market campaigns, sponsorships and fundings needed, what could be the impact and benefit of these campaigns to the organization etc.
- BI is used to fundamentally transform the ways in which a company competes in the marketplace. BI supports a new business model, and it enables the business strategy.
- Just consider an example of an entertainment company named Sarah's amusement that achieved its business target using BI.
- Sarah's amusement developed a customer loyalty program, known as *Total Benefits*. To implement the program, Sarah's created a data warehouse that collected data from nearby hotels, bars and casinos about their customers through different access points like internet, slot machines etc..
- Sarah's used this data to reward loyal customers and reach out to them in personal and attractive ways, such as through promotional offers. As a result, the company became a leader in the gaming industry.
- It used analytics to predict customer behavior.

Until now we have seen the basics of data warehouses and data marts. We have also seen the use of data warehouses and data marts in BI. Now, we will go ahead with how the user community can analyze the data in data warehouses and data marts, how the results of these analyses are presented to users, and how organizations can use the results of these analyses.

2.8.2 Business Intelligence Applications for Data Analysis

- Firstly we need to understand how users use BI to analyze the data, how they present the result of analyses and how users in the form of managers and executives implement these results.
- A variety of BI applications for analyzing data are available. They include multidimensional analysis (also called *online analytical processing*, or *OLAP*), data mining, and decision support systems. Now let us have a look at these applications.

Multidimensional Analysis or Online Analytical Processing (OLAP)

- Certain BI applications include online analytical processing (OLAP), also known as multidimensional analysis capabilities.
- OLAP involves operations such as “slicing and dicing” data stored in a multi dimensional format, drilling down in the data to greater detail, and aggregating the data.

- Let us have a look at the multi dimensional data cube as shown in Fig. 2.8.2 which represents the clothing product on the x-axis, geographical location on the y-axis, and year on the z-axis.

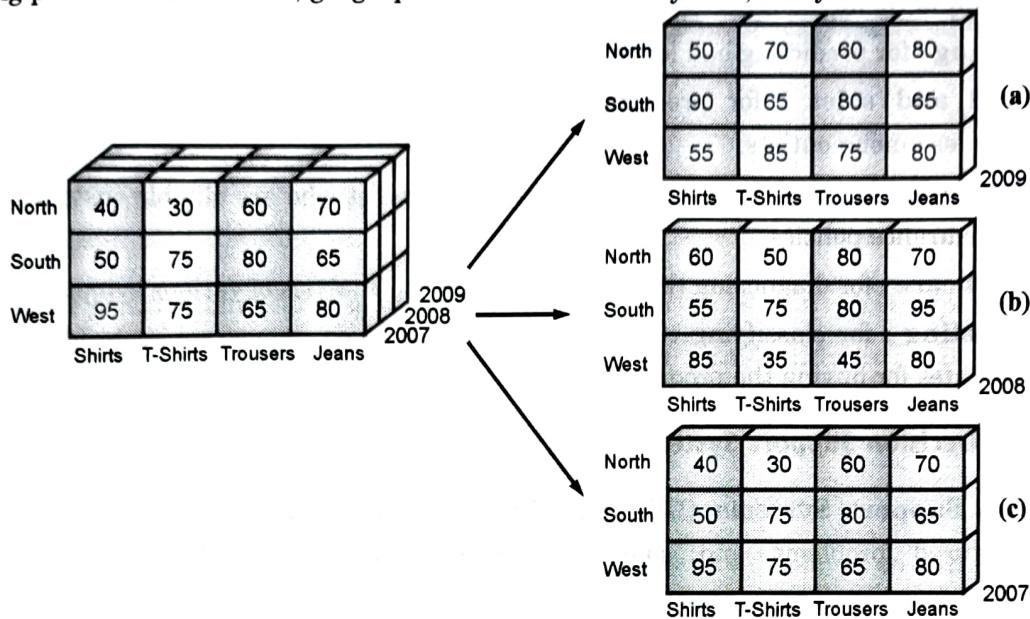


Fig. 2.8.2 : Representation of a multi dimensional cube

- Just imagine you want to know how many tshirts were sold by the company in the North region in the year 2008. A slice and dice operation will be performed on the cube, using *tshirts* as the specific measure for clothing product, *North* as the measure for geographical location, and year as 2008.
- Further, if you wanted to find how many tshirts were sold during 2007-2009, aggregation function, also called as “rollup” would be used.

2.8.3 Data Mining

- **Data mining** refers to the process of searching for valuable business information in a large database, data warehouse, or data mart.
- Two basic operations are performed in data mining :
 - Predicting trends and behaviours** which means finding predictive information in large databases. Say, for example a bank loan manager can perform analysis of certain parameters like past credit history of customer, assets, income level etc. and based on that make a decision whether to sanction the loan or not.
 - Identifying previously unknown patterns** : Like it is seen that in departmental stores usually people buy products in a particular pattern. If they purchase bread, they tend to buy butter and jam. So, data mining tools can identify such patterns and help make informed decisions like whether to give discounts when customer buys these products together. Another example could be of credit card usage patterns. If your card is stolen and used fraudulently, the usage pattern will surely vary visibly from your regular pattern. Data mining tools can distinguish this difference and bring the issue to your notice.

- Data mining has been used in several industries to achieve a competitive advantage. Let us have a look at a few of them.
 - o **Banking** : for predicting bad loans and which customers are eligible for issue of loan.
 - o **Retail and sales** : for predicting sales, determining inventory levels and distribution schedules among outlets.
 - o **Insurance** : for forecasting claim amounts and predict who are eligible customers for buying new insurance policies.
 - o **Healthcare** : for diagnosing the illness based on the analysis of various symptoms.
 - o **Marketing** : for classifying customer segment based on demographics to identify proficient candidates for buying the products.

2.8.4 Decision Support Systems

- **Decision Support Systems (DSSs)** combine models and data with the intent to analyze semistructured problems and some unstructured problems that involve extensive user involvement.
- **Models** are simplified representations, or abstractions, of reality. DSSs allow data analysts to access data, manipulate it and perform analysis on it. DSSs perform sensitivity analysis, what-if analysis, and goal-seeking analysis.
- Let us see what is each one of these.
 - o **Sensitivity Analysis** : *Sensitivity analysis* is the study of the impact that changes in one or more input parameters have on the output parameters.
 - o There are two types of input variables: decision variables and environmental variables. "What is our threshold for reordering raw materials?" is a decision variable. "What is the GST percentage?" is an environmental variable. Based on the analysis of the input variables, output variable is determined. As in this case the total cost of raw materials is the output desired. Sensitivity analysis is extremely important because it enables the system to adapt to changing environmental conditions and to the varying requirements of different decision-making situations.
 - o **What-if Analysis** : *What-if analysis* helps in predicting the impact of change in one or more input variables on the proposed solution. For example, what will happen to the total inventory cost if the originally assumed cost of carrying inventories is 15 percent rather than 12 percent? BI systems help data managers to ask such questions to the DSSs and get the responses appropriately.
 - o **Goal-Seeking Analysis** : *Goal-seeking analysis* tries to calculate the value of the inputs necessary to achieve a desired level of output. Say, for example the BI analysis initially predicted a profit of Rs.1 crore for the company. The manager might want to know how much sales quantity should be increased to get a profit of Rs.2 crores. For achieving this, various parameters need to be adjusted like increase in funding, lower product costs, enhance advertising efforts etc.

2.8.5 Business Intelligence Applications for Presenting Results

Dashboards and Data Visualization techniques are used for presenting the results of the various types of analysis performed.

Dashboard

- They are designed for use by top level executives, employees, business partners and even customers.
- A dashboard provides simple way to access timely information and managerial reports.
- It is user friendly, it has graphical interfaces, and, most significantly, it enables managers to examine exception reports and drill down into detailed data. This ability helps the executive to go deep down into levels of details.
- Helps to access real time data for the most critical factors responsible for success of business.
- Reports showing trend analysis and focusing on deviations can be displayed on dashboards.
- One wonderful example of a dashboard is the Bloomberg Terminal. Bloomberg LP a privately held company, provides a subscription service that sells financial data, software to analyze this data and trading tools.

Data Visualization Technologies

- After the data has been analyzed, it can be presented in different visual formats such as text, tables, charts, graphics etc.
- This process, known as *data visualization*, makes IT applications more attractive and understandable to users.
- A lot of data visualization softwares that support decision making are available.
- Two well-known ones are **geographic information systems** and **reality mining**.
 - o **Geographic Information Systems** : A geographic information system (GIS) is a computer based system for capturing, integrating, manipulating, and displaying data using digitized maps. Its most unique feature is that every record or digital object has an identified geographical location. This process, called *geocoding*, enables users to generate information for planning, problem solving, and decision making. In addition, the graphical format makes it easy for managers to visualize the data.
 - o **Reality Mining** : It is an integration of GISs and global positioning systems. **Reality mining** lets analysts to extract information from the usage patterns of mobile phones and other wireless devices. With this information they are able to provide a more accurate picture of what people do, where they go, and with whom they communicate.

► 2.9 MULTIPLE CHOICE QUESTIONS

- Q.1** The term Field in a data represents _____. (Jan 2021, 2 Marks)
- (a) Integrated collection of logically related data
 - (b) A group of related records
 - (c) Logical structure
 - (d) Data attribute ✓Ans. : (d)
- Q.2** Functions of a DBMS includes _____. (Jan. 2021, 2 Marks)
- (a) Database
 - (b) Datamart
 - (c) Data Warehouse
 - (d) Manipulation of records in a table ✓Ans. : (d)
- Q.3** Data Mart is a subset of _____. (Jan 2021, 2 Marks)
- (a) Data
 - (b) Data mining
 - (c) Data Warehouse
 - (d) Database ✓Ans. : (c)
- Q.4** Data mining is not used for _____. (Jan 2021, 2 Marks)
- (a) Day to Day operations
 - (b) Market analysis
 - (c) Customer retention
 - (d) Discover new correlations ✓Ans. : (a)
- Q.5** Data scrubbing is which of the following ? (Jan 2021, 2 Marks)
- (a) A process to reject data from the data warehouse and to create the necessary indexes
 - (b) A process to load the data in the data warehouse and to create the necessary indexes
 - (c) A process to upgrade the quality of data after it is moved into a data warehouse
 - (d) A process to upgrade the quality of data before it is moved into a data warehouse ✓Ans. : (c)
- Q.6** The data is nothing but _____ that are generated during day to day transactions. ✓Ans. : (a)
- (a) facts and figures
 - (b) fields
 - (c) attributes
 - (d) records
- Q.7** Data represented in a meaningful context is termed as ✓Ans. : (b)
- (a) Record
 - (b) Information
 - (c) Attribute
 - (d) Field
- Q.8** Which of the following is a barrier in managing data ✓Ans. : (c)
- (a) data is stored on homogenous computing environments
 - (b) data is simple facts and figures
 - (c) data is stored on heterogenous computing environments
 - (d) None of above
- Q.9** _____ can be defined as a collection of processes, roles, policies, standards, and metrics that ensure the effective and efficient use of information in enabling an organization to achieve its goals ✓Ans. : (a)
- (a) Data governance
 - (b) Data cleansing
 - (c) Data management
 - (d) Data mining

- Q.33** In this step data is converted into a format to be stored in Data warehouses, which was previously stored in a format suitable for legacy systems.
- (a) Data transformation (b) Data cleansing
 (c) Data extraction (d) Data integration
- ✓Ans. : (a)
- Q.34** Data Refreshing involves
- (a) involves functions such as sorting, summarizing, consolidatingetc.
 (b) involves updating data from data sources to datawarehouse
 (c) involves conversion of data formats
 (d) None of above
- ✓Ans. : (b)
- Q.35** Which of these is not a benefit of datawarehousing
- (a) non volatile (b) faster analysis
 (c) competitive advantage (d) expensive
- ✓Ans. : (d)
- Q.36** _____ is a process that helps organizations manipulate important knowledge that comprises part of the organization's memory, usually in an unstructured format.
- (a) Knowledge management (b) Data management
 (c) Information management (d) All of above
- ✓Ans. : (a)
- Q.37** Knowledge is information that is
- (a) contextual (b) relevant (c) useful. (d) all of above
- ✓Ans. : (d)
- Q.38** _____ deal with the use of modern information technologies to systematize, enhance, and expedite intrafirm and interfirm knowledge management.
- (a) Knowledge management systems (b) Data Management Systems
 (c) Information Management Systems (d) Database Management Systems
- ✓Ans. : (a)
- Q.39** Basic steps in KMS cycle are
- (a) identify-gather-modify-manage-distribute
 (b) create-capture-refine-store-manage-disseminate
 (c) create-capture-store-manage-disseminate
 (d) identify-gather-refine-modify-manage-distribute
- ✓Ans. : (b)
- Q.40** What are the different roles played by a manager?
- (a) negotiator (b) leader (c) analyst (d) all of above
- ✓Ans. : (d)
- Q.41** Decision making process is composed of three major phases. They are:
- (a) intelligence, design and choice (b) intelligence, analysis and design
 (c) intelligence, analysis and choice (d) intellect, design and choice
- ✓Ans. : (a)
- Q.42** _____ refers to the process of searching for valuable business information in a large database, data warehouse, or data mart.
- (a) Data mining (b) Data hunting
 (c) Data retrieval (d) Data searching
- ✓Ans. : (a)

- Q.43** Data mining can perform operations such as
 (a) identifying previously unknown patterns. (b) predicting trends and behaviours
 (c) All of above (d) None of above **✓Ans. : (c)**
- Q.44** Decision support systems (DSSs) perform various types of analyses such as
 (a) Sensitivity analysis (b) What-if analysis
 (c) Goal seeking analysis (d) All of above **✓Ans. : (d)**
- Q.45** _____ is the study of the impact that changes in one or more parameters have on the output parameters
 (a) Sensitivity Analysis (b) What-if analysis
 (c) Goal seeking analysis (d) None of above **✓Ans. : (a)**
- Q.46** _____ tries to calculate the value of the inputs necessary to achieve a desired level of output.
 (a) Sensitivity Analysis (b) What-if analysis
 (c) Goal seeking analysis (d) All of above **✓Ans. : (c)**
- Q.47** _____ are used for presenting the results of the various types of analysis performed.
 (a) Dashboards (b) Widgets
 (c) Graphical Interfaces (d) None of above **✓Ans. : (a)**
- Q.48** Data visualization techniques involve
 (a) representing the impact of change in one or more input variables on the proposed solution.
 (b) representing data in visual formats such as text, tables, charts, graphics after analysis.
 (c) representing the impact that changes in one or more input parameters have on the output parameters.
 (d) discovery and representation of new correlations. **✓Ans. : (b)**
- Q.49** A _____ is a computer based system for capturing, integrating, manipulating, and displaying data using digitized maps.
 (a) geographic information system (b) global positioning system
 (c) geographic positioning system (d) global information system **✓Ans. : (a)**
- Q.50** _____ is an integration of geographic information systems and global positioning systems.
 (a) Data mining (b) Reality Mining
 (c) Datawarehousing (d) Satellite mining **✓Ans. : (b)**

MODULE 3

CHAPTER 3

Ethical Issues and Privacy

University Prescribed Syllabus

Information Security, Threat to IS, and Security Controls.

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► 3.1 ETHICAL ISSUES

- **Ethics** mean the guidelines that decide whether a behavior is right or wrong. A **code of ethics** is a collection of principles that aim to help in ethical decision making.
- Most of the modern organizations have developed their own codes of ethics also commonly called as **business ethics** to guide themselves as well as employees towards a good conduct at the workplace and at the same time protecting their employees' moral rights.

► 3.1.1 Ethical Frameworks

- Although there are many more, the four broadly used ethical standards are **the utilitarian approach, the rights approach, the fairness approach, and the common good approach**.
- According to the utilitarian approach, the act that does the most good or least harm to someone is ethical.
- The rights approach considers those actions as ethical that protect and respect the moral rights of someone to the greatest.
- The fairness approach states that treat all human beings equally or atleast fairly.
- Lastly, the common good approach emphasizes on social relationship where reverence and consideration for all beings is considered to be ethical.
- By combining these four standards, we can build up a general framework for ethical decision making. The framework can be summarized into five steps as follows:
 - o Identify the ethical issue and how it is affecting an individual or a group of individuals.
 - o Collect the relevant facts from the concerned people so that you are able to make a right decision.
 - o Assess all possible actions that can be taken based on any of the above approaches such as utilitarian, rights, fairness or common good approach.
 - o Take up a decision to select the best possible approach that solves the issue and also check its consequences or impact.
 - o Carry out the appropriate action.
- To understand the ethical framework we can consider this example. As per our belief an ethical action would be the one where an individual who does more of physical hard work should be paid more and one who does less work should be paid less.
- But in practicality, a construction labour that does maximum physical hardwork is not paid higher or even equally to the Vice President (VP) of a company who does comparatively less physical hardwork. So, is it really unethical act to pay a VP more and labour less?
- But if we analyze the scenario and collect the facts we see that the person who is paid more as VP has done a lot of hardwork initially and taken lot of efforts to reach that position and a labour worker could not pursue a good qualification due to some reasons and as a result has to do a lot of physical hardwork to earn a living.

- The VP is a person who is actually controlling the entire organization and its decisions. The job may involve less physical work but more of logical decision making as well as responsibility. Therefore paying a VP more and construction worker less is ideally ethical.
- Thus, we can see that we can apply the above framework to analyze a situation and decide whether an action is ethical or not.
- Consider another example where Government taking a decision to demolish an illegally constructed building. Although it is correct by law but it might seem unethical to destroy homes of so many people living in that building and making them homeless. So, any decision that is unethical need not be illegal.
- The fundamental code of ethics includes **responsibility, accountability and liability**.
- **Responsibility** means that an individual is answerable for the consequences of decisions/actions taken.
- **Accountability** means to find out who is responsible for decisions/actions taken.
- **Liability** means a person has the right to legally recover the harm or loss caused due to the decision/action.

3.1.2 Ethics and Information Technology

UQ. Explain the Ethical issues and threats of information security? MU - Q. 1(c), Dec. 19, 5 Marks

UQ. Describe the categories of ethical issues related to information technology.

MU - Q. 2(e), Jan 21, 5 Marks

- Once we have understood the concepts of ethics and ethical framework in general, let us go ahead with ethics related to Information Technology.
- **Computer ethics** involve appropriate use of computers. Examples of unethical use of computers include excessive usage of office internet for personal use by employees, a firm selling its customer information databases to other companies, monitoring of employees activities by employer when at work etc.
- There should be some rules and principles within an industry that will guide to what is ethical and what is not.
- The vast growth of IT applications has generated a variety of **ethical issues** that fall into four categories. They are:
 1. **Privacy issues** involve issues related to accumulating and protecting information about individuals. E.g. what information about someone can be revealed or what should be kept private, to what extent surveillance should be carried on an employee within an organization etc.
 2. **Accuracy issues** involve issues related to ensuring the preciseness and correctness of information about individuals. E.g. how to ensure that the information about customers in company databases like their addresses, contact numbers is all updated and correct.

3. **Property issues** involve issues related to ownership of information. E.g. who has the copyrights for a particular intellectual property and what is the fair and just means to access it, say by paying some amount of access fees.
4. **Accessibility issues** involve issues related to rights of an individual to use particular information and to what extent and at what price. E.g. who has the right to access confidential information within an organization, under what restrictions and to what extent?

► 3.2 PRIVACY

- Privacy is the right of an individual to not be disturbed or observed by anyone whereas Information privacy is the right of an individual to decide how much information about oneself can be revealed and/or collected by others.
- Information technology is becoming so advanced that collecting information of people is becoming very easy and rapid.
- This is leading to many questions on privacy issues related to individuals. Few examples of the same are discussed below.

☛ 3.2.1 Digital Dossiers

- **Digital Dossier** is nothing but creation of electronic profiles of people who use the internet. People visiting shopping websites, social networking sites, querying search engines, leave behind their digital footprints and reveal a lot about themselves.
- This information can be collected together from various places to generate a digital dossier of the person which is depicted in Fig. 3.2.1.
- Not only this but enough data about someone can be captured through surveillance systems such as CCTV cameras on traffic signals and toll roads, over telephone calls, through government records etc. The process of forming a digital dossier is also called as **profiling**.

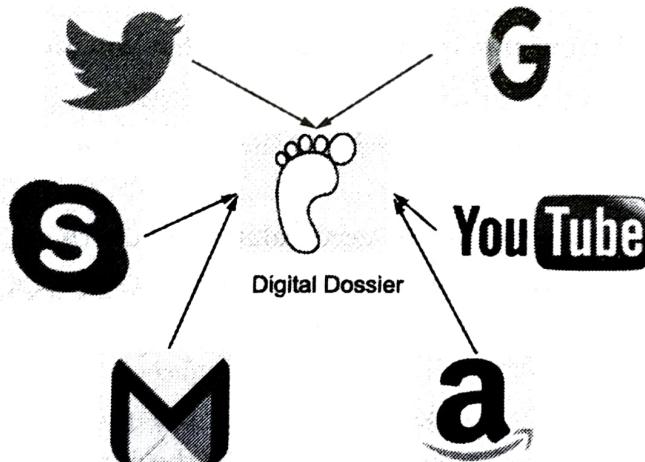


Fig. 3.2.1: Digital dossier

3.2.2 Electronic Surveillance

- Another major privacy related concern is Electronic Surveillance. According to law carrying out electronic surveillance is considered legal.
- Therefore, there is almost no restriction on employers conducting surveillance on their employees or by the government on the citizens.
- Employers can monitor and track the employees' e-mails, softwares and documents stored on the employees' computer and also trace their internet usage pattern.
- If needed employees may incorporate url filtering to restrict access to inappropriate content on the internet and also to avoid wastage of employee time and increase their productivity.
- The Government also keeps a track of vehicles passing through toll roads and traffic signals through CCTV surveillance.
- The technologies used to conduct this surveillance are becoming easily achievable and affordable at very cheaper costs.
- Devices such as digital cameras, sensors, data collection and storage technologies have become quiet inexpensive.
- That is the reason for rapid growth in usage of these technologies by various organizations and government agencies.

3.2.3 Personal Information in Databases

- Many Organizations collect and store information about individuals in their organizational databases.
- Banks maintain their customer databases, hospitals have their patient databases, and schools have their student databases. How appropriately is this information being used by organizations? And do they ensure that integrity of this information is maintained?
- Do the organizations guarantee that this information will not be misused or propagated to some other organizations for profit making without the consent of the individual? Maintaining an appropriate balance between data collection and personal privacy is very important.

3.2.4 Information on Internet Bulletin Boards, Newsgroup and Social Networking Sites

- In our daily lives we are making extensive use of newsgroups, chatrooms, weblogs and social networking sites.
- The bulletin boards and blogs are regularly updated and also contain personal opinions and views.
- Do these groups ensure that the information they reflect about someone is completely true, authentic and not offending anyone?
- Anonymous and offensive information on such websites about individuals can defame them and can have a negative impact on their image. It is a major ethical issue to maintain a right balance between freedom of speech and privacy.

3.2.5 Privacy Policies

- **Privacy policies** are rules framed by an organization to guide them as to which information about their customers and employees can be revealed and which should be kept private.
- Many organizations give their customers the choice to decide what kind of information and to how much extent can that information be collected from them in the form of opt-in and opt-out models, cookies, private browsing methods etc.

(i) Privacy Policy Guidelines

The Privacy policy guidelines emphasize on three major aspects.

- **Data Collection** : Data about individuals should be collected only with their consent. Secondly, only that much data should be collected that will suffice the business needs. Say, if a company wants to take feedback about their product from the customer, then only sufficient data to get reviews from the customer should be collected. No other hidden means should be used to track additional information about the customer without his consent.
- **Data Accuracy** : Very personal and essential information collected about individuals should be properly validated by the individuals themselves before storing them into company databases for future references. Changes to this stored data must be checked and updated regularly with the latest copy of it, so that all authorized users have access to the updated version of the information.
- **Data Confidentiality** : Proper security mechanisms to protect data from unauthorized access should be applied. Anyone other than the authorized user should take proper permissions to access the information.

(ii) Data Protection Laws

- The Data Protection Laws implement the above guidelines to streamline the ways an individual's personal data is collected, stored and disseminated.
- These laws help in protecting the privacy and integrity of data about individuals which is possessed by business organisations.
- In India today we have minimal laws that administer data protection and privacy.
- The Law in India that deals with data protection and privacy is the **Information Technology Act, 2000** and the **(Indian) Contract Act, 1872**.
- The Government has also advised the Information Technology Rules, 2011. The Rules only deal with protection of very confidential and personal information such as passwords, bank details, credit/debit card information, medical records, mental conditions, sexual orientation etc.

(iii) International Aspects of Privacy

- With the rapid growth and excessive use of the Internet, governments all over the world have enacted a large number of inconsistent privacy and security laws.

- Approximately fifty countries have some form of data-protection laws. Many of these laws conflict with those of other countries, or there are countries that have no privacy laws at all.
- The absence of consistent or uniform standards for privacy and security obstructs the flow of information among countries, a problem we refer to as *transborder data flows*.
- For example, since many countries are outsourcing their work into India, data protection has become a critical political issue.
- Lack of data protection laws in India does not generally affect India's ability to handle personal information from the United States but the growing market of outsourcing from EU countries is placing greater pressure for India to abide by their rules and regulations.
- So, the same country India has to follow different laws and to what extent it can actually fulfil the data protection restrictions is still questionable. And problems like these will become more complicated over a period of time where online businesses are increasing rapidly.
- Governments must make an effort to develop laws and standards to cope with rapidly changing information technologies in order to solve some of these concerns.

► 3.3 INFORMATION SECURITY

❖ 3.3.1 Introduction to Information Security

- **Information security** specifies the various rules designed to safeguard an organization's information and information systems (IS) from access and misuse by unscrupulous users.
- The security measures are applied to overcome the threats posed on the safety of these information resources.
- A **threat** is nothing but any risk or danger to which a system may be exposed. Whereas **vulnerability** refers to the weaknesses of the information systems that increase the chances of systems being affected by some form of threat.

The root causes to these vulnerabilities can be explained as below:

- (A) Today's Interconnected, Interdependent, Wirelessly Networked Business Environment
 - (B) Smaller, faster, cheaper computers and storage devices
 - (C) Decreasing skills necessary to be a computer hacker
 - (D) International organized crime taking over cybercrime
 - (E) Lack of management support

► (A) Today's Interconnected, Interdependent, Wirelessly Networked Business Environment

- With the advent of Internet, the computer systems can be connected anywhere over the globe and information can be easily shared anywhere and anytime.

- And as a result alongwith trusted networks within the organization, untrusted networks which are external to the organization can also easily get access to the organizational resources.
- To add to it, the upcoming use of wireless technologies is making it even more dangerous to secure private information.

► **(B) Smaller, faster, cheaper computers and storage devices**

- Modern technologies and computing equipments such as laptops, palmtops, pendrives, smart phones used for information storing, processing and sharing are becoming quiet smaller, cheaper and easily portable.
- Because of which they can be easily lost or stolen and as a result important information stored in them can easily be achieved by unauthorized users.

► **(C) Decreasing skills necessary to be a computer hacker**

- The Internet has become a huge source of information of any type.
- Due to which any person with minimal technical knowledge can easily learn the tricks to hack sensitive information from any computerized system.
- They can easily understand the code and scripts that can be used to invade information systems.

► **(D) International organized crime taking over cybercrime**

- Lot of cybercrimes are happening for money making purposes .Although they might not be that brutal but they may lead to losses of thousands of dollars to the victim.
- Computer-based crimes cause huge damage to businesses in terms of cost of loss of business as well as recovery costs.

► **(E) Lack of management support**

- Lastly, the support of top level management for incorporating security policies within the organizations for safeguarding their information resources is very important.
- The lower level managers and executives who are responsible for the day-to-day activities of the other employees must monitor and keep a track that those policies are being strictly implemented.

3.3.2 Principles of Information Security

Any information security measure implemented should follow the following principles.

- **Confidentiality** : Confidentiality refers to personal information about an individual that generally cannot be revealed to third parties without his consent. Very often the terms "confidentiality" and "privacy" are used interchangeably.
- **Integrity** : Integrity refers to ensuring that the data has not been corrupted or changed and is accurate and consistent.
- **Availability** : Availability refers to timely, reliable and continual accessibility of data.

- **Non repudiation** : Non repudiation refers to non denial by an individual of being responsible for a particular action.
- **Authenticity** : Authenticity refers to proving that the information is legitimate and reliable.
- **Accountability** : Accountability means taking responsibility for what you do with personal data and how you comply with the other principles.

3.3.3 Security Threats

UQ. Explain the Ethical issues and threats of information security ?

MU - Q. 1(c), Dec. 19, 5 Marks

UQ. What are major security threats to the information system? Discuss the measures taken to control information security.

MU - Q. 4(b), Dec. 19, 10 Marks

Information systems within organizations are susceptible to various types of threats. These threats can be classified into two major types :

(a) Unintentional Threats

(b) Deliberate Threats

We will discuss both the types in detail in the further section and the same has been shown in the Fig. 3.3.3.

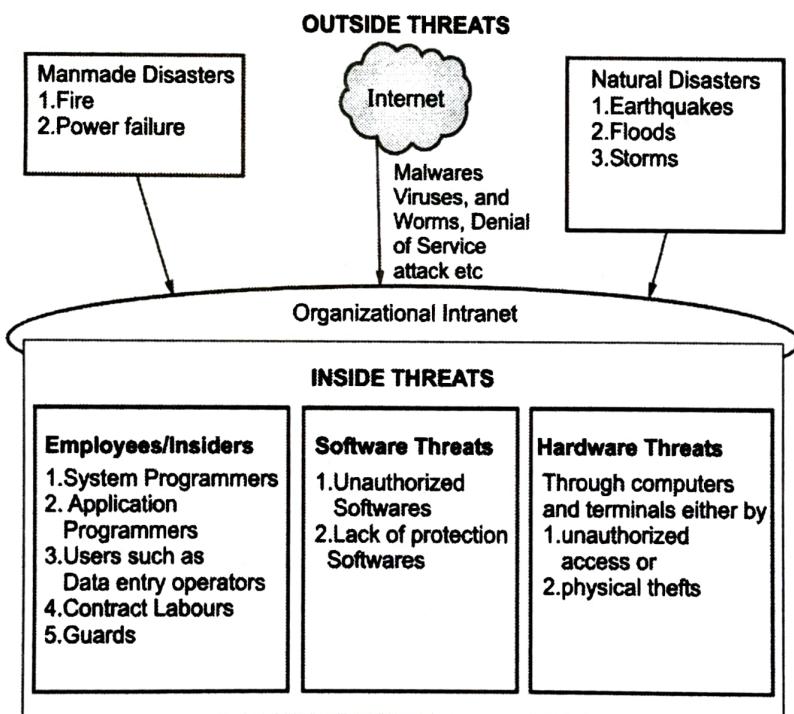


Fig. 3.3.3 : Security Threats

Let us have a look at Unintentional Threats.

► (a) **Unintentional Threats**

These type of threats are unintended and unplanned threats but if caused impose serious problems to information security. The main class of threats under this type are threats that are caused due to **Human errors**.

1) Human Errors

- Mistakes caused by employees within an organisation could pose severe issues to information security.
- Who are the people who could be a major cause of such problems? First and foremost the higher level employees who have access to the entire organizational data.
- Secondly, the human resource people who deal with the personal data of all the employees and the software people who control the entire information systems within the organization.
- The information security employees have all the privileges to access, create, store, and modify critical data within the organization. A small mistake by these people could lead to disastrous impact on the information security.
- Other than these, employees like contract labours and guards could also be indirectly responsible for information leakage because contract labours are also temporarily hired and cannot be completely relied upon.
- Security guards could also be appointed on contract basis and many a times they are the ones who are working when the entire office staff has left. Any kind of negligence from such employees also could be a risk factor.
- Other types of human errors which could lead to loss of information could be due to carelessness and laziness of individuals like forgetting to logout from personal machines, setting weak passwords, misplacing personal devices like laptops, disposing off old equipments without erasing personal data etc.

2) Social Engineering

- The second class of unintentional threats is **Social Engineering**.
- It is a type of attack caused by social interactions. The employees within the organization are fooled by attackers by psychologically manipulating them to reveal confidential information. Examples of social engineering attacks include **Impersonation, Exterminator, Tailgating, Shoulder Surfing**.
- **Impersonation** : Such type of attacks include fraud calls impersonating some senior official of the company, pretending to have forgotten some important password and tries to convince the junior employee to reveal the same.

- **Exterminator** : Somebody who pretends to be a Computer technician or an AC repair person and gets an entry into the organization. He then uses his tricks to gain information from employees through social skills.
- **Tailgating** : Also known as piggybacking, is a physical security breach in which an unauthorized person follows an authorized employee to enter a secured premise.
- **Shoulder Surfing** : An attack where the suspect watches over the employees shoulder to gather some secret information. May be a visitor in the company just tries to watch the computer screen standing behind the employee.

Also in public places like airports or public transport where the employee is doing his office work on personal laptop and somebody tries to spy the activities of the employee without his knowledge to gain some confidential information.

► (b) Deliberate Threats

Such attacks are caused on purpose to pose serious problems to information security. The various types of deliberate threats are discussed below.

- **Espionage** : Espionage is like trespassing, where an unauthorized person tries to gain access to organizational information through illegal means.
- **Information Extortion** : Information extortion is where an attacker steals or threatens to steal confidential information from the organization. The attacker may force the organization to pay a ransom for not misusing that information.
- **Sabotage or Vandalism** : Sabotage or vandalism involves defaming the image of the organization by giving negative reviews or false tweets about the company and its products and services. This leads to a catastrophic impact on the customer loyalty and the company might lose its customers.
- **Theft of Equipment or Information** : All the computing devices used these days such as laptops, PDAs, smartphones etc. are getting smaller in sizes but larger in their computing and storage capability. They are also easily portable and as a result chances of them getting lost or being stolen is increasing. And once stolen attackers could easily try to retrieve the information from these devices.
- **Identity Theft** : Identity theft is an intentional attempt to steal some ones identity to misuse it. Usually it is done to get access to the person's financial information such as bank account details, credit card information etc. This can be done through impersonation, stealing the mails or searching through disposed off items like old files and folders, pendrives etc. (also called as dumpster diving).
- **Compromises to Intellectual Property** : Intellectual property rights are the rights given to persons or organizations for creation of their original work and usually for a particular duration of time. Four types of intellectual properties are *Copyrights, Patents, Trademarks, and Trade Secrets*. Protecting such intellectual properties is a very critical issue for people who make their livelihood in knowledge fields.

- A **trademark** is a type of intellectual property consisting of a recognizable sign, design, or expression which identifies products or services of a particular source from those of others.
- A **trade secret** is an intellectual work, such as a business plan, that is a company secret and is not based on public information. An example is the Coca-Cola formula.
- A **patent** is an official document that grants the holder exclusive rights on an invention or a process for a specified period of time.
- **Copyright** is a statutory grant that provides the creators or owners of intellectual property with ownership of the property for a designated period. Owners are entitled to collect fees from anyone who wants to copy their creations. Copyright laws protect expression of ideas rather than the ideas themselves. Under section 13 of the Copyright Act 1957, copyright protection is conferred on literary works, dramatic works, musical works, artistic works, cinematograph films and sound recording.

- **Software Attacks**

Since the computers and the internet have evolved, software attacks have taken pace. Cybercrimes are increasing, attackers are using malicious softwares to infect as many computers all over the world with the intent of money making or personal rivalries. Few of the software attacks include:

- **Virus** : A small code or script that attaches to another computer program to cause malicious actions.
- **Worm** : A small computer code or script that not just performs malicious actions but also replicates and spreads by itself.
- **Phishing Attack** : Phishing attacks use some fraudulent technique to gain access to confidential information by impersonating some official looking emails or messages.
- **Denial-of-Service Attack** : Attacker sends so many requests to a computer system which it is unable to handle and as a result crashes.

- **Alien Softwares**

- **Alien softwares** are like undercover programs that are installed on your computer through deceitful methods.
- These softwares are not that harmful but could be annoying like the adware softwares that keep flashing some pop up ads on the screen or small pieces of code like the cookies that can track the behaviour and surfing patterns of an individual on the Web.

- **Supervisory Control and Data Acquisition(SCADA)Attacks**

- SCADA systems are distributed control systems used to control chemical, physical, and transport processes used in oil refineries, water and sewage treatment plants, electrical generators, and nuclear power plants.
- They make use of sensors that are connected in a network and if attackers get access to the network, they can cause severe damage to the operations of the oil refineries or nuclear plants.

- Cyberterrorism and Cyberwarfare

- o **Cyberterrorism and cyberwarfare** include making use of computer systems connected over a network to perform some kind of harm to other computer systems with the intent of destroying or damaging the systems or revealing some sensitive information.
- o Such actions are usually carried out for money or to oppose a political agenda.

3.3.4 Information Security Controls

UQ. Identify the three major types of controls that organizations can use to protect their information resources, and provide an example of each one? MU - Q. 2(f), Jan. 21, 5 Marks

UQ. What are major security threats to the information system? Discuss the measures taken to control information security. MU - Q. 4(b), Dec. 19, 10 Marks

- To safeguard the critical information within the organization many security controls are being implemented.
- All the aspects of an information system including hardware, software, data and networks need to be protected using various countermeasures.

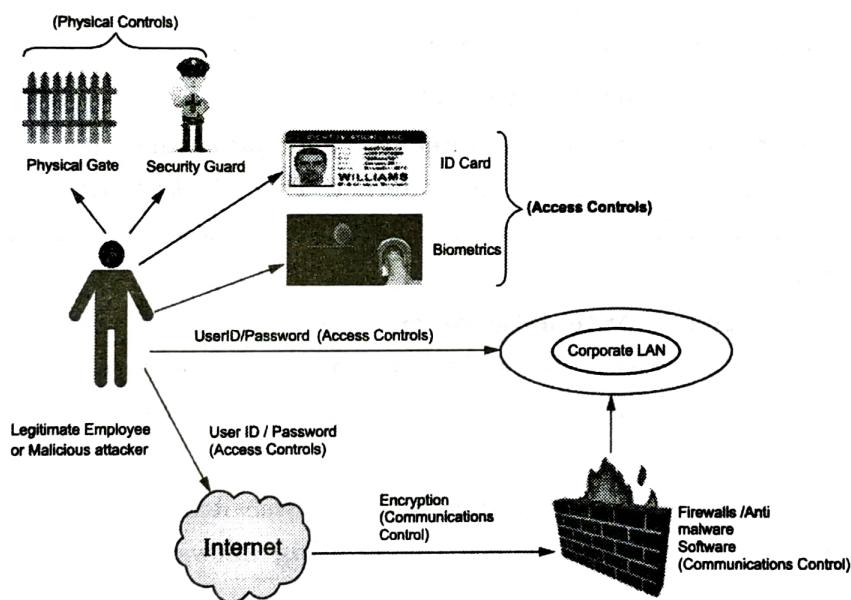


Fig. 3.3.4 : Types of Security Controls

- The three major types of controls include **physical controls, access controls, and communications controls**. Fig. 3.3.4 illustrates these controls.

Physical Controls

- **Physical controls** are applied to prevent unauthorized access to a company's confidential information.
- Common physical controls include physical gates, security guards and alarm systems.

- Such type of controls also keeps a check that the employees log off their systems when they leave the office.

Access Controls

- **Access controls** also avoid unauthorized access to organizational information .Common access controls include: **authentication and authorization**. **Authentication** is a process to check the identity of the person before giving him access to confidential data. Authentication methods involve IDs and passwords, biometrics etc.
- Biometric is a method of human identification based on his physical characteristics such as fingerprint recognition, face recognition, iris recognition etc.
- Once an individual is authenticated then is applied the process of authorization. **Authorization** decides what kind of privileges and access rights is given to the individual based on his identity.

Communications Controls

Communications controls deal with various **network controls**. They deal with secure transfer of data over the network. Communications controls consists of firewalls, anti-malware systems, encryption, virtual private networks(VPNs), secure socket layer(SSL) / transport layer security(TLS), and employee monitoring systems.

- **Firewalls** : A **firewall** is a system that filters the information that should enter corporate LAN from untrusted outside world through the internet. The filtration depends upon specific rules defined within the firewall. It prevents unauthorized users to access company's private network over the internet.
- **Anti-malware Systems** : **Anti-malware systems** commonly known as *antivirus* software identify and remove viruses and worms. They are installed on corporate computer systems. Most widely used anti viruses include McAfee, Norton antivirus, Quick Heal etc
- **Whitelisting and Blacklisting**
 - o **Whitelisting** allows only permitted softwares or websites to run on corporate systems i.e. those which are whitelisted whereas **Blacklisting** allows all the softwares and websites except those on the blacklist.
 - o For example, a company might blacklist porn websites so that employees do not indulge into unfair activities or may restrict peer-to-peer file sharing on its systems.
- **Encryption**
 - o It is the process of converting a plaintext (original message) into ciphertext (form which cannot be understood by anyone except the intended recipient). Encryption systems use keys which are used for encoding and decoding the messages.
 - o Common type of encryption method used is **Public-key encryption** which is an asymmetric key encryption i.e it makes use of two sets of keys-public and private for encryption and decryption process. Usually public key is known to all whereas private key is kept secret.

- There are third party verification authorities also called as **Certification Authority (CA)** such as Verisign, which issue digital certificates to organizations.
 - These digital certificates act as an identity proof for an organization and are valid for a particular period. Having a certificate from a CA ensures that the company is genuine and transactions carried out with such organizations are verified and safe.
- **Virtual Private Networking**
- A **virtual private network** is a private network but makes use of public network such as the Internet to connect users.
 - VPNs use a process called **tunnelling** that encrypts each data packet that is to be sent and envelopes each encrypted packet inside another packet. In this manner, the packet can travel across the Internet with confidentiality, authenticity, and integrity.
- **Secure socket layer protocol**
- It is also called as Transport Layer Security (TLS).
 - TLS encrypts and decrypts data between a Web server and a browser. Any website using TLS has the URL beginning with “https” rather than “http,” and it often displays a small padlock icon in the browser’s status bar. Padlock icon indicates secure connection.
- **Employee monitoring systems**
- They are a kind of surveillance systems that monitor the activities of employees like their usage of office computer systems, their e-mail activities, Internet surfing activities.
 - These systems are implemented by corporates as a step to avoid unethical behaviour as well as avoiding and tracking employee mistakes.
 - With the help of such systems, company authorities can easily identify employees who spend too much time surfing on the Internet for personal reasons or who visit questionable websites.

3.4 MULTIPLE CHOICE QUESTIONS

- Q.1** The purpose of a copyright is _____. (Jan. 2021)
- (a) Closely safeguarded as a secret, or legal protections are lost
 - (b) Information that gives one company a competitive advantage over others
 - (c) Designed to protect the expression of ideas
 - (d) Designed to protect inventions, tangible objects, or ways to make them ✓Ans. : (c)
- Q.2** _____ is the method of translating an original message into a type that, except for the intended recipient, cannot be interpreted by anyone. (Jan. 2021)
- (a) Virtual Private Network (VPN)
 - (b) Firewall
 - (c) Secure Socket Layer (SSL)
 - (d) Encryption ✓Ans. : (d)

- Q.3** The identity of the person who needs access is verified by a process called as _____
 (a) Authentication (b) Authorization (c) Biometrics (d) Password ✓Ans. : (a)
 (Jan. 2021)
- Q.4** Which of the following statements does NOT provide an accurate description of ethics?
 (a) Ethics is the code of moral principles that sets standards of "good" versus "bad" or "right" versus "wrong."
 (b) Ethics provide principles to guide the behaviour of individuals and groups.
 (c) Ethics is a set of principles that guide the organization's analysis of its external environment and the formulation of actions to respond to that environment.
 (d) Ethics provides principles that help people in making moral choices among alternative courses of action. ✓Ans. : (c)
- Q.5** _____ reflect(s) the code of moral principles that sets standards as to what is "good" versus "bad" or "right" versus "wrong" in people's conduct, and thereby guides their moral choices and behaviour.
 (a) Group norms. (b) Legal behavior (c) Ethics (d) Civil law. ✓Ans. : (c)
- Q.6** _____ is the practice and precautions taken to protect valuable information from unauthorised access, recording, disclosure or destruction.
 (a) Network Security (b) Database Security
 (c) Information Security (d) Physical Security ✓Ans. : (c)
- Q.7** From the options below, which of them is not a vulnerability threat to information security?
 (a) natural calamity like floods (b) without deleting data, disposal of storage media
 (c) unchanged default password (d) latest patches and updates not done ✓Ans. : (a)
- Q.8** A _____ is a computer program that can invade computer and perform a variety of functions ranging from annoying (e.g. popping up messages as a joke) to dangerous (e.g. deleting files)
 (a) Computer Virus (b) Antivirus
 (c) Ms Word (d) Ms Access ✓Ans. : (a)
- Q.9** _____ is the right to determine when and to what extent information about you can be gathered and/or communicated to others.
 (a) Information Privacy (b) Information Integrity
 (c) Information Right (d) Information Leakage ✓Ans. : (a)
- Q.10** Which of the following is not a vulnerability factor to organizational information?
 (a) Today's interconnected, interdependent, wirelessly networked business environment
 (b) Smaller, faster, cheaper computers and storage devices;
 (c) Decreasing skills necessary to be a computer hacker;
 (d) Increasing use of firewalls. ✓Ans. : (d)

- Q.21** The process of forming a digital dossier is also called as _____
(a) Dossiering (b) Footprinting
(c) Profiling (d) None of above **✓Ans. : (c)**

Q.22 _____ is the creation of electronic profiles of people who use the internet.
(a) Digital Profile (b) Digital Dossier (c) Digital Print (d) Digital trace **✓Ans. : (b)**

Q.23 The Privacy policy guidelines emphasize on three major aspects of data:
(a) data collection, data accuracy, data confidentiality
(b) data privacy, data accuracy, data property
(c) data authenticity, data confidentiality, data integrity
(d) data responsibility, data accountability, data liability **✓Ans. : (a)**

Q.24 The Law in India that deals with data protection and privacy is the
(a) Information Technology Act, 2000 (b) Data Protection Act, 2000
(c) Information Privacy Act, 2000 (d) None of above **✓Ans. : (a)**

Q.25 Transborder Data flow issues deal with
(a) The absence of uniform standards for privacy and security that obstructs the flow of information among cities
(b) The absence of uniform standards for privacy and security that obstructs the flow of information among countries
(c) The absence of uniform standards for privacy and security that obstructs the flow of information among states
(d) None of above **✓Ans. : (b)**

Q.26 _____ specifies the various rules designed to protect an organization's information and information systems (IS) from misuse.
(a) Information protection (b) Information privacy
(c) Information security (d) Information system protection **✓Ans. : (c)**

Q.27 A _____ is any risk or danger to which a system may be exposed.
(a) Threat (b) Vulnerability (c) Hazard (d) Menace **✓Ans. : (a)**

Q.28 _____ refers to the weaknesses of the information systems that increase the chances of systems being affected by some form of threat.
(a) Threat (b) Vulnerability (c) Risk (d) Danger **✓Ans. : (b)**

Q.29 Which of these is not a principle of Information security
(a) Confidentiality (b) Integrity (c) Non-repudiation (d) Testability **✓Ans. : (d)**

Q.30 The two major categories of threats to information systems are
(a) intentional and deliberate (b) purposeful and unpurposeful
(c) unintentional and deliberate (d) None of above **✓Ans. : (c)**

Q.31 Which of these are examples of unintentional threats?

- (a) Human errors
- (b) Social engineering
- (c) Impersonation
- (d) All of above

✓Ans. : (d)

Q.32 _____ include fraud calls pretending to have forgotten some important information.

- (a) Exterminator
- (b) Impersonation
- (c) Tailgating
- (d) Shoulder surfing

✓Ans. : (b)

Q.33 Somebody who pretends to be a computer technician or fire marshal and gets an entry into the organization is which type of attack?

- (a) Exterminator
- (b) Impersonation
- (c) Tailgating
- (d) Shoulder surfing

✓Ans. : (a)

Q.34 It is a physical security breach in which an unauthorized person follows an authorized person to enter a secured premise.

- (a) Exterminator
- (b) Impersonation
- (c) Tailgating
- (d) Shoulder surfing

✓Ans. : (c)

Q.35 _____ involves defaming the image of the organization by giving false negative reviews.

- (a) Sabotage
- (b) Espionage
- (c) Tailgating
- (d) Impersonation

✓Ans. : (a)

Q.36 Information extortion is where

- (a) an unauthorized person tries to gain access to organizational information through illegal means
- (b) an attacker steals or threatens to steal confidential information from the organization and asks for ransom for not misusing it.
- (c) an attacker tries to defame the reputation of an organization.
- (d) None of above

✓Ans. : (b)

Q.37 _____ is an intentional attempt to steal someones identity to misuse it.

- (a) Identity theft
- (b) Identity breach
- (c) Identity robbery
- (d) Identity burglary

✓Ans. : (a)

Q.38 _____ are the rights given to persons or organizations for creation of their original work and usually for a particular duration of time.

- (a) Right to Identity
- (b) Authorization Rights
- (c) Intellectual property rights
- (d) Access control rights

✓Ans. : (c)

Q.39 A _____ is a type of intellectual property consisting of a recognizable sign, design, or expression which identifies products of an organization.

- (a) Trademark
- (b) Patent
- (c) Copyright
- (d) Trade secret

✓Ans. : (a)

Q.40 A small computer code or script that not just performs malicious actions but also replicates and spreads by itself.

- (a) Worm
- (b) Virus
- (c) Bug
- (d) Germ

✓Ans. : (a)

Q.41 A _____ is an official document that grants the holder exclusive rights on an invention or a process for a specified period of time.

- (a) Trademark
- (b) Patent
- (c) Copyright
- (d) Trade secret

✓Ans. : (b)



- Q.42** Attacker sends too many requests to a computer system which it is unable to handle and as a result crashes. Which type of attack is it?
 (a) Denial of service attack (b) Phishing attack
 (c) Trojan horse attack (d) Alien attack ✓Ans. : (a)
- Q.43** Which controls prevent unauthorized access to organizational information?
 (a) Physical controls (b) Access controls
 (c) Communication controls (d) Patent control ✓Ans. : (b)
- Q.44** Access control involves
 (a) authentication and authorization (b) verification and validation
 (c) authentication only (d) verification only ✓Ans. : (a)
- Q.45** _____ is a method of human identification based on his physical characteristics such as fingerprint,iris etc
 (a) Physical metrics (b) Geometrics
 (c) Biometrics (d) None of above ✓Ans. : (c)
- Q.46** A _____ is a system that filters information that should enter corporate LAN from untrusted outside world through the internet.
 (a) Firewall (b) Virtual Private Network
 (c) Secure Socket Layer (d) Transport Layer Security ✓Ans. : (a)
- Q.47** Any website with URL beginning with “https” is using
 (a) Firewall (b) Transport Layer Security
 (c) Virtual Private Network (d) Tunneling ✓Ans. : (b)
- Q.48** A _____ is a private network but makes use of public network such as the Internet to connect users.
 (a) Virtual Public Network (b) Virtual Private Network
 (c) Bayesian Network (d) Neural Network ✓Ans. : (b)
- Q.49** Public-key encryption makes use of
 (a) asymmetric keys (b) symmetric keys
 (c) public keys (d) private keys ✓Ans. : (b)
- Q.50** Third party verification authorities also called as _____ issue digital certificates to organizations.
 (a) Certification Power (b) Certification Supremacy
 (c) Certification Autonomy (d) Certification Authority ✓Ans. : (a)
- Q.51** Which of these is not an Anti-malware system?
 (a) CCleaner (b) McAfee (c) Norton Antivirus (d) QuickHeal ✓Ans. : (a)

MODULE 4

CHAPTER 4

Social Computing (SC)

University Prescribed Syllabus

Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.

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4.1 INTRODUCTION TO SOCIAL COMPUTING

- The information systems developed initially focused more on efficiency of business processes, increasing productivity, reducing cost, increased profits etc. But now there is a diversion in the way information systems are working.
- The information systems are combined with another attribute called social behaviour to add value to business processes.
- This led to emergence of new field in business called Social Computing.
- **Social Computing** is an area of computer science that is concerned with the intersection of social behaviour and computational systems.
- There are various social platforms or softwares such as blogs, emails, wikis, instant messaging, social networking sites which are an important part of social computing.
- So, now it is not just the company who has control of what is being displayed on the web but even users such as customers can contribute to the content.
- They can provide this content directly when they give their reviews or feedback of a product that they had purchased from a company or by rating movies they watched.
- This type of platform is giving the control now in the hands of the user to interact directly and make this information available to everyone. Such content can help other users to make a decision while buying a product.
- At the same time it may help the organization to better understand the opinion of people about their product. If the opinion is bad the company can think of devising measures to improve their product.
- That is the power of social computing. Since, humans are social individuals and their behaviour and decisions are influenced by the people around them, the main aim of social computing is to improve association and interaction among people.
- Now, business organizations have to be keener, genuine, and truthful towards their customers as well as employees because failing to do so can affect their image badly and this can be easily reflected on the social media platforms by their customers or employees.
- All over the world wherever these social platforms like Facebook, Twitter, Youtube, Picasa, Wikis, etc. are being used extensively, social media is gaining popularity.
- Business organizations are making use of social computing in different ways for advertising and marketing their products and services, to improve customer relationship management processes, to develop better supply chain, make their human resource management efficient etc.
- Social Computing makes it so easy for someone who wants to start his business because all the knowledge about the competitors, their products, and people's feedback about the competitor products everything is available on such social platforms.
- As a result of use of Social Computing in business, it is often termed as Social Commerce. Social Computing makes use of Web 2.0 tools extensively. So let us see what Web 2.0 is.

4.2 WEB 2.0

- The first generation of Web was Web 1.0 which marked the beginning of creation of websites and commercialization of the Web. Users hardly interacted with Web 1.0 websites. We can say it was more static and only for information sharing purpose.
- As against Web 1.0, Web 2.0 is a more flexible and dynamic platform. It emphasizes more on user participation and social interaction. Web 2.0 is also called participative social web.
- It generates dynamic content that is receptive to user inputs. It provides various online tools and platforms where people can share their thoughts, perspectives, opinions, experiences etc.
- Web 2.0 websites range anywhere from social networking sites that let users upload photos and tag them, websites which deliver functionalities such as web services, others that mix up data from two or more applications as in web mashups or simply gather and display information on a particular topic from multiple sources as in wikis.
- The end user is not just a user of the application but he can also participate and contribute to the contents through blogging, podcasting, tagging, web content voting, rss feeds etc. We will discuss a few Web 2.0 tools in the next section.

4.2.1 Ajax

- Ajax stands for Asynchronous Javascript and XML. It makes the applications more dynamic, interactive and user friendly.
- It updates part of a webpage asynchronously without the need to reload the entire webpage. The technology makes use of an XMLHttpRequest object to request data from a web server which is in-built into the browser and JavaScript and HTML DOM to display or use the data.
- This makes the webpages more responsive by reducing the response time and enhances user experience.

4.2.2 Really Simple Syndication (RSS)

- This tool allows you to accumulate information about a particular topic of interest from different websites at one place, so that the user need not browse through several websites to collect the information.
- RSS is nothing but a collection of web feeds that provide updated information about anything such as blog entries, news headlines, or audio or video files.
- Using RSS anyone can syndicate/publish their content and anyone who is interested in the content can subscribe to it.
- When there are updates to the subscribed contents, the subscriber is notified. The subscriber can click on the notification link to view the complete content.
- There is a RSS feed reader that fetches the information and converts the files into the latest updates from websites in an easy to read format.

- The RSS reader is similar to your email inbox. When you subscribe to the RSS feed for a particular website, the RSS reader displays content from that website.

4.2.3 Tagging

- A **tag** is a meaningful term or a metadata used to describe something or someone, say for eg, a blog, a picture, an article, or a video clip. Application of tagging is seen commonly on Facebook, Twitter, and Instagram.
- **Tagging** helps to identify someone in a post, photo, tweet, or status update. This **tag** takes the form of a clickable name that will notify a person that you have referred to them in a post or photo.
- This type of tagging is called **phototagging** where the tagged photos get linked with the associated user's profile.
- Similarly, there is **geotagging** that deals with tagging information on maps, like Google map allows users to add pictures and information, such as hotel reviews and ratings to the maps.
- This helps other users as they can see pictures, ratings and other relevant information alongwith the location details.

4.2.4 Blogs

- A **blog** is an informational website that displays the information in a descending chronological order. The **bloggers** are the ones who contribute to the content.
- They are individuals or groups who share their views on common topics of interest. They write stories, convey news, and provide links to other articles of interest to them.
- Anyone can create blogs by registering to blogging service providers such as www.blogger.com, which is now owned by Google.
- **Blogosphere** is a term for millions of blogs on the Web. Although blogs could be useful but it is not necessary that they are always authentic and true.
- The views that clients put on the blogs about a company and its products and services need not always be correct.
- Another way of blogging is through short messages or by taking pictures or videos and publishing them. This is known as **microblogging**. Usually these messages are short upto 140 characters.
- **Twitter** is one of the most popular and free microblogging service. The messages sent by users on Twitter are known as **tweets**. All the users who sign up to someone's profile can see those tweets on the user's profile page.
- It can be used as an effective tool by companies to improve their business. They can provide information about their products and services and can also get feedback about the same from their customers.

4.2.5 Wikis

Wikis are collaborative websites with open editing facility. Any user can add, delete or modify content on the wiki pages.

Wikipedia is the world's largest online encyclopedia with around 3.4 million articles. There are administrators who monitor the content on these pages and have the authority to delete content which is not authentic. But still there is a controversy on the reliability of the content on such wikis.

Wikis enable companies to collaborate with customers, suppliers, and other business partners on projects. Wiki pages describing a company's product can be created and customers can be given access to edit these wiki pages with their opinions, reviews or add any additional description of the product.

4.2.6 Social Networking Websites

Social networking website is a network formed by connecting people together over a social platform with the intent of friendship, business collaboration, improving family relationship, trade etc. On social networking websites individuals can create their own profile pages for free.

They can then post pictures, videos or music, play games, chat with one another and also form virtual communities such as virtual marketplaces where buying and selling of goods can be done.

Facebook is a social networking site for general public to meet socially, **LinkedIn** which is a professional networking site and **Youtube** which is media sharing site.

4.2.7 Web Mashups

Web Mashup is a website that takes various content from different websites and mixes them together to create a new content. The first ever mashup being created was **Google Maps**.

For example a travel agent can create a mashup on his website by taking maps from Google and then adding descriptive information about the location, tourist attractions and hotels in the nearby locality. A vast list of mashups can be found on www.programmableweb.com.

4.3 WEB 3.0

- While Web 2.0 technologies were still emerging, there came up a new era of web that was **Web 3.0**. It is a leap forward to open, trustless and permissionless networks.
- Why do we say soopen, trustless and permissionless?
 - ‘Open’ because these technologies are built using open source softwares and collaborative development by open community of developers.
 - ‘Trustless’ because there is no need of any third party authentication or verification.

- ‘Permissionless’ because no special permissions are required for participation. Anyone from the client side or developer side can contribute to the content.
- Web 3.0 focuses on innovative technologies such as edge computing, decentralised data networks and artificial intelligence.
- It all deals with computing which is distributed and brings computation and data storage closer to the location where it is needed to improve response times and save bandwidth.
- Web 3.0 refers to the evolution and alteration of Web into a database and also further upgradation of back-end of the Web.

➤ 4.3.1 Features of Web 3.0

Below are five main features that can help us to define Web 3.0:

1. **Semantic Web** : It is also called the Web of Data or Linked Data Web. Semantic Web deals with meaning of data and not the structure of data. It enables data to be linked from one source to any other source so that machines can perform even more complex tasks. It encompasses various technologies like Semantic Search and Natural Language Processing (NLP).The basic standards of Semantic Web include:
 - (i) **Resource Description Framework (RDF)** : The entire Semantic Web information is stored and represented in RDF. It is the data modeling language for the Semantic Web.
 - (ii) **SPARQL** : It is the query language of the Semantic Web. It is designed to query data across various systems.
 - (iii) **OWL** : It is the Web Ontology Language also called schema language, or knowledge representation language of the Semantic Web. OWL helps to define every concept carefully so that they can be understood and reused in different contexts in combination with other words.
2. **Artificial Intelligence** : It is humanlike brainpower put into machines. Artificial intelligence will make machines more intelligent thereby fulfilling the needs of users. Say for example, Company websites will be able to display more appropriate data to users by applying filters intelligently based on their previous searches and preferences.
3. **3-D Graphics** : Web 3.0 will change the way internet is presented to the world from two dimensional views to three dimensional views, turning it into more realistic. The 3-D graphics technology is vastly being used in Web 3.0 such as online games, e-commerce, etc. In online games like Second Life players actually get into their online characters or so called Avatars and forget their real selves. That would be the impact of 3-D world.
4. **Ubiquity** : Ubiquitous means anywhere and anytime. With the advent of mobile devices and internet access, the Web 3.0 experience can be made available anywhere at any time. The internet will no longer be restricted to only your desktops or smartphones but it will be omnipresent. Web 3.0 hence can be called as the web of everything and everywhere, as most things around us can be easily connected online which is also referred to as Internet of Things.

5. **Connectivity** : With Web 3.0, information happens to be more connected because of semantic metadata. It enriches the user experience due to vast availability of information.

➤ **4.3.2 Advantages and Disadvantages of the Web 3.0**

➤ **Advantages**

1. Semantic web enhances information linking
2. Enables efficient searching of information
3. Better web browsing experience
4. More human machine interaction

➤ **Disadvantages**

1. Need of powerful devices to support Web 3.0
2. Very complicated for novices to understand the upcoming technologies

➤ **4.3.3 Challenges of Web 3.0 Implementation**

The few biggest challenges to Web 3.0 are as follows:

1. As the internet is enormous so is the data floating over it. With so much of information and every piece of information having so many terminologies, with every terminology used in different contexts, it is a challenging task to be able to deal with such vast amounts of data.
2. The queries fired by users could at times be very vague leading to the need of other methods to deal with this vagueness, such as fuzzy logic systems.
3. The results presented may be uncertain and to deal with this uncertainty there is a need of newer techniques such as probabilistic reasoning. For example, a disease diagnosing system may diagnose a disease wrongly as the symptoms presented by the patient might correspond to many diseases each with different probabilities.
4. Inconsistent data over the internet might lead to difficulty in predictive analysis.

► **4.4 BENEFITS OF SOCIAL COMPUTING**

After briefing out the different generations of the Web, the technologies used and their relevance to social computing, let us now see the benefits of Social Computing to both the business organizations as well as customers.

4.4.1 Benefits to Business Organization

UQ. Describe the benefits of social commerce to customers.

(MU - Q. 3(B), Jan. 21, 5 Marks)

UQ. What are the potential benefits of social commerce to the customers and to the business?

(MU - Q. 4(A), Dec. 19, 10 Marks)

1. The social platform has become a very significant marketing tool for businesses to make their brand awareness.
2. They can easily advertise and market their products through user generated content, for example, through reviews or even via viral marketing by sharing of promo links among friends.
3. New products can be discussed and innovative ideas can be shared between business partners through communication within virtual communities.
4. They can understand the customer needs more appropriately through feedbacks, reviews and ratings on the business website or other platforms like Twitter and Facebook.
5. Increased sales and motivation for developing new and better products when customers give positive feedback on the social networking sites.
6. Negative feedbacks help the business organizations to improvise on the quality of product and service in order to retain their image and reputation in the market.

4.4.2 Benefits to Customers

1. Customers' expectations can be fulfilled faster and in a complete manner as the social platform is open for interactions.
2. Customers browsing experience is enhanced as better searching, filtering, chatting facilities are available.
3. Better decision making while buying a product by analysing the reviews and ratings given by other customers who have already bought the product.
4. One customer can support the other through online forums.
5. Customer complaints are handled very quickly because disgruntled customers can defame the business organization by giving negative feedback on social platforms like Twitter, Facebook or any other consumer complaint forum.

4.4.3 Problems of Social Computing

- Inspite of all of its benefits, social computing does face some problems.

1. Negative feedback from unhappy customers about a company's product and/or services may have harmful impact on the sales of the company.
2. The company's competitors may also purposely post wrong reviews about the company's products on their business pages on social networking sites to defame them. The company should be ready to face these glitches and handle them properly.

- 3. The company cannot even block such competitors or customers neither can they delete the comments because this might create suspicion in the minds of the other customers.
- Let us now proceed with the applications of Social Computing in different business areas.

► 4.5 SOCIAL COMPUTING IN BUSINESS-SHOPPING

- While speaking about social computing in business we are actually referring to carrying out electronic commerce transactions through social computing.
- Through social interactions, customers can participate in the marketing and selling of products and services in virtual markets.
- In this type of social commerce all the key aspects of social networks are applied into shopping such as making friends, groups, reviews, ratings, comments, discussions, etc. The experience of the shopper is enhanced by giving him options to shop by age, gender, price, location etc.
- Shoppers can form groups and communities and promote products that they liked and also write short descriptions or blogs for the same by creating their own profile pages.
- Customers refer these feedbacks and descriptions before making a purchase.
- There are various websites like Pricekart.com that use comparison agents for shoppers to make better buying decisions. A sample page of the same is shown in Fig. 4.5.1.

Fig. 4.5.1: Use of comparison agents

- Group shopping websites such as Groupon.com offer major discounts or special deals on group bookings at restaurants, spas, or some concerts or shows.
- Customers who purchase a deal get bonus points if they convince other friends to buy the deal.
- Shopping communities and clubs such as Shopify.com arrange special sales and offers on luxury brands only for their members for some limited time period.
- Well known social market places such as Ebay and Amazon act as intermediaries to facilitate online buying and selling of products and services.
- Also there are peer-to-peer shopping models which are similar to the old barter systems. Consumers use such shopping models to sell, buy, rent, or barter online with other individuals. For example, websites like OLX where one consumer can sell product to another consumer directly.
- Zoom car is a car-sharing company where owner of the car can rent his car to another individual and get paid depending on the number of hours of usage.

► 4.6 SIGNIFICANCE OF SOCIAL COMPUTING IN BUSINESS : MARKETING

UQ. Discuss the significance of social computing in marketing in detail. (MU - Q. 5(A), Dec. 19, 10 Marks)

- Marketing can be defined as the process adopted by business organizations for showcasing and promoting their products and services.
- It focuses on strategies to achieve customer loyalty and build profitable customer relationships.
- Initially the business organization has to identify the target market segment and then build strategies to understand and fulfil their needs.
- What kind of messages will attract the customer and how they can be propagated all over on social media say through promotional mails, web ads, viral marketing or some other technique.
- Social computing can be used in two ways to support marketing: **advertising and market research.**

❖ 4.6.1 Advertising

- Social advertising is that form of advertising that makes use of social information on social networks for targeting and delivering advertising content.
- This is not any explicit way of advertising but very generally peer pressure or a friend endorsing or recommending a product, or any other form of social influence. So, here the customers themselves become a medium of promoting the product.
- Placing advertisements on dominant portals and social networking websites where the visitor traffic is high is another way of marketing the product to large number of customers.
- Word of mouth or **Viral marketing** advertising where businesses also use social media to identify who are the potential customers and convince them to spread positive messages about their products or services.

- Companies offer special discounts, better deals or referral points to customers who socially influence others to purchase the product.
- Social networking websites also provide ways to advertise in social media.
- For example, Facebook lets a company create its business page, including a store that attracts fans and lets them meet other customers and then advertise the Facebook store.
- Twitter lets business organizations to tweet their success stories to customers.

4.6.2 Market Research

- In the older days collecting customer demographics for marketing purpose was very time-consuming because the marketing people had to go to the customer and convince them to provide the same.
- But in these modern times the things have changed completely. People become members of social networks and voluntarily submit their information to the websites.
- Since everything is open on the social web, sellers can easily find the potential customers interested in their products.
- **Conversational marketing** is an effective tool for promoting the products. These tools enable customers to provide feedback via blogs, wikis, online forums, and social networking sites.
- Since here social relationships are used for marketing, it becomes a very successful, faster as well as cheaper tool for marketing.
- Social computing is not restricted to businesses that collect demographic information for market research but even customers can use it for carrying out market research before buying a product or availing a service.
- For example : Users carry out complete survey of cars on Cars.com based on their choices and preferences before buying the car.

4.7 SOCIAL COMPUTING IN BUSINESS : CUSTOMER RELATIONSHIP MANAGEMENT

UQ. Describe how social computing inspires customer service.

(MU - Q. 1(D), Dec. 19, 4 Marks)

UQ. Discuss why social computing is so important in customer relationship management?

(MU - Q. 3(a), Jan. 21, 5 Marks)

- Social Computing has greatly transformed the way businesses are serving their customers and focussing more on building healthy customer relationships. At the same time it inspires the way customers are interacting with the businesses and their expectations from them are increasing.
- Let us take a look at how social computing improves customer service.
 - (i) Business organizations are using social computing to better understand their customers. They are becoming more watchful of the negative comments posted by their customers and taking it positively to overcome the problems and improve product quality as well as customer service.



- (ii) Customers are now not just buyers but also advocates and influencers who actually influence the buying patterns of their peers on the social network. Hence, businesses need to be very keen in responding to customers quickly and fulfilling their requests faster.
- (iii) Since customers have all the power and they are the ones who can fame or defame a brand, companies need to meet every requirement and expectation of the customer.
- (iv) Social computing provides many opportunities for businesses to interact with their customers and resolve their complaints efficiently thereby turning disgruntled customers into supporters for the firm.
- (v) Providing discounts and intimating regular customers about offers and sales through emails are other ways of building better relationships with the customers.
- (vi) To extend customer service, businesses can invite customers to become Facebook fans of their company page and also follow the company on Twitter. This way they can be the first person to know about the company's exclusive promotions and offers.

4.7.1 Different Types of CRM

Q.U. Define CRM. Describe the different types of CRM.

(MU - Q. 6(A), Dec. 19, 10 Marks)

- Definition:** Customer relationship management (CRM) is a customer-centric organizational strategy. Business organizations focus on better understanding customers' requirements for products and services and then fulfilling their needs by providing high-quality, responsive service.
- In this way the company can retain existing customers and gain new ones.
- Since customers have all the power and they are the ones who can elevate or demote the image of the company, organizations have extended their focus from conducting business transactions to managing customer relationships.
- CRM builds sustainable long-term customer relationships that create value for the company as well as for the customer and this is the key to its success.
- Getting back a lost customer is far more difficult and expensive than retaining an existing customer. So the company's aim should be to keep the customers happy and maintain good customer relationships.
- The two basic types of CRM are Operational CRM and Analytical CRM.

4.7.1(A) Operational Customer Relationship Management Systems

- **Operational CRM systems** basically deal with front office business processes.
- Front office processes include marketing, sales and support.
- Operational CRM systems provide the sales and service employees access to complete details of customers, their purchase history, credit details and all interactions with the organization.
- These systems help identify the most profitable customers, and provide them the best service.
- Improving the order management processes, improving customer satisfaction as well as maximizing sales and profits is the ultimate aim of such systems.

- These processes help in better understanding the customer requirements, fulfill them effectively and thus build healthy relationships with them.

4.7.1(B) Analytical Customer Relationship Management Systems

- In contrast to Operational CRM systems that handle front office business processes, **Analytical CRM systems** are more into business analytics.
- These systems involve acquiring business intelligence by analyzing customer behaviours and expectations which have been already collected in front office processes.
- These systems involve processes that collect information related to customer requests and responses to the company's sales and marketing strategies.
- They make use of modern technologies like data warehousing, data mining and decision support, which perform analyses on the collected historical information about the customer's behaviour, their relationships with the organization; create various statistical models of this information over time and then make predictions about acquiring, retaining, and losing customers.
- The analyses is presented in the form of reports for the management to make further decisions such as how to improve customer retention, customer profitability analyses etc.
- Fig. 4.7.1 illustrates the relationship between operational CRM systems and analytical CRM systems.

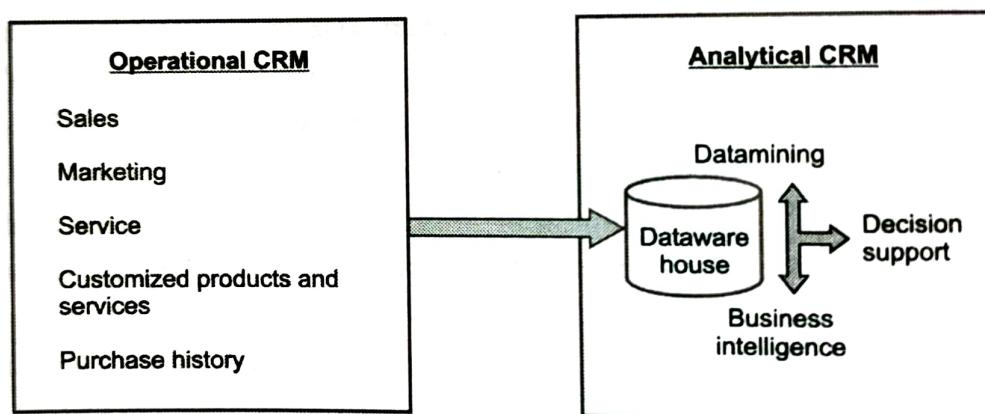


Fig. 4.7.1: Operational and Analytical CRM

4.8 OVERVIEW OF E-BUSINESS AND E-COMMERCE

- Any organization who wants to add a new channel to its traditional way of doing business i.e. a brick and mortar shop can think of building a website for practicing Electronic Commerce (E-commerce).
- An understanding of what purpose will be satisfied by these websites is very important i.e. buying and selling of goods, reducing operational and transactional costs, create a brand image, make aware people about existing brick and mortar shops. In this section we will see the basics of E-business and E-commerce.

4.8.1 E-Commerce

- **Electronic commerce** describes the process of buying, selling, and /or exchanging of products and services through computer networks via electronic medium such as internet.
- E-Commerce (EC) can be classified based on the degree of digitization used as **pure e-commerce** and **partial e-commerce** in contrast to traditional commerce which involves pure physical organizations referred to as **brick-and-mortar organizations**.
- In contrast, in *pure EC* all dimensions are digital and organizations engaged in pure EC are called **virtual (or pure-play) organizations**.
- The other type of e-commerce that includes a mix of digital and physical dimensions is called *partial EC* and organizations engaged in such kind of commerce are known as **clicks-and-mortar organizations**.
- Purchasing a book from **Amazon.com** is an example of partial EC because the goods, although bought online are delivered physically by some freight transportation such as FedEx or UPS. In contrast, buying and downloading an e-book from **Amazon.com** is pure EC because the product is delivered digitally.
- Ecommerce can also be classified based on the parties involved in conducting the e-commerce transaction as :
 1. **Business-to-consumer electronic commerce (B2C)** : In B2C, the sellers are organizations, and the buyers are individuals.
 2. **Business-to-business electronic commerce (B2B)** : In B2B transactions, both the sellers and the buyers are business organizations. B2B comprises the vast majority of EC volume.
 3. **Consumer-to-consumer electronic commerce (C2C)** : In C2C (also called customer-to-customer), an individual sells products or services to other individuals. C2C is usually carried out on the Internet in the form of auctions and classified ads.
 4. **Business-to-employee (B2E)** : In B2E, an organization uses EC internally to provide information and services to its employees. For example, companies allow employees to manage their benefits, buy discounted insurance, travel packages, and tickets to events, on the corporate intranet. Also, many companies have electronic corporate stores that sell the company's products to its employees, usually at a discount.
 5. **E-government** : E-government involves e-commerce to deliver information and public services to citizens. It involves Business-to-government (B2G) and Consumer-to-government (C2G) e-commerce transactions. E-government helps the government in delivering the public services more effectively. An example of B2G is business organizations filling up e-tenders for government contracts, C2G where individuals pay taxes online to government, G2C where governments transfer benefits such as pension funds directly to beneficiary's bank account through online mode.

4.8.2 Benefits & Limitations of E-Commerce

(A) Benefits of E-Commerce

1. E-commerce provides broader access to global market by breaking the limitations of physical boundaries.
2. It strives to lower the operational and transactional costs.
3. It provides faster access and 24 × 7 availability to different products and services.
4. Customers get access to variety of products and services, around the clock.
5. Any kind of information, services, and products can be delivered to people in cities, rural areas, and developing countries.

(B) Limitations of E-Commerce

Despite all these benefits, EC has some limitations.

1. One major technological limitation is the lack of universally accepted security standards.
2. In less-developed countries, availability of Internet to take advantage of e-commerce is a major concern. Also, telecommunications bandwidth is insufficient, and accessing the Web is quite expensive.
3. There still are cultural constraints where people are reluctant to use electronic medium to make purchases. They perceive that e-commerce is still insecure.
4. E-commerce still has unresolved legal issues and transborder issues.

As time passes, these limitations will surely diminish.

4.8.3 Electronic Payment Mechanisms

Implementation of e-commerce also involves **electronic payment mechanisms** that help buyers to pay electronically rather than writing cheques or carrying cash.

There are many types of electronic payment methods, two of which are discussed below.

- **Electronic Cheques** : Electronic cheques also called as *e-checks* are used mostly in B2B transactions. They are similar to the normal paper cheques. The customer must have an account in bank to issue an e-cheque. When the customer buys a product or a service, he will mail the encrypted electronic cheque to the seller. The seller deposits the cheque in the bank account, and the funds are transferred from the buyer's account into the seller's account. Like regular cheques, e-cheques need to be digitally signed.
- **Electronic Cards** : Electronic cards are used in B2C and C2C types of transactions. The most common form of electronic cards is credit cards, stored-value money cards, and smart cards. Customers can charge online payments to their card account and make payments.

4.8.4 E-Business

- **Electronic business** is a comparatively broader concept. E-Business is a superset of E-Commerce or rather E-Commerce is a subset of E-Business.
- In addition to the buying and selling of goods and services, e-business extends to servicing customers, collaborating with business partners and suppliers and also carrying out electronic transactions within an organization.
- E-business includes a lot of business processes including online order processing, Customer Relationship Management (CRM), Supply Chain Management (SCM) and many more.

4.8.4(A) Important components of E-Business

The important components of E-Business are:

1. **E-Procurement** : It is acquisition of products and services electronically in order to minimize cost and effort.
2. **Online Stores** : Online stores include e shops, web stores, mobile commerce setup basically for shopping of products. It saves great deal of time and money because there is no need to visit the store physically. All the transactions and payment happen online.
3. **Online Marketplace** : Online marketplaces are like intermediaries that provide a platform for buyers and suppliers to come together and carry out the transactions.
4. **Online Communities** : Such web communities allow people with common interests to come together and share their ideas and opinions. The individuals and the business organizations can form such communities where businesses can promote their products and individuals can become customers once they are convinced about the quality of the product through opinions of peers in the online communities.
5. **Online Companies** : These are nothing but businesses that have made their online presence and offer goods and services to consumers virtually through electronic platform unlike traditional organizations who have a physical presence.

4.8.4(B) Functions of Electronic Business

The most significant function of E-Business is to create value for the Business through electronic medium. Some of the important functions covered under E-Business are:

- **Structuring** : This function deals with making variety of information available online.
- **Selection** : This function deals with providing relevant information as and when requested by the customer.
- **Matching** : This function deals with offering the best matches to the customer from a wide selection of suppliers thereby making decision making easier for the customer.

- **Transaction** : This function handles the order processing and payment once the customer has placed the order.
- **Coordination** : This function deals with adding value to the product by combining offers with the products after coordinating with the vendors who are providing the product.
- **Communication** : This function deals with improving communication of the organization with customers and suppliers for maintaining good relationships and business loyalty.

► 4.9 MOBILE COMMERCE

- Mobile commerce (m-commerce) is a type of electronic commerce that is conducted purely using wireless medium over the internet. Say for example, using mobile phones to buy a dress online or ordering a pizza online.
- Mobile commerce has made the lives of people easier and at the same time created a new opportunity for business organizations to carry out their businesses, promote their products and services and attract new customers.
- The ever increasing use of m-commerce is motivated by following factors:
 1. The use and increasing production of wide range of mobile devices.
 2. Availability of proper internet connectivity and sufficient bandwidth for transmitting text, video, multimedia etc.
 3. And thirdly, all this i.e. the mobile devices as well as the network connectivity is available at very affordable rates.

➤ 4.9.1 Mobile Commerce Applications

The most common mobile commerce applications include location-based applications, financial services, intrabusiness applications, accessing information, and telemetry.

1. **Location-Based Applications and Services** : When we carry out B2C type of m-commerce, location based services play a very important role. They provide location specific information such as locating nearby restaurant or ATM, checking traffic status on a particular route or track a shipment etc.
2. **Financial Services** : Financial services in m-commerce include making payments of products purchased, bill payments, money transfers through wireless payment services, mobile banking, e-wallets etc. Without the need to go to the bank or any restriction on time people can do the financial transactions with convenience.
3. **Intrabusiness Applications** : Apart from B2C m-commerce, mobile computing is also used by organizations for their internal transactions. Companies can use mobile services to assist their



employees in various tasks like in dispatch functions such as delivery of various products say a food order or courier service to the customer.

4. **Accessing Information** : To carry out mobile commerce another important function is making enough information available to the users. Mobile portals could be created that aggregate all the information and display it on the portal.
 5. **Telemetry Applications** : Telemetry is the wireless transmission and receipt of data gathered from remote sensors. In mobile computing telemetry have various applications. Say, a car manufacturer wants to remotely diagnose a problem in the remote vehicle or doctors can monitor patients and control medical equipments from a distance.

► 4.10 MULTIPLE CHOICE QUESTIONS

- Q.6** Which one of these is not a social platform?
 (a) Twitter (b) Jitter (c) Youtube (d) Facebook ✓Ans. : (b)
- Q.7** Social Computing makes it so easy for someone who wants to start his business because
 (a) it helps generate new revenue from online sales
 (b) all the knowledge about the competitors, their products, and people's feedback everything is available on such social platforms
 (c) it helps reduce transaction costs
 (d) increases the loyalty of existing customers via Web customer service and support ✓Ans. : (b)
- Q.8** What is not true about Web 1.0 websites?
 (a) They marked the beginning of creation of websites and commercialization of the Web.
 (b) Users hardly interacted with these websites.
 (c) They were more static and only for information sharing purpose.
 (d) Used various tools such as AJAX, RSS, Wikis ✓Ans. : (d)
- Q.9** What is not true about Web 2.0?
 (a) Web 2.0 is a more flexible and dynamic platform.
 (b) It marked the beginning of commercialization of Web
 (c) It emphasizes more on user participation and social interaction
 (d) It generates dynamic content that is receptive to user inputs. ✓Ans. : (b)
- Q.10** Web 2.0 is called as participative social web. State whether true or false.
 (a) True (b) False ✓Ans. : (a)
- Q.11** Which of these is not a Web 2.0 tool?
 (a) AJAX (b) Semantic Web (c) Wikis (d) Tweets ✓Ans. : (b)
- Q.12** Which statement is true about Ajax?
 (a) Ajax makes the applications more dynamic, interactive and user friendly.
 (b) Ajax technology makes use of an XMLHttpRequest object to request data from a web server which is in-built into the browser.
 (c) Ajax updates part of a webpage asynchronously without the need to reload the entire webpage.
 (d) All of above ✓Ans. : (d)
- Q.13** Really Simple Syndication is a technology that
 (a) updates part of a webpage asynchronously without the need to reload the entire webpage.
 (b) allows you to accumulate information about a particular topic of interest from different websites at one place.
 (c) makes use of an XMLHttpRequest object to request data from a web server
 (d) None of above ✓Ans. : (b)

- Q.14** A _____ is a meaningful term used to describe something or someone.
 (a) Tag (b) Wiki (c) RSS (d) Tweet ✓Ans. : (a)
- Q.15** _____ helps to identify someone in a post, photo, tweet, or status update.
 (a) Tweeting (b) Tagging (c) Following (d) None of above ✓Ans. : (b)
- Q.16** Phototagging is the one that
 (a) deals with tagging information on maps
 (b) allows users to add pictures and information on maps
 (c) the tagged photos get linked with the associated user's profile.
 (d) None of above ✓Ans. : (c)
- Q.17** _____ that deals with tagging information on maps, like photos and information on Google maps
 (a) Phototagging (b) Geotagging (c) Tagging (d) Tweeting ✓Ans. : (b)
- Q.18** A _____ is an informational website that displays the information in a descending chronological order.
 (a) AJAX (b) Web Mashup (c) Wikipedia (d) Blog ✓Ans. : (d)
- Q.19** The _____ are the ones who contribute and share their views on common topics of interest on blogging websites
 (a) Tweeters (b) Bloggers (c) Visitors (d) Mashupers ✓Ans. : (b)
- Q.20** _____ is a term for millions of blogs on the Web.
 (a) Blogosphere (b) Webosphere (c) Blogspot (d) Weblog ✓Ans. : (a)
- Q.21** Another way of blogging through short messages upto 140 characters is called
 (a) Microblogging (b) Miniblogging
 (c) Tinyblogging (d) None of above ✓Ans. : (a)
- Q.22** _____ is one of the most popular and free microblogging service
 (a) Facebook (b) Twitter (c) Youtube (d) Google ✓Ans. : (b)
- Q.23** _____ are collaborative websites with open editing facility, where any user can add, delete or modify content on the web pages.
 (a) Mashups (b) Newsfeeds (c) Tweets (d) Wikis ✓Ans. : (d)
- Q.24** _____ is the world's largest online encyclopedia with around 3.4 million articles.
 (a) Facebook (b) Wikipedia (c) Youtube (d) Google ✓Ans. : (b)
- Q.25** Which of these is not a form of social networking website?
 (a) Facebook (b) Myntra (c) LinkedIn (d) Youtube ✓Ans. : (b)

Q.26 Social networking is a

- (a) professional networking site and also supports media sharing .
- (b) network for business collaboration and improving family relationship.
- (c) network formed by connecting people together over a social platform with the intent of friendship
- (d) All of above

✓Ans. : (d)

Q.27 _____ is a website that takes various content from different websites and mixes them together to create a new content.

- (a) Wiki
- (b) Web Mashup
- (c) Newsfeed
- (d) Tweet

✓Ans. : (b)

Q.28 Web 3.0 focuses on

- (a) innovative technologies such as edge computing
- (b) decentralised data networks
- (c) artificial intelligence
- (d) All of above

✓Ans. : (d)

Q.29 Semantic Web is

- (a) Web of Data or Linked Data Web
- (b) Web that deals with meaning of data and not the structure of data.
- (c) Both a and b
- (d) Neither a nor b

✓Ans. : (c)

Q.30 An example of peer-to-peer shopping model is

- (a) Flipkart
- (b) OLX
- (c) Snapdeal
- (d) Myntra

✓Ans. : (b)

Q.31 Well known social market places that act as intermediaries to facilitate online buying and selling of products and services.

- (a) Amazon
- (b) Torrent
- (c) Youtube
- (d) Twitter

✓Ans. : (a)

Q.32 The type of marketing in which businesses use social media to identify who are the potential customers and convince them to spread positive messages about their products or services.

- (a) Affiliate marketing
- (b) Viral marketing
- (c) Permission marketing
- (d) Email marketing

✓Ans. : (b)

Q.33 Social advertising is that form of advertising that

- (a) Generate new revenue from online sales
- (b) Increase the loyalty of existing customers via Web customer service and support content.
- (c) makes use of social information on social networks for targeting and delivering advertising
- (d) All of above

✓Ans. : (c)



- Q.34** _____ is a tool that enables customers to provide feedback via blogs, wikis, online forums, and social networking sites.
- (a) Affiliate marketing (b) Conversational marketing
 (c) Email Marketing (d) None of above ✓Ans. : (b)
- Q.35** _____ is a customer-centric organizational strategy that focuses on better understanding of customers' requirements.
- (a) Supply Chain Management (b) Enterprise Resource Planning
 (c) Customer Loyalty Management (d) Customer Relationship Management ✓Ans. : (d)
- Q.36** CRM is an organizational strategy
- (a) that builds sustainable long-term loyalty relationships with customers
 (b) that builds sustainable long-term loyalty relationships with suppliers
 (c) that builds sustainable long-term loyalty relationships with employees
 (d) None of above ✓Ans. : (a)
- Q.37** The two basic types of CRM are
- (a) Strategic CRM and Operational CRM (b) Strategic CRM and Analytical CRM
 (c) Operational CRM and Analytical CRM. (d) None of above ✓Ans. : (c)
- Q.38** Which of these is not applicable to Operational CRM systems
- (a) provides complete details of customers and their purchase history
 (b) deal with customer-facing functions
 (c) handles customer order processing
 (d) performs analysis on customer behavior ✓Ans. : (d)
- Q.39** Analytical CRM systems deal with.
- (a) providing complete details of customers and their purchase history
 (b) acquiring business intelligence by analyzing customer behaviours and expectations
 (c) Increase the loyalty of existing customers via Web customer service and support
 (d) None of above ✓Ans. : (b)
- Q.40** The most common form of electronic cards are
- (a) credit card (b) stored-value money cards
 (c) smart cards. (d) All of above ✓Ans. : (d)
- Q.41** In _____ electronic commerce the sellers are organizations and the buyers are individuals.
- (a) Business-to-business (b) Business-to-consumer
 (c) Consumer-to-Consumer (d) Consumer-to-Government ✓Ans. : (b)
- Q.42** In _____ electronic commerce, both the sellers and the buyers are business organizations.
- (a) Business-to-business (b) Consumer-to-Consumer
 (c) Business-to-consumer (d) None of above ✓Ans. : (a)

Q.43 _____ comprises the vast majority of EC volume.

- (a) Business-to-business
- (b) Consumer-to-Consumer
- (c) Business-to-consumer
- (d) None of above

✓Ans. : (a)

Q.44 Which of these is not true about C2C transactions?

- (a) C2C is usually carried out on the Internet in the form of auctions and classified ads.
- (b) an individual sells products or services to other individuals
- (c) websites such as OLX are examples of C2C ecommerce
- (d) performs analysis on customer behavior

✓Ans.: (d)

Q.45 In _____ an organization uses EC internally to provide information and services to its employees such as manage their benefits or buy discounted insurance etc.

- (a) Business-to-employee
- (b) Consumer-to-Consumer
- (c) Business-to-consumer
- (d) None of above

✓Ans. : (a)

Q.46 Which of these is not true about E-government?

- (a) It involves e-commerce to deliver information and public services to citizens.
- (b) Increase the loyalty of existing customers via Web customer service and support
- (c) It involves business organizations filling up e-tenders for government contracts
- (d) It transfers benefits such as pension directly to beneficiary's bank account through online mode.

✓Ans. : (b)

Q.47 E-Commerce is a _____ of E-Business.

- (a) superset
- (b) equivalent
- (c) subset
- (d) none of above

✓Ans. : (c)

Q.48 E-business includes a lot of business processes such as

- (a) Online order processing
- (b) Customer Relationship Management
- (c) Supply Chain Management
- (d) All of above

✓Ans. : (d)

Q.49 _____ describes the process of buying, selling, and /or exchanging of products and services through computer networks via electronic medium such as internet.

- (a) E-shopping
- (b) Electronic commerce
- (c) E-marketing
- (d) None of above

✓Ans. : (b)

Q.50 _____ refers to e-commerce that is conducted entirely in a wireless environment.

- (a) Wireless Commerce
- (b) W-Commerce
- (c) Mobile commerce
- (d) None of above

✓Ans. : (c)

MODULE 5

CHAPTER 5

Computer Networks

University Prescribed Syllabus

Computer Networks Wired and Wireless technology, Pervasive computing, Cloud Computing Model.

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► 5.1 COMPUTER NETWORK FUNDAMENTALS

❖ 5.1.1 Concept

- **Computer networks** is an important component of Computer based Information Systems. It has also become a vital tool for modern business organizations. The reason for the same being that :
 - o Networks facilitate companies to share important information across different inter and intra organizational systems efficiently.
 - o Networks form a significant linkage between business organizations, their business partners, their suppliers and their customers.
 - o Geographically dispersed employees can easily communicate, interact and share their ideas with the help of networking facility.
- **Computer Networks** is an interconnection of various devices such as computers, routers, printers etc., with the help of some form of communication medium in order to transmit information. Different types of communication media can have different transmission rates measured in bits per second and more commonly called as **bandwidth**. Bandwidth can vary from around 750 MHz for coaxial cables to few THz for optic fibres. Voice as well as data communications can happen over different bandwidths.

❖ 5.1.2 Types of Networks

There are different **types of computer networks** from small range to wide range.

- The shortest range networks are the **Personal area networks (PANs)** which have their scope only over a few meters. The devices need to be placed very close to each other in order to transmit and receive information.
- **Local Area Networks (LANS)** that can span over a comparatively larger area as of PANs, say within the same building. Every device in the LAN has a *network interface card* (NIC) that facilitates the connection of the device on the network to the communication medium.
- **Wide Area Networks (WANs)** that cover very large geographic areas like countries or continents. WANs usually connect two or more LANs. Internet is a common example of WAN. Different telephone companies and communications service providers provide this networking capability.
- Another type of network which is just a combination of the above mentioned networks is the **Enterprise Network**. Large enterprises can combine multiple LANs and WANs for communication purposes between different departments within same organization or outside the organizations with business partners and customers who are remotely located.

❖ 5.1.3 The Internet and the World Wide Web(WWW)

- The **Internet** is a universal WAN that connects millions of computer networks all over the world. Commonly referred to as “NET”, it is a network of networks.

- Today, the Internet has become a very fundamental communication, collaboration and information sharing need for all business organizations connected worldwide. It can be accessed easily and inexpensively using devices such as computers, laptops, mainframes, palmtops, smart phones etc.
- The Internet facility can be made available on various devices by subscribing for a connection with the **Internet Service Provider (ISP)** such as Microsoft, America Online and many more. Also, many **telephone companies** and **cable service providers** offer Internet connectivity. Fees are charged for the setup and periodic subscription.
- Each device on the Internet is identified by a unique address, called the **Internet Protocol (IP) address**. The IP address consists of sets of numbers, in four or six parts, separated by dots depending upon which addressing scheme is being used either **IPV4 or IPV6**.
- For example, the IPV4 address of your computer might look like this 135.62.128.91 which is 32 bit address.
- Whereas an IPV6 address takes a form 2001:0db8:85a3:0000:0000:8a2e:0370:7334 which follows a 128 bit addressing scheme. The increasing number of devices being connected to the Internet such as smart phones, smart watches, Alexa etc and each requiring a unique IP address has led to the need of IPV6 addressing scheme with 2^{128} addresses possible.
- **The Internet Corporation for Assigned Names (ICANN)** takes the responsibility of assigning these addresses throughout the world.
- **The World Wide Web (WWW)** is a system of universally accepted standards for storing, retrieving, formatting, and displaying information via client/server architecture.
- The Internet and WWW are different. The Internet functions as a transport mechanism, whereas the World Wide Web is an application that uses those transport functions.
- The Web comprises of all types of data like text, images, audio, video, graphics, animation, and hypermedia.
- Organizations that wish to offer information through the Web must create their **Website**, which is nothing but a collection of pages or rather, **webpages** that are linked to one another. They provide basic information about the organization and its products and services. Certain websites facilitate ecommerce transactions as well.
- The user must specify a **uniform resource locator (URL)** to access the website. The URL points to the address of the computer/server from where the specified resource can be accessed on the Web.
- Suppose, a user wants to access a website of Amazon. It can be accessed using an IP address. But as numeric IP addresses are difficult to remember, most of the computers can be remembered by their human readable names as well.
- These names are called **domain names** which are registered through companies such as GoDaddy who are also called as *registrars*.
- They have been authorized by ICANN for this purpose. DNS is like Internet phone directory and stands for "**Domain Name System**".

- It is a system that lets you connect to websites by mapping the domain names with the unique IP address of the server where a website is stored.
- For example, consider the **uniform resource locator (url)** of Amazon <http://www.amazon.com>. There are three important parts: rightmost one is the top-level domain or TLD (sometimes called an extension or domain suffix)(i.e. com), a domain name (or IP address) (i.e. amazon), and an optional subdomain (i.e.www).
- The domain name and top-level domain taken together form the "root domain." The "http://" is part of a page's URL and is known as the "hypertext transfer protocol."
- Few popular TLDs include **com** for commercial sites, **edu** for educational sites, **mil** for military government sites, **gov** for civilian government sites, **org** for organizations.
- Users access the Web primarily through software applications called **browsers**.

5.1.4 Network Protocols

Network Protocols are the rules and procedures that the various devices connected to the network should follow to be able to communicate with one another. The two major protocols are the **Ethernet** and **Transmission Control Protocol/Internet Protocol**.

- **Ethernet** : It is a common LAN protocol .Most large corporations use 10 gigabit Ethernet, where the network provides data transmission speeds of 10 gigabits (10 billion bits per second).
- **Transmission Control Protocol/Internet Protocol** : It is the protocol for the Internet. It is a set of many protocols, the core ones being the Transmission Control Protocol (TCP) and the Internet Protocol (IP).
- The basic functions of **Transmission Control Protocol (TCP)** is to establish a connection between the computers on the network for transmission of data packets, proper sequencing , assembly and reassembly of packets, and acknowledgement of packets that have been transmitted.
- **Internet Protocol (IP)** is responsible for routing of packets from the source to the destination. Each packet carries information such as source and destination IP address. The packets travel independently across the network
- The **Application layer** enables client application programs to access the other layers, and it defines the protocols that applications use to exchange data. One such application layer protocol is the **Hypertext Transfer Protocol (HTTP)** used by the **World Wide Web**, which defines how messages are formulated and how they are interpreted by the web browsers and web servers. It is an important part of the url of a website as already seen above.
- **Network Applications** : Business organizations use networks to improve their business processes. There are various network applications that satisfy the different business functions such as communication through emails, e-chats and internet telephony, collaborative work platforms by virtual meets through video conferencing, e-learning via Massive Online Open Courses or MOOCs, virtual universities, and telecommuting etc.

5.1.5 N/W architectures

Usually, the network processing happens in a distributed manner. The organization's computer systems are not located at one place and are distributed over the entire firm. The common types of distributed processing are: (a) Client/Server and (b) Peer-to-Peer.

(a) Client / Server Architecture

- In this type of architecture, some computer systems act as clients whereas some act as servers. The systems that request for a service are clients and the ones that satisfy the request are servers.
- All the computing services and major processing happens at the servers which are very powerful machines.
- Less powerful machines like the clients request these services from the servers. 'Thin' and 'Fat' clients are examples of such architecture where *fat clients* have large storage and processing power and therefore can run local programs even if the network goes down.
- In contrast, *thin clients* may have no local storage and only limited processing power. Thus, they must depend on the network to run applications. A simple representation of client/server model is shown in Fig. 5.1.5(a).

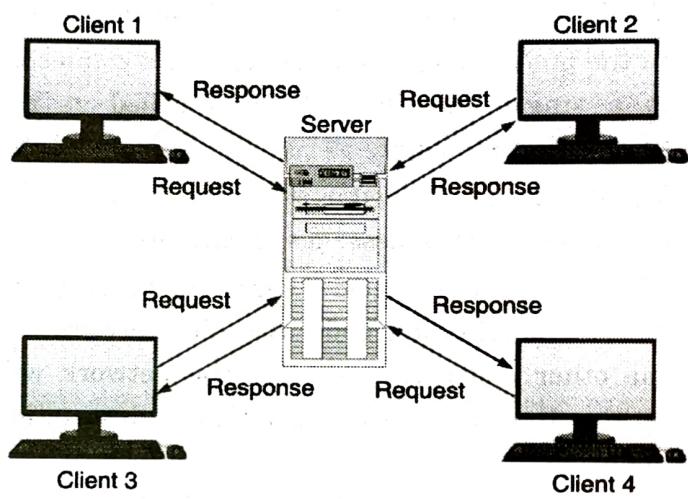


Fig. 5.1.5(a) : Client/server network processing

(b) Peer-to-Peer

- Peer-to-peer (P2P) processing is a type of client/server distributed processing where each computer system can behave as both a client and a server.
- Each computer can access all files on all other computers. BitTorrent is an open-source, free, peer-to-peer file-sharing application that simplifies the problem of sharing large files over the network by dividing them into tiny pieces, or "torrents. Peer-to-peer model looks like as depicted in Fig. 5.1.5(b).

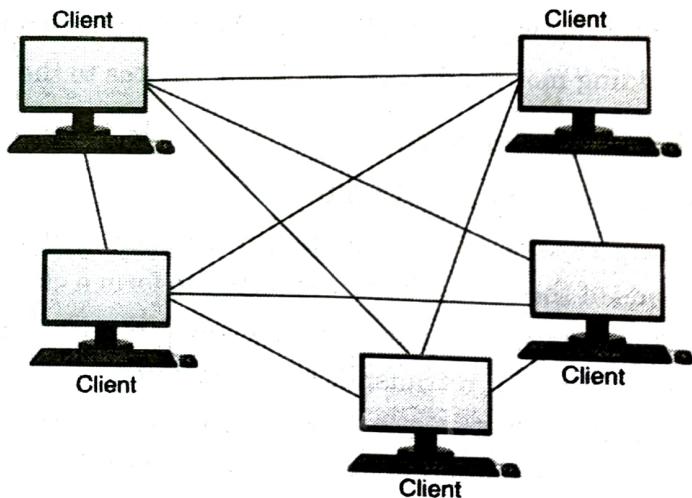


Fig. 5.1.5(b) : Peer-to-Peer processing

5.1.6 Network Topologies

The physical network topology defines the structure of how the various devices are connected to one another in a network. The common topologies are discussed below.

- | | | |
|-------------------|-------------------|-------------------|
| (a) Bus Topology | (b) Ring Topology | (c) Star Topology |
| (d) Tree topology | (e) Mesh topology | |

► (a) Bus Topology

As shown in the Fig. 5.1.6(a),

- Bus Topology is the simplest of all topologies with a single bus that carries all the messages.
- In the bus topology, all the devices are connected to a single bus/cable which is called as the **backbone network**.
- The devices also called as nodes connected to the network can send messages to each other.
- When one source node sends a message to another destination node over the network, all the other nodes connected to the network will receive the message along with the destination node.
- Ethernet 802.3 and 802.4 standard networks make use of this topology.
- A bus topology is the simplest, but still it requires a lot of cabling and as a result determining the cable faults becomes tedious. If any fault occurs in the cable which is the network backbone, then entire network will collapse and communication between nodes will be hampered.
- Adding more and more number of devices to the same network would slow down the network.

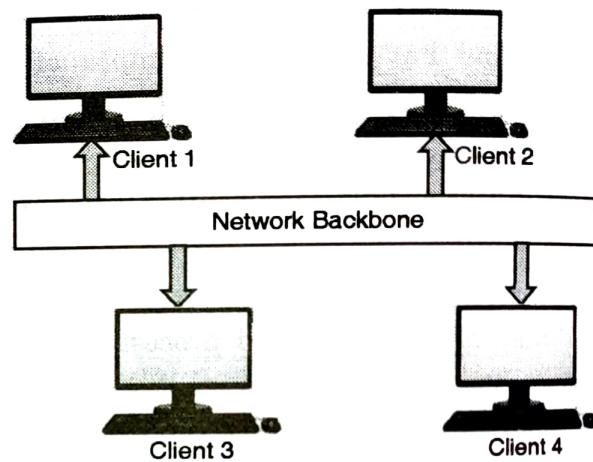


Fig. 5.1.6(a) : Bus Topology

► b) Ring Topology

As depicted in the Fig. 5.1.6(b),

- Ring topology is similar to bus topology, but here the ends of the network are connected to form a closed loop.
- The node that receives the message from the previous computer will retransmit to the next node.
- The data flows in a single clockwise direction, in a single loop endlessly as there are no termination ends. In this topology, a token is used by the sender which contains the destination address along with the data.

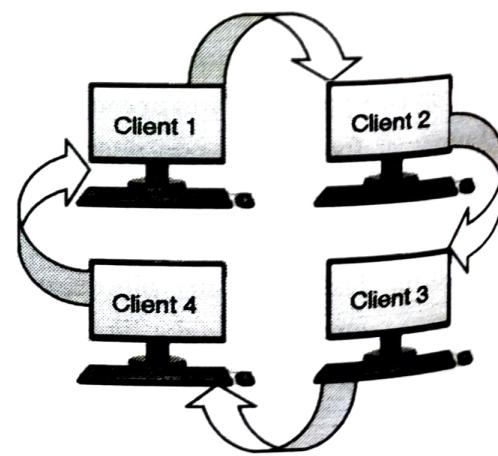


Fig. 5.1.6(b) : Ring Topology



- The data is passed from one node to another node until it reaches the destination. Once the token is received by the destination device, then it sends the acknowledgment to the sender.
- Same issue as in bus topology persists with ring topology, that if fault occurs in the cable then entire communication between nodes will be hampered.
- Also, adding more number of devices would slow down the network.
- Here in addition, the breakdown of any one node leads to the failure of the overall network.

► (c) Star Topology

- As shown in Fig. 5.1.6(c), In Star topology every node in the network is connected to a central controlling node.
- The central node or hub is often known as the server, and the peripheral nodes connected to the server are known as clients.
- Hubs or switches can also be used as connection devices in a physical star topology.
- Troubleshooting is easier as all the devices are connected to a central node.
- Failure at one node will not affect the rest of the network.
- Adding new devices is easy as it needs just making a connection with the central node.
- If the central hub fails, then the entire network crashes and none of the devices will be able to communicate.

► (d) Tree Topology

As shown in Fig. 5.1.6(d),

- Tree Topology combines the characteristics of both bus topology and star topology.
- All the nodes are connected with each other in hierarchical fashion.
- The top-most node in tree topology is known as a root node, and all other nodes are the descendants of the root node. Normally, it forms a parent-child like hierarchical structure.

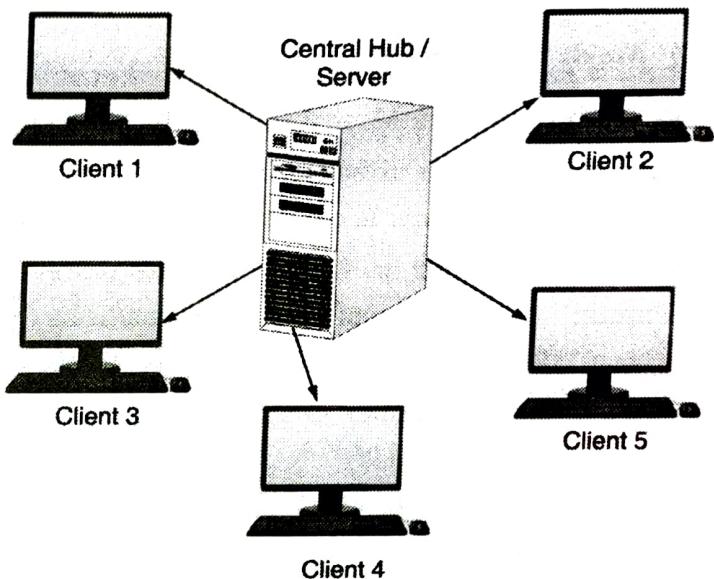


Fig. 5.1.6(c) : Star Topology

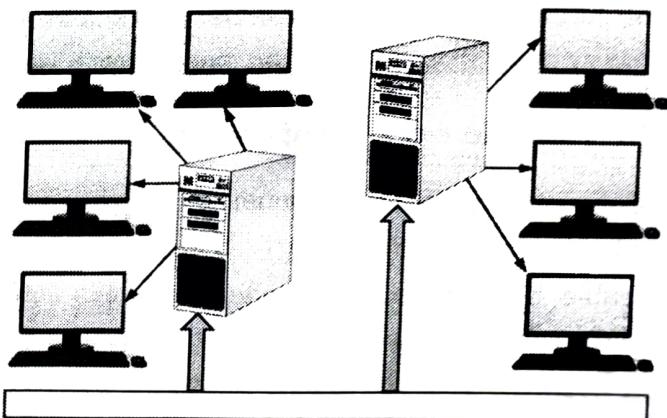


Fig. 5.1.6(d) : Tree Topology

- The whole network can be divided into separate segments each being managed as a star network.
- This topology is frequently used for broadband transmission where signals are to be sent over long distances without being attenuated.
- Tree topology is easily expandable.
- Breakdown of a single link does not affect the rest of the network but as the root nodes are sharing a common bus and if that fails, the entire network would fail.
- Since, the hierarchy can be long; troubleshooting could be a tedious task.
- The setup could be costly for broadband transmission.

► (e) Mesh Topology

Fig. 5.1.6(e) shows a Mesh Topology.

- Here, every node is directly connected to every other node in the network and therefore there are multiple paths from one computer to another computer.
- Mesh topology can be formed by using the formula: Number of connections/links = $(n*(n-1))/2$; where n is the number of nodes present in the network.
- Since, there are multiple paths between two nodes, there is high reliability achieved in transmission of data. Even if one link fails (may be the direct link), data can take another path to reach the destination although it might take a little longer time.
- But when there is point-to-point direct transmission, it is comparatively faster.
- Adding a new connection or a new device does not affect the working of the rest of the network.
- Managing such kind of mesh networks is very cumbersome.
- Lot of redundant connections might affect the efficiency of the network.

❖ 5.1.7 Network Components

Computer network components comprise of both hardware and software. Hardware components include Network Interface Card (NIC), switch,

cable, hub, router, and modem whereas software components include network operating system and networking protocols. It is not necessary that all the components will be required at the same time. Depending on the type of network that needs to be configured certain components can be added and certain can be removed. For example, the wireless network will not require an explicit cable so that can be removed. Let us discuss each of them.

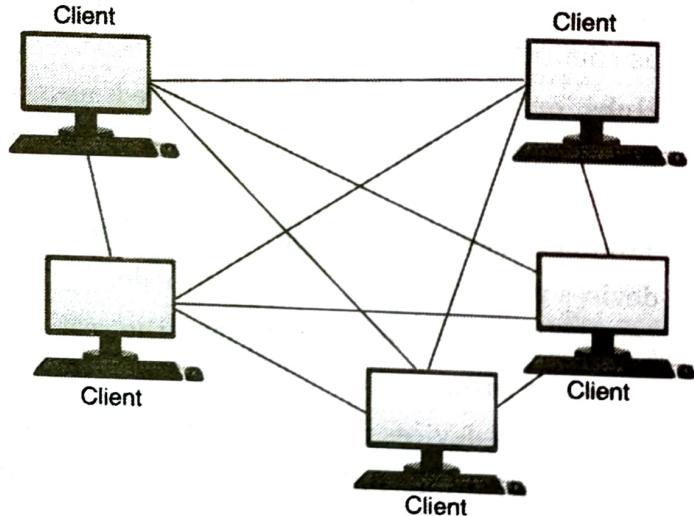


Fig. 5.1.6(e) : Mesh Topology

(a) Hardware Components

- i) **Network Interface Card (NIC)** : NIC is a hardware component used to connect a computer with another computer onto a network. To identify the network card or rather the device uniquely a physical address or MAC address is encoded on the card. NIC comes in two flavors wired and wireless. Wired NIC is present inside the motherboard and requires cables to transfer data. Whereas Wireless NIC has an antenna to obtain connection over wireless network as found in laptops.
- ii) **Hub** : A hub is a hardware device that divides the network connection among multiple devices. When computer sends some message, first it goes to the hub. The hub will broadcast it to the entire network. All the devices connected on the network will check whether the message is destined for them or not. If not, the message will be dropped by those devices and will be accepted only by the node to which it is addressed to. But as this process consumes a lot of bandwidth, these days hubs are replaced by switches and routers.
- iii) **Switch** : A switch is a hardware device that connects multiple devices on a computer network. A switch is smarter than a hub. Switch does not broadcast the message sent by a node on the network instead delivers the message only to the correct destination based on the physical address present in the message. It therefore increases the speed of the network.
- iv) **Router** : A router is a hardware device which is used to connect a LAN to the internet. It checks the incoming packets and forwards them to the appropriate route towards the destination. It makes use of routing and forwarding table as well as routing algorithms to route the packet along the shortest path available.
- v) **Modem** : A modem is a hardware device that allows the computer to connect to the internet over the existing telephone line. It stands for Modulator/Demodulator. It converts the digital data into an analog signal over the telephone lines. Based on the differences in speed and transmission rate, there are different types of modems like Standard PC modem or Dial-up modem, Cellular Modem and Cable modem.
- vi) **Cables and Connectors**: Cables and connectors are used to connect two or more devices over the network so that they can transmit data. There are three types of common cables used in transmission: Twisted pair cable, Coaxial cable and Fibre-optic cable which we will see in the next section.

(b) Software Components

- **Network Operating System** : Network Operating Systems are usually installed on the server and facilitate computers connected in a network to share files, database, applications, printers etc.
- **Protocol Suite** : A protocol suite is a set of rules followed by every device connected on the network for data communication. The two popular protocol suites are OSI Model (Open System Interconnections) and TCP / IP Model. The important protocols for networking and data transmission have been already discussed in Section 5.1.4.

► 5.2 TYPES OF TRANSMISSION MEDIA- WIRED AND WIRELESS TECHNOLOGIES

- The data that needs to be transmitted from source to destination requires some kind of communication media to carry the data. Communication channels such as wired or wireless can be used as a medium for the same.
- Twisted-pair cable, coaxial cable, or fiber-optic cable are examples of wired/cabled or guided media whereas microwave, satellite, radio, or infrared are examples of wireless/broadcast or unguided media.
- Wired media use physical wires or cables to transmit data. Twisted-pair and coaxial cables are made of copper, and fiber-optic cable is made of glass.
- Data transmissions over wireless media are through electromagnetic waves. The classification of transmission media can be summarized as in Fig. 5.2.1.

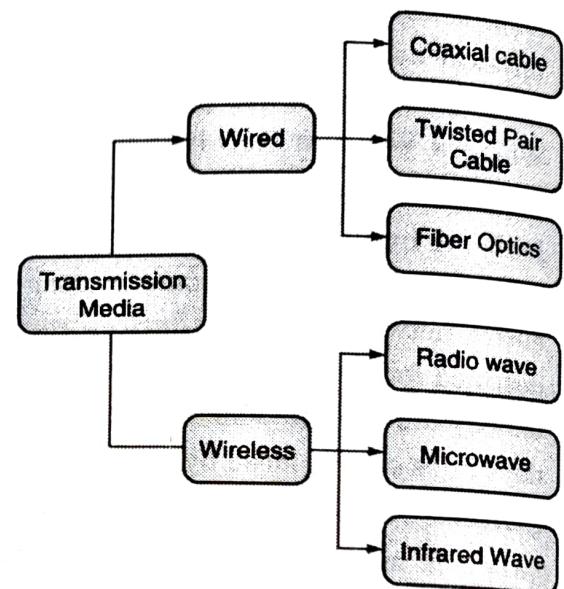


Fig. 5.2.1 : Transmission Media

► 5.2.1 Wired Networks

- Wired network consists of physical connection between two or more devices using physical cables. They are also called as Ethernet networks and mostly used in local area networks (LAN).
- Ethernet is the fastest wired network protocol, with connection speeds of 10 megabits per second (Mbps) to 100 Mbps or higher (now upto 10000Mbps/10 Gbps).
- The most commonly used wired network topologies are bus, ring, star, mesh which have been already discussed in Section 5.1.6.
- The benefit of a wired network is that bandwidth is very high and that interference is very limited due to direct connections and hence is safer.
- But the only disadvantage is that they need a lot of rewiring every time they are moved.
- Normally the range of wired networks is somewhere within a 2,000-foot-radius. Beyond these distances the data transmission may become slow or even nonexistent.

Types of wired media are:

- | | | |
|-----------------------|-------------------|------------------|
| (a) Twisted-Pair Wire | (b) Coaxial Cable | (c) Fiber Optics |
|-----------------------|-------------------|------------------|

► (a) Twisted-Pair Wire

- It consists of strands of copper wires twisted in pairs.
- The twisting of wires reduces noise on the wires by cancelling the electromagnetic interference from the environment during transmission.

- It is a very common form of wiring and used in almost all business telephone wiring.
- These types of wires are widely available and quiet inexpensive but relatively slow in transmission.
- The twisted pair wires look like as shown in Fig. 5.2.1(a).

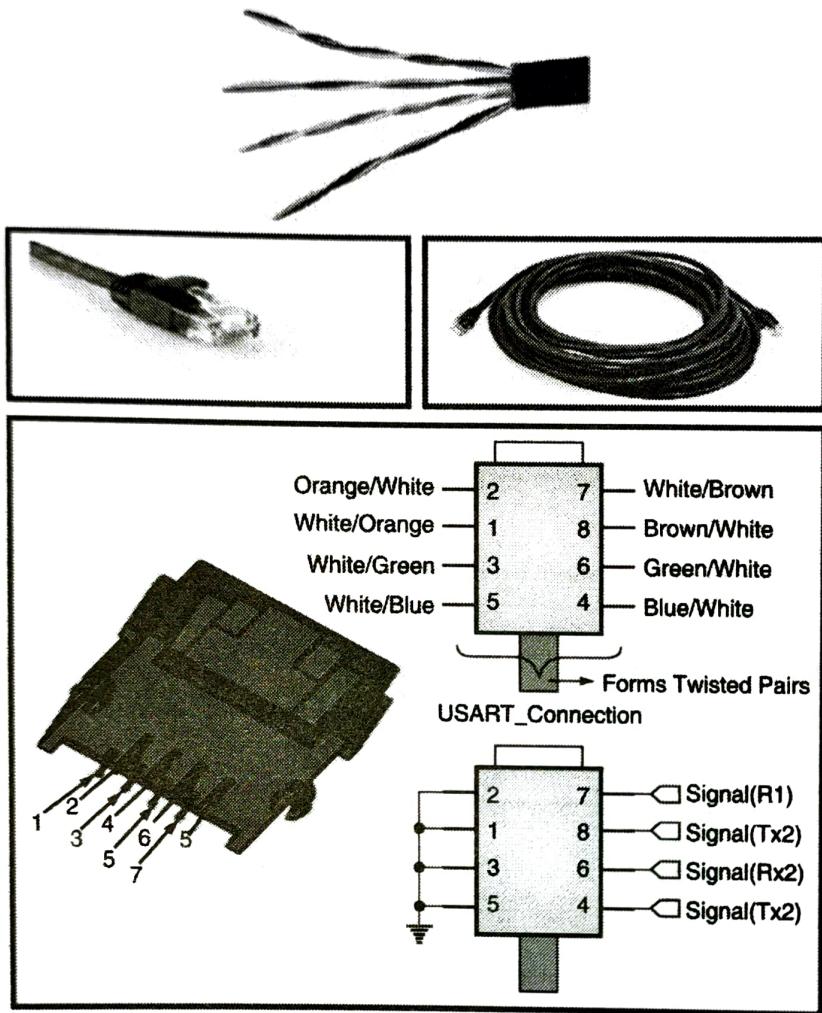


Fig. 5.2.1(a) : Twisted Pair Cable

► (b) Coaxial Cable

- Coaxial Cables consist of insulated copper wires.
- There is a cylindrical wire between an insulating sheath. Surrounding the insulating sheath is a conductive sheath, acting simultaneously as a shield and a return path for the signal.
- Due to this shielding most of the electromagnetic energy remains inside the surrounding conductive sheath and as a result avoids interference of noise.
- These cables are even more noise resistant than twisted pair cables.
- Coaxial cables can carry large amounts of data and therefore used for high speed transmission as in Cable TV network.

- However, coaxial cables are very expensive as well as inflexible as compared to twisted pair cables. The coaxial cables are shown in Fig. 5.2.1(b).

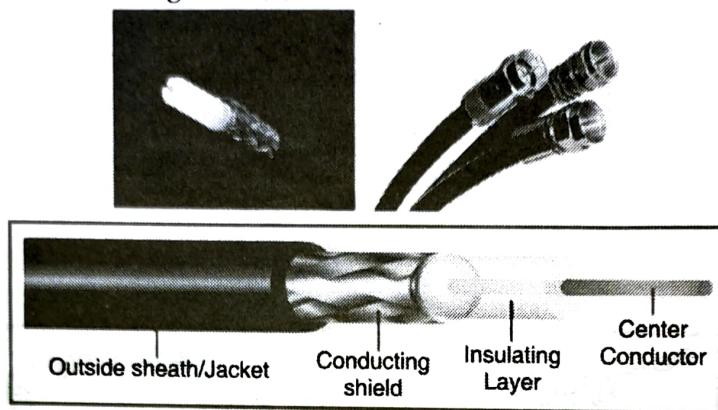


Fig. 5.2.1(b) : Coaxial Cable

► (c) Fiber Optics

- Fiber Optics cables consist of numerous thin fibres of glass through which the light pulses are sent to transmit information.
- The fiber-optic cable is surrounded by cladding which is a coating that prevents the light from leaking out of the fiber.
- They are the lightest of all types of wired cables, provide the greatest security from any kind of external interference as well as can transmit large amounts of data.
- They provide extremely fast data transfer rates. The Fiber Optic Cables are shown in Fig. 5.2.1(c)

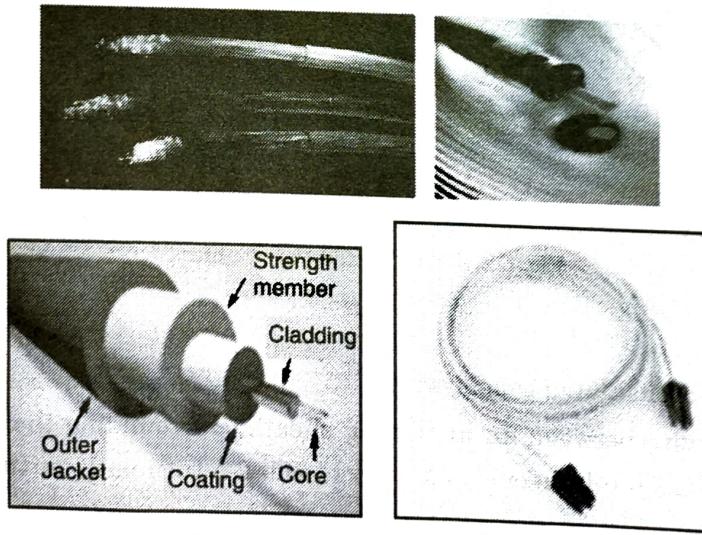


Fig. 5.2.1(c) : Fibre Optic Cable

5.2.2 Wireless Networks

- In wireless networks, there are no physical wires instead electromagnetic waves are used for transmission of information.
- This increases mobility but surely affects the range of transmission.

- These networks provide anytime, anywhere access to information by devices such as personal computers, smart phones, laptops, iPads etc.
- Wireless networks can be stationary as in microwave towers or they can be mobile as in MiFi devices. Wireless technologies enable individuals and organizations to conduct mobile computing, mobile commerce, and pervasive computing.
- The frequency used for wireless communication is from 3 KHz to 900THz.
- Wireless networks are reliable as long as they are not interfered by devices operating at same radio frequencies. Wireless networks can easily be installed without physically destructing the existing wired network.
- Wireless technologies include both wireless devices, such as smart phones, which are small, easily portable and affordable and secondly, wireless transmission media, such as microwave, satellite, and radio.

(A) Wireless Devices

UQ. Describe the most common types of wireless devices.

MU - Q.3(c), Jan. 21, 5 Marks

- People are finding wireless technologies more convenient to use due to anywhere and anytime access. As a result of which people can make best utilization of their time for work while travelling.
- The wireless devices such as smart phones, laptops, and ipads are easily portable and give flexibility in managing the working hours.
- The devices have achieved high computational capability and all this is available at a reasonably affordable cost. With the help of these devices we can connect to the Internet wirelessly.
- Modern smart phones provide capabilities that include cellular telephony, Bluetooth, Wi-Fi, digital cameras for capturing images and video, global positioning system (GPS), an organizer, a scheduler, an address book, a calculator, access to e-mail, instant messaging, text messaging, music player, a video player, Internet access etc.
- Also there are small portable wireless devices such as MiFi, that provide Wi-Fi hotspot to upto 5 devices to connect at the same time anywhere you go. The range is upto 30 feet or around 10 meters. Thus wireless technologies and devices are making the work easy, convenient and faster.

(B) Wireless Transmission Media

► (a) Microwave

- Microwave transmission systems transmit data via electromagnetic waves. The signals which have transmitting frequency ranging from 1GHz to 300GHz are called microwaves.
- These types of transmissions are used when very large amounts of data need to be transmitted and need to cover finitely long distances. The transmitters and receivers need to be in **line-of-sight** to each other for efficient communication without interference.



- But as the Earth's surface is curved and not flat, the microwave towers should be spaced after every 30 miles to satisfy the line-of-sight constraint.
 - For very long distances microwave systems provide very limited support. Also, disturbances in climatic conditions like heavy storms or rains can affect the transmission.
- **(b) Satellite**
- Satellite transmission systems make use of communication satellites.
 - The three satellites orbiting around the Earth are :
 - (i) Geostationary-earth-orbit(GEO), (ii) Medium-earth-orbit(MEO), and
 - (iii) Low-earth-orbit(LEO).
 - GEO is the farthest from earth and LEO is the closest. The three communication satellites along with their features and distance from earth's surface are summarized in the below given Table 5.2.2. Like in microwave there is constraint of line of sight, similarly in satellite communication there is something called **footprint**.
 - The footprint is dependent on distance. The farther the satellite from the Earth's surface, highest is its footprint and the nearer the satellite, shorter is the footprint. The same has been depicted in Fig. 5.2.2.

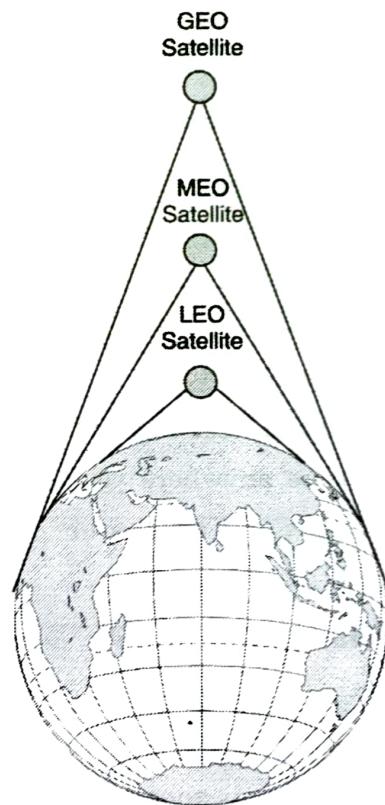


Fig. 5.2.2 : Satellite Orbits and Footprints

Table 5.2.2 : Details of communication satellites

| Name of satellite | Key features | Number of satellites orbiting around the earth | Distance above earth's surface |
|---------------------------------------|---|--|--------------------------------|
| Geostationary Earth Orbit(GEO) | <ol style="list-style-type: none"> 1. Since they are farthest from the earth's surface, their footprint / coverage is the maximum. 2. Therefore number of satellites required is less. 3. Satellites appear stationary relative to point on earth. 4. Transmission delay is high as it is farthest from earth's surface. | 8 | 22,300 miles (from equator) |
| Medium Earth Orbit(MEO) | <ol style="list-style-type: none"> 1. Since, they are closer from the earth's surface as compared to GEO satellites, their footprint / coverage is comparatively lesser than GEO. 2. Therefore, number of satellites required is more. 3. Satellites are moving relative to point on earth 4. Transmission delay is less as it is a little nearer to earth's surface. | 10-12 | 6434 miles |
| Low Earth Orbit(LEO) | <ol style="list-style-type: none"> 1. Since they are closest to the earth's surface, their footprint is the least. 2. Therefore number of satellites required is more. 3. Satellites are moving relative to point on earth. 4. Transmission delay is minimum as they are closest to earth's surface. | Too many | 400-700 miles |

Internet over Satellite(IoS)

- There are many remote areas or hilly areas in the world where installing physical cables is impossible or too expensive to provide Internet access. Internet over Satellite (IoS) is the best option for such regions.
- IoS enables users to access the Internet via GEO satellites from a dish mounted on the side of their homes.
- As these satellites are too far from the surface of the earth, some amounts of transmission delays may occur. Also, they are susceptible to environmental disturbances like heavy storms and rains.

Radio

- **Radio transmissions** use radio frequencies to transmit data at high speeds and can easily cross organizational walls.
- The signals which have transmitting frequency ranging from 3 KHz to 1 GHz are called radio waves.
- The problem with this type of transmission is that two devices operating at same radiofrequency can create interference problems for each other.
- Radio signals can travel only 30 to 40 miles from their source and if the distance increases the signal diminishes. However, satellite radio can be used to overcome this problem.

Infrared

- Infrared waves are another type of wireless media having transmitting frequency ranging from 300GHz to 400THz.
- **Infrared** light is red light that is not commonly visible to human eyes.
- Use of infrared waves is done in remote control units for televisions, CD and DVD players.
- Infrared transceivers are used for short distance communication between connecting devices.

5.2.3 Wireless Computer Networks Based on Distance Coverage

In the previous sections we saw the various transmission media and the devices that make use of them to form wireless computer networks. We will now discuss few wireless networks based on the distance that they can cover. They are categorized as short range, medium range and wide range wireless networks.

(A) Short Range Wireless Networks

(i) Bluetooth

- Bluetooth technology makes use of omnidirectional, low power radio waves to create a connection between two Bluetooth enabled devices.
- In Bluetooth 1.0 around 8 devices can be linked and they should be spaced not more than 10 meters to achieve transmission rates of 700 kbps.

- In Bluetooth 2.0 around 8 devices can be linked and they should be spaced not more than 100 meters to achieve transmission rates of 2.1 Mbps.
- Different devices such as Bluetooth enabled Laptops or mobile phones, Bluetooth speakers, Bluetooth headphones make use of this technology.

(ii) Near Field Communications (NFC)

- This technology is found embedded in mobile phones, credit cards or many other smart cards for sharing pictures, contacts or making payments.
- Its range is the smallest upto few cms-4cm or 1 1/2 inch and base frequency of 13.56 MHz

(B) Medium Range Wireless Networks

(i) Wireless Fidelity (WiFi)

- A type of medium range wireless LAN technology.
- It requires wireless access point to connect to Wireless LAN or satellite dishes that provide internet connection.
- The distance it can cover is upto 300 feet and you can get connected to such WiFi networks anywhere, also in many public places like airports, railway stations, many hotels and restaurants provide this WiFi connectivity. The only thing is, you need to have the network security key to access that wireless network.
- WiFi frequency ranges somewhere between 2.4GHz to 5 GHz.
- WiFi speed ranges fom 54Kbps for 802.11a standard to upto 7 Gbps for 802.11ad standard
- Mobile devices such as laptops, PCs, smartphones have built in wireless network interface capability to connect wirelessly to the internet.

(ii) Wi-Fi Direct

- It is a type of WiFi technology where the devices can connect and communicate directly without the need of wireless antenna. It is peer-to-peer wireless connection.
- **Wi-Fi Direct** enables devices such as mobile phones, PCs, and gaming devices to create their own **Wi-Fi** networks without an internet connection.
- It's frequency ranges from 2.4 GHz upto 5 GHz and it can cover a distance of around 200 meters(600-800 feet)
- The technology is similar to bluetooth with wider scope and speeds of upto 250 Mbps.

(iii) Mi-Fi

- This technology makes use of small, portable wireless device with the help of which maximum 5 devices can be connected and communicate at the same time.
- The device provides Wi-Fi connectivity anywhere you travel but the devices should be in the range of 10 meters from the wireless device.

(C) Wide Area Wireless Networks

- These types of networks provide internet connectivity over geographically dispersed areas.
- They operate over licensed wireless spectrums regulated by Government as against bluetooth, Wi-Fi which operate over unlicensed spectrum.
- The two types of wide area wireless networks are cellular radio and wireless broadband.

(i) Cellular Radio

- It is a type of communication network with very high transmission speed.
- In this technology, two way radio communications happens over a cellular network of base stations. The cell phones communicate with radio antennas or towers placed within adjacent geographic areas called cells.
- This technology has evolved in several stages such as:
 - o First generation (1G) cellular networks that used analog signals and had low bandwidth.
 - o 2G technology was primarily developed for voice communication, and it provides data communication up to 10 kbps.
 - o 2.5G provides voice and data communication upto 144 kbps.
 - o 3G supports voice and data upto 384 kbps when device is moving and 2 Mbps at fixed locations. It supports video, web browsing, instant messaging etc.
 - o 4G maintains 100 Mbps for high mobility and 1 Gbps for low mobility. It is a more intelligent and faster technology.

(ii) Wireless Broadband or WiMax

- Wireless Broadband provides long distance broadband wireless internet connections to homes and businesses located miles away and also in rural areas.
- It has an access range of upto 31 miles.
- The transfer rate is upto 75 Mbps and it supports voice and video communication.
- Mobile WiMAX is implemented in three spectrum bands 2.3-2.4 GHz, 2.5-2.7 GHz, and 3.4-3.6 GHz.

UQ. Differentiate between computer network wired and wireless technology.

(MU - Q.1(E), Dec. 19, 5Marks)

| Sr.No. | Wired Technology | Wireless Technology |
|--------|---|--|
| 1 | Makes use of cables/wires as transmission media. | Makes use of electromagnetic waves as transmission media. |
| 2 | More secured and faster as there is direct physical connectivity and also the transmission is guided. | Less secured and transmission can suffer from external interference and tapping as transmission is through air which is unguided |

| Sr.No. | Wired Technology | Wireless Technology |
|--------|--|---|
| 3 | Superior networking performance even for longer distances. | Networking performance is distance sensitive. |
| 4 | Expensive technology | Cost-effective technology |
| 5 | No mobility can be achieved. | Greater mobility is achieved through wireless networks. |

5.2.4 Pervasive Computing

UQ. Describe technologies that underline pervasive computing, providing examples of how businesses can utilize them?

(MU - Q.3(D), Jan. 21, 5 Marks)

- **Pervasive Computing** also called as **Ubiquitous Computing** is anywhere, anytime computing.
- According to this technology, every object around us such as mobile phones, clothes, washing machines, books etc. can be made to have computational capability.
- The processing power is embedded into these objects with the help of microprocessor chips.
- Ubiquitous computing has evolved after mobile computing and includes various technologies such as wireless communication and networking, mobile devices, embedded systems, wearable devices, radio frequency ID (RFID) tags, software agents, Internet capabilities, voice recognition and artificial intelligence (AI).
- The two key technologies behind Pervasive Computing are : **Radio frequency identification (RFID) technology** and **Wireless sensor networks (WSNs)**.

(a) Radio frequency identification(RFID) technology

- **Radio-frequency identification (RFID)** uses electromagnetic waves to automatically detect tags attached to objects.
- An RFID system basically consists of a transponder (transmitter and responder). When it receives an electromagnetic signal from a nearby RFID reader device, the tag transmits digital data back to the reader.
- Manufacturers attach tags with radio transponders and RFID chips on goods and then track their movement through radio signals.
- RFID technology facilitates large organizations to manage and track their stock and inventory. An RFID tag can be attached to all the objects in the inventory and used to track and manage the stock details without manual data entry.
- Manufactured products such as automobiles or garments can be tracked from the factory until shipped to the customer.
- Many organisations require that their vendors place RFID tags on all shipments to improve supply chain management.

(b) Wireless sensor Networks (WSNs)

- WSNs are formed by interconnection of several battery powered wireless sensors called motes that are placed anywhere in the physical environment. These motes are capable of collecting, processing and storing the data.
- Embedding processor chips and sensors in any kind of object and using Web Technology is making these objects smart. egs: Smart watches, Digital thermostats, Sensors in vegetable cartons, Jet engines, etc.
- This technology can be broadly called as Internet of Things (IOT).
- Having their roots in military applications for battlefield surveillance; today WSNs are widely used in industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, etc.
- WSNs are used in agriculture field to monitor environmental conditions and manage irrigation facilities.
- Sensors in jet engines produce data in real time on the operating performance of the engines.
- Sensors in fruit and vegetable cartons can track location and even sense the freshness of the product thereby warning about spoilage.
- IBM has initiated a long-term project with the local government to use sensors, software, and the Internet to improve the city's use of water, electricity, and transportation.

5.2.5 Cloud Computing Model

- Cloud computing is a type of computing that lets customers easily access resources such as servers, storage, applications etc. over the Internet.
- These resources are shared by multiple computing devices over the network and can be acquired as and when needed and released when the work is done.
- Cloud computing refers to offering computing services from servers in a network.
- **Typical features of cloud services are :**
 - o available on demand
 - o can be accessed over a network
 - o share resources between multiple applications and tenants
 - o scale elastically based on dynamic computing needs
 - o provide measured service
 - o pay-per-use(utilty computing)
- As shown in the Fig. 5.2.5, there are multiple cloud services right from infrastructure, applications to storage that can be accessed from thousands of different locations globally.

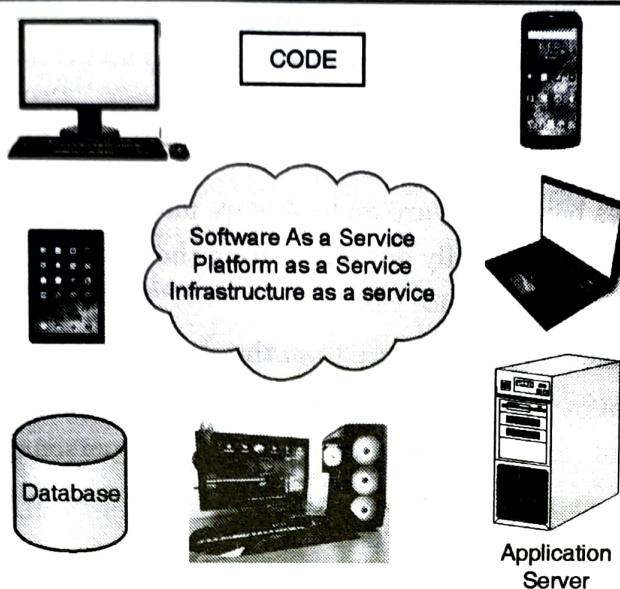


Fig. 5.2.5 : Cloud Computing Model

- **Cloud Computing Deployment Models based on Infrastructure Ownership**

- o **Private** : Private cloud is cloud infrastructure deployed for a single organization, whether managed internally or by a third party, and hosted either internally or externally.
- o **Public** : When the cloud services are deployed over the public Internet it is called Public cloud. Many services are free for general public over public cloud but certain premium services may be charged.
- o **Hybrid** : Hybrid cloud is a combination of a public cloud and a private cloud. This type of infrastructure might be advisable when certain temporary resource needs cannot be satisfied by private clouds.
- o **Community** : Community cloud shares infrastructure between several organizations from a specific community with common concerns (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party, and either hosted internally or externally.

- **Cloud Computing Models based on Services provided**

- o **Infrastructure-as-a-Service (IaaS)** : These are cloud based services that provide infrastructure services as and when required over the internet such as storage, networking, virtualization etc.
- o **Platform-as-a-Service (PaaS)** : These are cloud services that provide services such as hardware and software environment required for development over the internet
- o **Software-as-a-Service (SaaS)** : This cloud service makes available different application softwares for use over the internet.

 **Advantages of Cloud Computing**

1. Users can easily access or store information from anywhere, anytime, from any device connected to the internet.

2. As the data is stored on the cloud, there is always a backup and recovery for your data.
3. It enhances an organization's productivity and efficiency by ensuring that the data is all the time available and that too on a click of a second.
4. Cloud computing reduces both hardware and software maintenance costs for organizations as they do not hold or buy anything physically but rent it from the cloud service provider. The cloud service provider takes care of the maintenance job.
5. The users pay only for the services they use from the cloud i.e. pay-per-usage.
6. Cloud offers huge amount of virtual storage which is physically not possible on our personal computer systems. Cloud storage can be used to store all our personal data, photos, documents etc.
7. Cloud service provider guarantees the security of our confidential information by implementing various security mechanisms.

Disadvantages of Cloud Computing

1. You need to be always connected to the internet to access cloud services.
2. Organizations may face problems when transferring their services from one vendor to another, if the platforms provided by the vendors are different.
3. The cloud users have limited control over the services within a cloud infrastructure as everything is controlled by the cloud service provider.
4. Although cloud service providers take full responsibility of security of your confidential data on the cloud but still there could be chances that as we are sending our sensitive information to a third party, it could be hacked.

► 5.3 MULTIPLE CHOICE QUESTIONS

- Q.1** Traveling sales people and those at regional sales offices can use the Internet, extranets, and other networks to transmit customer orders from their laptop or desktop PCs, thus breaking barriers. **(Jan. 21, 2 Marks)**
- (a) Physical (b) Competition (c) Structural (d) Geographic ✓ Ans. : (d)
- Q.2** All of the following would typically be supported by an organization's intranet information portal except: **(Jan. 21, 2 Marks)**
- (a) Communication and collaboration (b) Business operations and management
 (c) Web publishing (d) Recruitment ✓ Ans. : (d)
- Q.3** _____ is a method of delivering software in which a vendor hosts the applications and customers access these applications over the Internet. **(Jan. 21, 2 Marks)**
- (a) Software-as-a-Service (b) Prototyping Option
 (c) Leasing the application (d) Service-oriented architecture ✓ Ans. : (a)
- Q.4** Transmission rates of communication media measured in bits per second is also called as **(a)**
- (a) Bandwidth (b) Velocity (c) Speed (d) Frequency ✓ Ans. : (a)



- Q.5** _____ networks span over an area such as within the same building.
 (a) WAN (b) MAN (c) CAN (d) LAN ✓ Ans. : (d)
- Q.6** Every device in the LAN has a _____ that facilitates the connection of every device to the communication medium.
 (a) SIM card (b) Smart Card
 (c) ID Card (d) Network Interface Card ✓ Ans. : (d)
- Q.7** The _____ is a universal WAN that connects millions of computer networks all over the world.
 (a) Internet (b) Intranet (c) Cybernet (d) Ethernet ✓ Ans. : (a)
- Q.8** Which of these is not an Internet Service Provider?
 (a) Microsoft (b) America Online (c) MTNL (d) Facebook ✓ Ans. : (d)
- Q.9** Each device on the Internet is identified by a unique address, called the _____
 (a) IP address (b) LAN address
 (c) PAN address (d) WAN addressss ✓ Ans. : (a)
- Q.10** _____ takes the responsibility of assigning IP addresses to systems throughout the world globally.
 (a) The Indian Institute of Technical Education
 (b) The Certification Authority
 (c) The Internet Corporation for Assigned Names ✓ Ans. : (c)
 (d) None of above
- Q.11** Human readable names for IP addresses are called _____
 (a) Aliases (b) MAC addresses
 (c) domain classes (d) domain names ✓ Ans. : (d)
- Q.12** Users access the Web primarily through software applications called _____
 (a) Operating system (b) Browsers (c) Portals (d) Compilers ✓ Ans. : (b)
- Q.13** In the URL www.amazon.com , com is called
 (a) Top level domain (b) Sub domain (c) domain (d) None of above ✓ Ans. : (a)
- Q.14** Which of these is not an Internet protocol?
 (a) TCP (b) IP (c) Ethernet (d) None of above ✓ Ans. : (c)
- Q.15** _____ is a protocol used by the World Wide Web, which defines how messages are formulated and how they are interpreted by the web browsers and web servers.
 (a) http (b) TCP (c) IP (d) ftp ✓ Ans. : (a)
- Q.16** Which of these is not a network application?
 (a) e-learning (b) telecommuting
 (c) videoconferencing (d) talking ✓ Ans. : (d)



- Q.17** In client-server architecture, the system with all the computing capability is called
 (a) client (b) server (c) peer (d) master ✓ Ans. : (b)
- Q.18** Which of these is a peer-to-peer application?
 (a) Thin client (b) Fat client (c) Flat client (d) BitTorrent ✓ Ans. : (d)
- Q.19** In this topology, a token is used by the sender which contains the destination address along with the data.
 (a) Ring topology (b) Bus topology (c) Star topology (d) Tree topology ✓ Ans. : (a)
- Q.20** If the central hub fails, then the entire network crashes and none of the devices will be able to communicate. This is a drawback of which network topology?
 (a) Ring topology (b) Bus topology (c) Star topology (d) Tree topology ✓ Ans. : (c)
- Q.21** Mesh topology can be formed by using which formula for number of connections?
 (a) $(n+1)/2$ (b) $(n*(n+1))/2$ (c) $(n-1)/2$ (d) $(n*(n-1))/2$ ✓ Ans. : (d)
- Q.22** A hub is a hardware device
 (a) that divides the network connection among multiple devices.
 (b) that routes data packets on the network.
 (c) that connects a LAN to the internet.
 (d) that allows the computer to connect to the internet. ✓ Ans. : (a)
- Q.23** A switch is a hardware device
 (a) that takes care of sequencing of data packets.
 (b) that connects multiple devices on a computer network smartly.
 (c) that connects a LAN to the internet
 (d) that allows the computer to connect to the internet over existing telephone line. ✓ Ans. : (b)
- Q.24** A _____ is a hardware device that connects a LAN to the internet.
 (a) Switch (b) Hub (c) Router (d) Modem ✓ Ans. : (c)
- Q.25** A modem is a hardware device
 (a) that divides the network connection among multiple devices.
 (b) that takes care of sequencing of data packets.
 (c) that routes data packets on the network.
 (d) that allows the computer to connect to the internet over existing telephone line. ✓ Ans. : (d)
- Q.26** Which is the fastest wired network protocol?
 (a) Ethernet (b) HTTP (c) Bluetooth (d) Zigbee ✓ Ans. : (a)
- Q.27** The twisting of wires in twisted pair cables
 (a) makes the transmission faster as physical wires are twisted.
 (b) reduces noise on the wires by cancelling the electromagnetic interference.
 (c) increases bandwidth due to twisting more than one wire.
 (d) doesn't cause any significant change. ✓ Ans. : (b)

- Q.28** The microwave signals have transmitting frequency ranging from
 (a) 1GHz to 300GHz (b) 1MHz to 50 MHz
 (c) 1MHz to 300MHz (d) 1GHz to 50 GHz ✓ Ans. : (a)
- Q.29** Distance of GEO satellite from the equator is
 (a) 6434 miles (b) 22,300 miles (c) 400-700 miles (d) 10,000 miles ✓ Ans. : (b)
- Q.30** Distance of MEO satellite from the earth's surface is
 (a) 6434 miles (b) 22,300 miles (c) 400-700 miles (d) 10,000 miles ✓ Ans. : (a)
- Q.31** Distance of LEO satellite from the earth's surface is
 (a) 6434 miles (b) 22,300 miles (c) 400-700 miles (d) 10,000 miles ✓ Ans. : (c)
- Q.32** No. of GEO satellites orbiting around the earth are
 (a) 8 (b) 12 (c) 10 (d) 4 ✓ Ans. : (a)
- Q.33** No. of MEO satellites orbiting around the earth are
 (a) 8 (b) 10-12 (c) 15 (d) 4 ✓ Ans. : (b)
- Q.34** Which type of satellite transmission has the highest transmission delay?
 (a) Geostationary Earth Orbit (b) Low Earth Orbit
 (c) Medium Earth Orbit (d) None of above ✓ Ans. : (a)
- Q.35** Which electromagnetic signals are used in remote control units for televisions, CD and DVD players?
 (a) Microwave (b) Radiowave (c) Bluetooth (d) Infrared ✓ Ans. : (d)
- Q.36** Which of these wireless technologies is omnidirectional?
 (a) Bluetooth (b) NFC (c) Infrared (d) None of above ✓ Ans. : (a)
- Q.37** Bluetooth 2.0 has a range of
 (a) 10 meters (b) 100 meters (c) 10 feet (d) 100 feet ✓ Ans. : (b)
- Q.38** The technology which is similar to Bluetooth but has a wider scope and speeds of upto 250 Mbps.
 (a) WiFi (b) NFC (c) WiFi Direct (d) Infrared ✓ Ans. : (c)
- Q.39** 3G cellular networks support
 (a) data communication (b) voice and data communication
 (c) voice communication (d) none of above ✓ Ans. : (b)
- Q.40** In _____ computing, the processing power is embedded into any object with the help of microprocessor chips.
 (a) Parallel Computing (b) Data Computing
 (c) Soft Computing (d) Pervasive Computing ✓ Ans. : (d)
- Q.41** Which of these is not a feature of Cloud Computing?
 (a) pay-per-use (b) single-tenancy
 (c) on demand computing (d) elasticity ✓ Ans. : (b)

MODULE 6

CHAPTER 6

Information System Within Organization

University Prescribed Syllabus

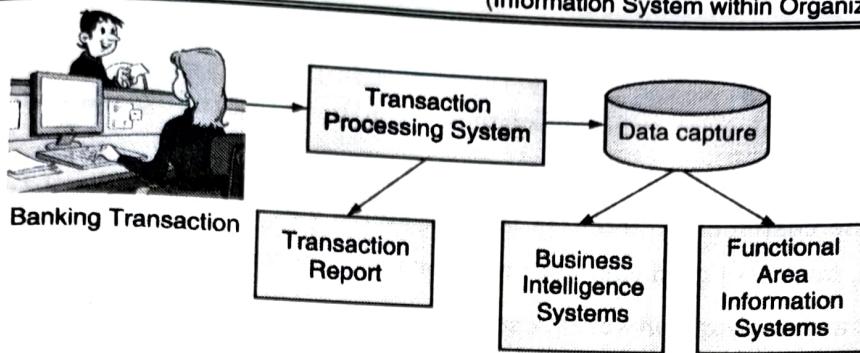
Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications : Various System development life cycle models.

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Computer based information systems are much more reliable, and they provide many other benefits over traditional paper based systems. Various processes from collection, storage, analysis, and distribution of information become quite easy and faster using computerized information systems. There are various types of Information systems used within organizations. We will have a quick look at the different information systems and the scope of their usage.

► 6.1 TRANSACTION PROCESSING SYSTEMS

- A **transaction** is any business event or activity that generates data valuable enough to be captured and stored in a database.
- Examples of transactions could be anything like an order processed, a booking cancelled, product manufactured, a service sold, a person hired etc.
- A **transaction processing system (TPS)** deals with the monitoring, collection, storage, and processing of data generated from the organization's fundamental business transactions.
- The TPS constantly gather data in real time and it is stored in the company's databases.
- They are very essential to the success of the business organization as they support all major and core business processes.
- These systems should be designed to handle large volumes of data accurately, securely, without any errors and intermissions.
- The outputs of TPSs are inputs to various functional area information systems and business intelligence systems.
- The TPSs need to take care of access control and synchronization control. i.e. errors due to simultaneous updates from multiple locations by authorized users must be avoided. Suppose a withdrawal is done from ATM as well as by cash slip at the same time from the same account then the TPSs must be able to handle and reflect these simultaneous updates without any inconsistencies.
- The TPSs should be capable of reversing a transaction. Suppose a railway reservation is cancelled, then the refund with the applicable deductions must be reflected back in the customer's account. Also at the same time the seat availability due to cancellation must be reflected back in the railway database.
- The TPSs should maintain regular audit trails as well.
- The data is processed by these types of systems in two ways either batch processing or online transaction processing.
 - o In **batch processing**, the transactions are grouped into batches and then these batches are processed together at regular intervals.
 - o In **online transaction processing (OLTP)**, the transactions are processed online in real time as and when they occur.
- A simple transaction processing system is shown in Fig. 6.1.1.

**Fig. 6.1.1 : Typical Transaction Processing System**

6.2 FUNCTIONAL AREA INFORMATION SYSTEM(FAIS)

UQ. What are the functional areas of Information system. Explain in detail. (MU-Q. 5(B), Dec. 19, 10 Marks)

- Within an organization, every department incorporates its own set of application programs and information systems. These systems are commonly known as Functional Area Information Systems (FAISs).
- As the name implies these FAISs support business processes of a specific functional area within the organization quite efficiently.
- Typical FAISs are production management information systems, accounting and finance information systems, marketing and sales information systems, human resource information systems etc.
- Fig. 6.2.1 summarizes the overall information systems supporting the various functional areas.

➤ Activities Supported by Functional Area Information Systems

☞ Accounting and Finance

- o Accounting and Finance information systems help in financial planning and budgeting.
- o They help in allocating financial resources appropriately to various activities within the organization.
- o They support organizational investment management in stocks and bonds.
- o These systems also facilitate budgetary control by comparing overall expenditures with the incoming cashflows.
- o They also deal with managing the payroll of the employees.
- o Also as a part of accounting and finance information systems, regular financial auditing is carried out to monitor organization's financial health.

❖ Marketing and Sales

- Marketing and sales information systems help in maintaining customer profiles and their choices and preferences.
- Based on the customer preferences these systems can better handle their customers, satisfy their needs, maintain good customer relations and thereby help in customer retention.
- Sales force automation softwares are used to automate the business processes of sales, thus improving the productivity of sales representatives.
- They also deal with planning of Advertising campaigns for promoting the products.

❖ Production/Operations and Logistics

- These information systems deal with various business processes like manufacturing resource planning, materials requirement planning, inventory management and quality control.
- Manufacturing and material management systems basically deal with planning the production, purchasing, inventory and labour management.
- Inventory management systems monitor inventory levels, threshold to decide when new orders need to be placed to keep the stock updated.
- Quality control and monitoring supports keeping track of defects in products encountered and minimizing the defect rate.
- These days computer supported manufacturing approach is in use that integrates several automated systems, such as computer-assisted design (CAD), computer-assisted manufacturing (CAM) etc.

❖ Human Resource Management

- Human resource management information systems support recruitment processes right from shortlisting candidate profiles, conducting interviews and tests, to final selection of candidates.
- These systems maintain employee records. They support conduction of regular trainings for the employees.
- They facilitate continuous performance evaluation of employees to decide upon best employees and rewarding them appropriately.
- These systems manage the employee benefits data like retirement and pension policies, holiday schemes etc.

| Functional Area | Accounting | Finance | Human Resource | Production / Operation | Marketing |
|------------------|---|-------------------------------|----------------------------------|---------------------------------------|--|
| Management Level | | | | | |
| STRATEGIC | Profitability Planning | Financial Planning | Employment Planning | Product Lifecycle Management | Sales forecasting, Advertising |
| TACTICAL | Auditing, Budgeting | Investment Management | Benefits, Performance Evaluation | Quality Control, Inventory Management | Customer relationship Management, Sales Force Automation |
| OPERATIONAL | Payroll, Accounts Payable and Accounts Receivable | Manage Financial Transactions | Maintain Employee Records | Order processing and fulfillment | Customer profile, Set pricing |

Fig. 6.2.1 : Information systems supporting the functional areas

6.3 ENTERPRISE RESOURCE PLANNING(ERP) AND ERP SUPPORT OF BUSINESS PROCESS

6.3.1 ERP Systems

- The FAIS are designed to serve individual departments within an organization. They hardly communicate with any other system outside their functional area.
- But there could be cases where more than one FAIS require the same data and multiple copies of the same data are maintained.
- Say for example, same product details would be maintained by sales and marketing as well as production department separately.
- Here at this point, Enterprise Resource Planning systems can be used to resolve this problem. ERP systems are designed to correct the lack of communication among the FAIS. ERP systems overcome this problem by tightly integrating the functional area IS via a common database.
- The main objective of ERP systems is to provide a single business process view of the entire organization and combine together the planning, management and organization's overall resources using a common software and database platform.
- The major objectives of ERP systems are to tightly integrate the functional areas of the organization and to enable information to flow smoothly across them.
- Few of the leading ERP software vendors are SAP, Oracle, PeopleSoft.
- Organizations can either use commercially available ERP softwares or can custom build ERP systems as per their organizational business requirements.



6.3.2 ERP II Systems

- The ERP systems have been evolving with time where initially ERP systems integrated only the core business processes of manufacturing like raw material management, inventory management, order fulfilment etc.
- Gradually, in the later versions of ERP softwares other modules such as sales and marketing, customer relationship management, supply chain management were also added.
- These days business organizations have started implementing a newer approach of ERP systems called ERP II.
- ERP II employs a Web enabled platform to hook up all the business processes together under one packaged ERP solution.
- Not just within the organization but ERP II systems provide Web enabled links among interorganizational processes within the industry value chain as well.
- All the key business systems from suppliers and procurement, inventory and manufacturing, distribution and order fulfilment, to customer relationship everything is encompassed under a single umbrella of web enabled ERP II systems.
- The ERP II system and various modules covered within it are depicted in Figure 6.3.2.
- Manufacturing and Production, Accounting and Finance and Human Resource make up the core modules whereas Supply Chain Management, Customer Relationship Management, Business Intelligence, E-Business are all extended modules.

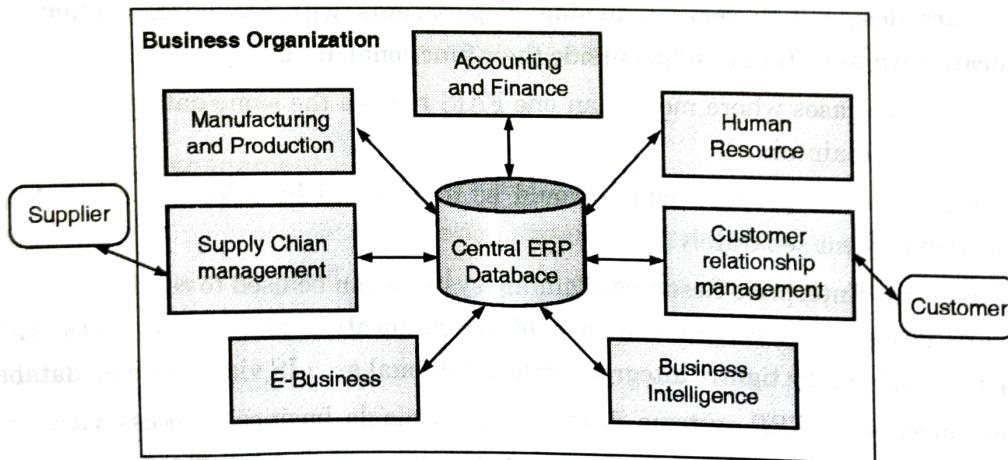


Fig. 6.3.2 : ERP II Systems

- Let us first have a look at core modules.
 - o **Manufacturing and Production :** This module encompasses all the processes associated with production planning, material requirement planning, procurement, inventory, production scheduling, quality control, transportation and distribution.

- o **Accounting and Finance** : All the aspects of financial management like accounting, cash management (inflow and outflow), budgeting, credit management, tax accounting, asset management are covered up in this module.
- o **Human Resource** : This module deals with business processes associated with workforce planning, employee recruitment, payroll, performance management, employee benefits, their trainings etc.

The extended modules are described below.

- o **Customer Relationship Management** : This module supports all the activities associated with organization's relationship with the customer like maintaining customer information, their preferences and purchase history, their credit information, enabling customer satisfaction, maintaining customer loyalty, enforcing customer retention, etc.
- o **Supply Chain Management** : This module manages information flows among various stages of supply chain to manage its efficiency. It tries to optimise the entire supply chain, right from acquisition of raw materials to delivery of finished products.
- o **E-Business** : This module provides web based interface to business-to-consumer and business-to-business transaction information. Customers and suppliers can access the ERP through this interface to get whatever information they want such as order status and tracking, invoice settlements etc.
- o **Business Intelligence** : These modules help in accumulating the information from various areas of the business organization and then perform analysis on this information using various analytical tools (BI tools).The results of the analysis help the managers in taking useful business decisions.

6.3.3 Benefits and Limitations of ERP Systems

- ERP systems provide substantial benefits to the business organization. Few of them are:
 - o They make organizations more flexible and adaptive. This is so because now information can easily flow among various functional areas through the common ERP database which was not possible in the traditional isolated systems.
 - o These systems enhance the decision making process for improving business performance as they collect information from varied functional areas. So the decisions made are more better and accurate.
 - o The ERP systems integrate various facets of business under a single packaged solution thereby trying to improve the quality and efficiency of the different business processes within the organization. Quality of customer service, quality of production etc., everything is highly improved.

The major drawbacks of ERP systems are:

- o The pre packaged ERP solutions available in the market have been designed considering the best possible solutions for achieving business objectives in general for any industry.



- For certain business organizations whose procedures do not match exactly with the predefined solutions provided by the ERP software, then in that case, the organization will have to manipulate their business processes as per the software.
- Further, the employees should be willing to accept the changes in the existing way of carrying out the business processes.
- Cost involved in implementing an ERP system is quite high. They could also be time consuming to implement and risks of failure are also substantial. Many businesses have faced heavy losses because either core business processes or information systems failed or did not work properly.
- Failures could also be caused because the ERP systems were designed without proper knowledge of core business processes, lack of involvement of employees while implementing these systems or insufficient training on how to use the systems.

❖ 6.3.4 Implementing ERP Systems

Companies can implement ERP systems in two ways, either using on-premise software or by using software-as-a-service.

- **On-premise software based ERP systems :**

They can be implemented in three ways:

- *Vanilla approach* where the organization implements the standard packaged ERP solution. The organization has barely any chance to diverge from the standard functionalities provided by the packaged software.
 - *Custom approach* where the organization implements a customized ERP system built by adding functionalities specific to the business organization. Customization can turn out to be more expensive and sometimes risky as code is rewritten everytime new version of the ERP software is released.
 - *Best of breed* method combines benefits of vanilla and custom approach, thereby avoiding excessive costs and risks related to complete customization.
- **Software-as-a-service (SaaS) :** Rather than buying or custom building a complete ERP solution, an organization can avail software-as-a-service. The organization will rent the software from the ERP cloud vendor over the Internet using SaaS.
- The ERP cloud vendor takes care of software updates, security and other concerns. Organizations who cannot afford large IT investments can go for this option. Moreover such systems can be accessed anytime and from anywhere.

❖ 6.3.5 ERP Support for Business Processes

- ERP systems support a lot of standard business processes. They handle and manage end to end, cross-departmental processes.

Cross-departmental processes are those that have their origin in one department and end up in some other department. Say, for example the procurement process begins in the warehouse department and ends in the accounting department after the payment is processed. Another variation of cross-departmental processes is where the processes originate and end up in the same department but need the involvement of other departments. For example, the production process has its origin in warehouse department and ends also in the warehouse department but needs the involvement of the production department as well.

6.3.6 Reports

UQ: Compare and contrast the three basic types of reports which are closely associated with FAIS and ERP systems.

(MU - Q. 3(E), Jan. 2020, 5 Marks)

- Generally, reports are generated by all the information systems like Transaction Processing Systems, Functional Area Information Systems, ERP systems etc.
- The three basic types of reports which are closely associated with FAIS and ERP systems generally fall into three categories: **routine, ad-hoc (on-demand), and exception.**
- **Routine reports** are those which are generated at regular intervals or rather scheduled intervals. They could be reports that are generated on hourly or daily basis. Daily absenteeism report, hourly report of the defects encountered and quality check etc., are all examples of routine reports. These are very helpful to the managers for evaluating routine progress.
- **Ad-hoc (on-demand) reports** are those which are not routine but out-of-the-routine reports. Which means sometimes the managers may not want the routine reports that are generated on regular basis but they might ask report for a different time interval. Say, for example, production report of last three days and not the entire week.
- Adhoc reports are further classified as

- o **Drill-down reports** display information in greater levels of detail. For example, a manager might want the sales data by city and then by a particular area within that city and then further in detail a particular store in that area.
- o **Key-indicator reports** summarize the performance of critical activities. For example, a finance manager of the company might want reports to monitor cash flows and cash on hand.
- o **Comparative reports** help to compare the performances of different business units or of a single unit at different times. For example, sales report on weekdays and weekends for comparison purpose.

Exception reports are generated only when something happening in the on-going business process falls outside certain threshold standards. For this, first the management fixes up certain performance standards for the organization.

The business processes are monitored to check for any deviations from the standards. If so, they are reported in such exception reports and necessary actions are further taken.



- For example, the management would decide upon the acceptable threshold of return of defective products, say around 5% of total items produced. But, as per the exception reports if the number exceeds 5% that means a strict line of action needs to be taken.

6.4 ACQUIRING INFORMATION SYSTEMS AND APPLICATIONS

6.4.1 Planning for and Justifying IT Applications

- Whenever an organization plans for acquiring a new IT application or an information system (IS), the first step of the planning process is analysis of the organization's strategic plan.
- Strategic planning means clearly identifying the firm's overall mission, what goals need to be achieved and how to achieve them.
- After an IT strategic plan is ready, operational planning on the same begins, where the executive managers and the IT managers will start planning the IS system projects to be undertaken to achieve the IT strategic plan.
- The IS operational plan comprises of the overall mission and objectives to be achieved through the implementation of the IS, environment in which the IS will work, resources required ,constraints(financial,personnel,technological) if any,prioritized list of applications already present and applications that need to be developed in the year, etc.

6.4.2 Evaluating and Justifying IT Investment : Benefits, Costs, and Issues

The next thing to be done after the IT plan is ready is justifying the investment into the IT projects. Because the organization has limited resources which are to be allocated into various other sectors along with IT sector, so a proper analysis of the costs that will be incurred and benefits that will be achieved has to be carried out. Based on that a decision would be made whether the IT investment is beneficial or not. This analysis is called **cost-benefit analysis**.

- **Assessing Costs** : First thing is calculating the costs that will be incurred. Costs are of two types **fixed and variable**.
 - o **Fixed Costs** : These are usually onetime costs and do not occur or change frequently. The development cost, cost of IT infrastructure are majorly onetime costs. Salaries of IT managers, although salaries may hike but it is not that frequent .So, they all come under fixed costs.
 - o **Variable Costs** : These are the on-going costs which will be incurred until the IS is in use. For example, the maintenance cost, electricity bills, internet charges etc.
- **Assessing Benefits** : Next is evaluating the benefits that will be achieved. Benefits can be **tangible or intangible**.
 - o **Tangible Benefits** : Tangible benefits are those that can be easily quantified like yearly profit gained, total yearly sales, etc.
 - o **Intangible Benefits** : Certain benefits which cannot be measured directly are intangible. For example, improved customer satisfaction, employee retention etc.

- **Conducting Cost - Benefit Analysis :** Once both the costs and benefits are identified, a cost-benefit analysis is conducted. The costs and benefits are compared to evaluate whether the IT investment will be profitable to the organization or not. For doing so there are four common approaches:

- o **Breakeven Analysis :** It determines the point called the break-even point, at which the cumulative dollar value of the benefits equals the investment made in the IT project.
- o **Net Present Value (NPV) :** This method brings the future values of benefits to their present-value by adjusting the organization's cost of funds that will be incurred in future. For this the NPV method uses a multiplying factor called the "discounting factor". Then a comparison of present value of the future benefits and the costs required to achieve those benefits is done to determine whether the benefits exceed the costs.
- o **Return on Investment (ROI) :** Return on investment is calculated by dividing the net income generated by a project by the average assets invested in the project. ROI is given in percentages and higher the ROI, better is the investment.
- o **Business Case approach :** In this approach, system developers write business cases for justifying the investment and funding for one or more IT projects. These business cases describe what will be done, how it will be done, and how the new system will better support the organization.

6.4.3 Strategies for Acquiring IT Applications

UQ: Describe the four fundamental business decisions that organizations must make when acquiring information systems. (MU - Q. 3(F), Jan 2020, 5 Marks)

- After an organization has justified an IT investment, it must then decide how to pursue it. From the evaluations of cost-benefit analyses, there would be several options in front of the management for acquiring IT applications.
- To select the best option, organizations must make a series of business decisions. The fundamental business decisions are:

How much computer code does the company want to write ?

An organization can decide to use a totally prewritten application and not write any computer code, or to customize a prewritten application i.e. to write some new computer code as per needs, or to custom-write an entire application from scratch.

How will the company pay for the application ?

Once the organization has decided how much computer code to write, it must decide on how to pay for it. If prewritten applications or customized prewritten applications are going to be used then in that case organizations can buy them or lease them. For totally custom built applications, organizations can use internal funding.

☞ Where will the application run ?

The next decision is whether to run the application on the company's platform or on someone else's platform. If the management decides, the organization can opt for an application service provider or a software-as-a-service vendor.

☞ Where will the application originate ?

The organization can use prewritten applications that can be open-source softwares or proprietary softwares purchased from vendors. The open-source applications or proprietary softwares can also be customized by acquiring license to do so. Further, the organization will have to take a decision on whether partial or full customization that needs to be done, should be done in-house or outsourced to a third party solution provider.

- In a gist, the feasible acquisition methods for an organization are:
 - Purchase a prewritten application: Standard packaged solutions available in the market can be purchased by the organization. This option is time-saving and most cost-effective and all standard features required are available in the software.
 - Customize a prewritten application: If license for customizing the prewritten application from the vendor is available, then modifying the application is also a good option. But customizing very complex softwares can be cumbersome.
 - Lease the application: If purchasing a software is too expensive, the organization can go for leasing the softwares. Especially for small to medium sized organizations who cannot afford such huge IT investments can go for this option.
 - Application service providers and Software-as-a-service vendors: An **application service provider (ASP)** is an agent or a vendor who assembles the software needed by enterprises and then packages it with services such as development, operations, and maintenance. The customer then accesses these applications via the Internet.

Software-as-a-service (SaaS) is a method of delivering software in which a vendor hosts the applications and provides them as a service to customers over a network, typically the Internet.

In both the cases, the organization will not own the software instead they will subscribe for a particular service from the service provider and pay as per their usage. The services are shared by multiple customers and hence it is quite cheaper.

- **Use open-source software:** Using open-source softwares is another economical solution. Organizations can get hold of a license to implement an open-source software product and either use it as it is, customize it, or develop applications with it.
- **Use outsourcing :** Acquiring IT solutions from outside contractors or external organizations is called **outsourcing**. Organizations can use outsourcing in many situations. For example, they might want to try and test new IT technologies without making a large up-front

investment or outsourcing might also be used because the external organization has an expertise in providing that service.

- o **Employ custom development :** Organizations can also opt to custom-build an application from scratch. Development can be carried out in-house or can be outsourced. Although this approach is time consuming and costly than buying or leasing but it will best satisfy all the organizational needs. While going for custom development basic system development lifecycle(SDLC) is essential. The next section focuses on various system development life cycle models.

6.5 VARIOUS SYSTEM DEVELOPMENT LIFE CYCLE MODELS

> The Traditional Systems Development Life Cycle(SDLC)

- o The traditional systems development life cycle is the basic development methodology used by organizations for large-scale IT projects.
- o The SDLC consists of a systematic and sequential set of steps to develop quality software products. The basic SDLC is depicted in Fig. 6.5.1.

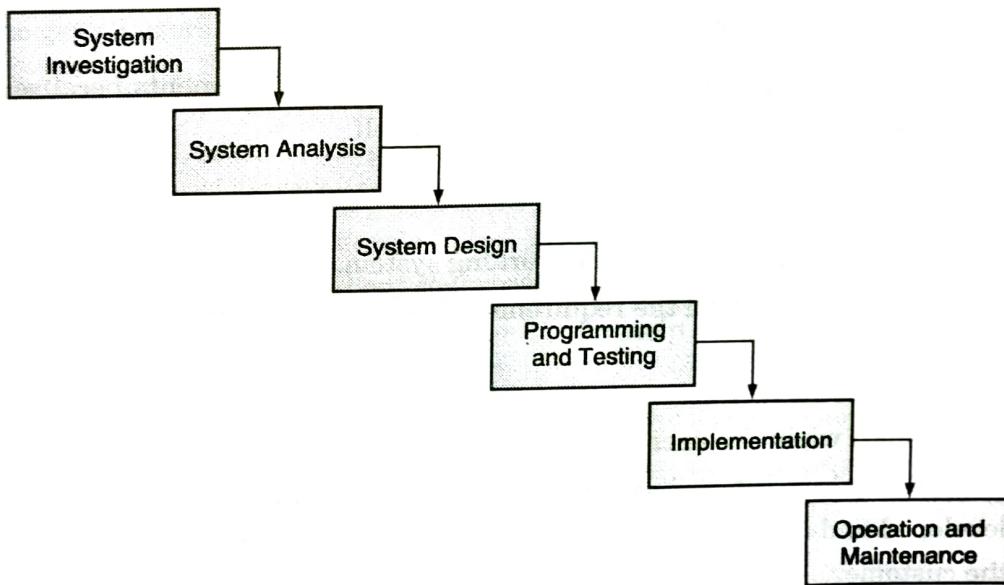


Fig. 6.5.1 : Traditional system development life cycle model

- The steps are described as under:

- o **Systems investigation :** This step involves basic understanding of the business problem to be solved, what technologies would be needed to solve the problem, study of whether the solution is actually feasible.
- o **Systems analysis :** In systems analysis phase, a complete analysis of business problem that needs to be solved with the help of the proposed information system is done. A clear understanding and specification of the software requirements is the aim of this phase.

- **Systems design** : Systems design helps in creating a blueprint of the solution. The technical specifications such as system inputs, outputs, user interfaces, hardware, software, databases, and how they are integrated together to form the software architecture, are represented in the system design phase.
- **Programming and testing** : Programming involves translating the design specifications into machine readable form. Actual coding in specified programming language is done.
- **Implementation:** Also known as deployment involves the switch over from old computer systems to the newly implemented one. Making the necessary organizational changes to get the new system accommodated is a part of deployment.
- **Operation and maintenance:** Once the new system is in operation, continuous monitoring whether the system is behaving as desired in actual environment, debugging defects if encountered are all part of maintenance phase. Any future updatations or additional functionalities needed, are done in the maintenance phase.

Advantages

1. It strictly follows a systematic, disciplined and structured approach to development.
2. Enforces quality by maintaining standards.
3. Very less chances of missing important issues in collecting user requirements because this model expects all the requirements to be stated in the beginning itself.

Disadvantages

1. Too lengthy and takes too long to get the actual working system.
2. Users might find it difficult to state all the requirements in the beginning.

Prototyping

- This approach can be used when the user is not clear about the requirements.
- With the initial set of requirements, a basic model or a smaller version of the actual system called a prototype is developed and in further iterations the remaining requirements are added as per the feedback from the customer.
- The iterations will continue till the customer is completely satisfied.

Advantages

1. This model helps to make clear user requirements in every iteration.
2. Promotes involvement of customer.
3. Promotes communication between developers and users.
4. Working model can be seen at early stages.

☛ Disadvantages

1. In a hurry to develop the prototype quality compromises could be done.
2. For large number of users this model may not be practically possible.

➤ Joint Application Design

- Joint application design (JAD) is a group discussion technique for collecting requirements and creating system designs.
- JAD involves a group meeting which is attended by the analysts, members from development team and all of the users.
- During this meeting, all the attendees sit, discuss and agree upon the systems requirements.

☛ Advantages

1. Involvement of many users in the development process.
2. Greater user support for new system.
3. Improved quality of the new system.

☛ Disadvantages

1. Difficult to get all users to attend JAD meeting and all attendees to come to common conclusion.

➤ Rapid Application Development

- This method involves developing the system rapidly in short duration of time of near about 60-90 days.
- To achieve rapid application development, problem is modularized, multiple teams are formed and the development is carried out concurrently.
- Also, maximum use of reusable components can help save time of developing software from scratch.
- At the end, all the modules are integrated together and complete system is built.

☛ Advantages

1. Can speed up systems development.
2. Users intensively involved from the start.

☛ Disadvantages

1. This model is not useful if the problem cannot be properly modularized.
2. Lot of human resources are required to form sufficient teams to work in parallel.

➤ Agile Development

- Currently, many organizations are moving from the traditional system development to agile development.



- Agile is more rapid, adaptive and collaborative approach to software development.
- Agile is also a swift development methodology where the product functionalities are delivered in iterations and the duration of iterations is kept very short, usually in weeks.
- This methodology requires frequent user communication to better understand the user needs.
- The software developed need not include every possible feature that the user will require. Rather, it must meet only the user's more important and immediate needs. It can be updated later to introduce additional functions as they become necessary.
- One approach to agile development is the **scrum approach**.
- Scrum model agrees upon the fact that a development problem cannot be completely understood or stated in the beginning itself.
- Scrum focuses on maximizing the development team's ability to deliver iterations quickly.
- In the Scrum model certain roles have been defined like scrum master who manages the entire scrum process, product owner who could be the business user or owner, team of usually about seven people who perform the entire analysis, design, development and testing.
- The entire scrum process is divided into **sprints**. Size of a sprint is usually 2 to 4 weeks.
- There is a product backlog that contains prioritized set of requirements to be completed. In every sprint requirements to be achieved are extracted from this backlog and carried forward for completion.
- During the execution of a sprint, the sprint backlog cannot be changed until the sprint is completed.
- The sprints should be completed on time and after every sprint the team demonstrates the work completed to the users for feedback.
- The changes expected or incomplete requirements again get added into the product backlog. This is how agile development methodology works in faster iterations.

Advantages

1. Rapid and continuous development.
2. Customer communication and involvement is high.
3. As iterations are kept short, problems are identified and rectified at a very early stage.
4. Close interaction between development team and users.

Disadvantages

1. It is not useful for small development projects.
2. There is a lack of concentration on necessary designing and documentation.
3. Cost of agile methodology is comparatively higher.

M 6.6 MULTIPLE CHOICE QUESTIONS

- Q.1** Which of the following is not an advantage of the buy option for acquiring IS applications? (Jan 2020, 2 Marks)
 (a) Few types of off-the-shelf software are available, thus limiting confusion.
 (b) The software can be tried out.
 (c) The buy option saves time.
 (d) The company will know what it is getting. ✓Ans. : (a)
- Q.2** Which of the following systems acquisition methods saves the company's time, enables the company to select software that has been used for similar problems in other organizations, and allows the company to try out the software? (Jan 2020 2 Marks)
 (a) Systems development life cycle (b) Prototyping
 (c) End-user development (d) Buy option ✓Ans. : (d)
- Q.3** _____ is a method of delivering software in which a vendor hosts the applications and customers access these applications over the Internet. (Jan 2020 2 Marks)
 (a) Software-as-a-Service (b) Prototyping
 (c) Leasing the application (d) Service-oriented architecture ✓Ans. : (a)
- Q.4** A _____ is any business event that generates data worthy of being captured and stored in a database.
 (a) transaction (b) process (c) functional area (d) contract ✓Ans. : (a)
- Q.5** A _____ deals with the monitoring, collection, storage, and processing of data generated from the organization's fundamental business transactions.
 (a) transaction processing system (b) Prototyping system
 (c) enterprise application integration system (d) analytical processing system ✓Ans. : (a)
- Q.6** Which of the following is NOT a specific type of transaction processing system?
 (a) Order processing system (b) Purchasing system
 (c) Performance evaluation system (d) Accounting system ✓Ans. : (c)
- Q.7** Which of the following is NOT a typical activity of a Transaction Processing System?
 (a) Data analysis (b) Data collection
 (c) Data editing (d) Data storage ✓Ans. : (a)
- Q.8** Which of these is not a type of Functional Area Information System?
 (a) Enterprise Resource Planning system
 (b) Finance and accounting management system
 (c) Human Resource management System
 (d) Sales and marketing management System ✓Ans. : (a)



- Q.20** In _____ approach the organization implements a customized ERP system built by adding functionalities specific to the business organization.
- (a) Vanilla (b) Jellybean (c) Best of breed (d) Custom ✓Ans. : (d)
- Q.21** _____ approach combines benefits of vanilla and custom approach, thereby avoiding excessive costs and risks related to complete customization.
- (a) Vanilla (b) Jellybean (c) Best of breed (d) Custom ✓Ans. : (c)
- Q.22** Cross-departmental processes are those that
- (a) interfere with each other's processes.
 - (b) can create confusion while execution of departmental work.
 - (c) have their origin in one department and end up into some other department.
 - (d) no such processes actually exist.
- ✓Ans. : (c)
- Q.23** Three basic types of reports closely associated with ERP and FAIS are:
- (a) Drill-down, Key indicator, Comparative (b) Exception, Key indicator, Adhoc
 (c) Key indicator, comparative, Routine (d) Routine, Adhoc, Exception ✓Ans. : (d)
- Q.24** _____ reports are those which are generated at scheduled intervals
- (a) Routine (b) Exception (c) Key indicator (d) Adhoc ✓Ans. : (a)
- Q.25** _____ reports are those which are not routine but out-of-the-routine reports, like production report of last three days and not the entire week.
- (a) Routine (b) Exception (c) Key indicator (d) Adhoc ✓Ans. : (d)
- Q.26** If a manager might want the sales data by city and then by a particular area within that city and then further in detail a particular store in that area. Which report can better display this information?
- (a) Routine (b) Exception (c) Key indicator (d) Drill down ✓Ans. : (d)
- Q.27** _____ reports summarize the performance of critical activities.
- (a) Routine (b) Exception (c) Key indicator (d) Drill down ✓Ans. : (c)
- Q.28** _____ reports help to compare the performances of different business units or of a single unit at different times.
- (a) Routine (b) Exception (c) Key indicator (d) Comparative ✓Ans. : (d)
- Q.29** _____ reports are generated only when something happening in the on-going business process falls outside certain threshold standards.
- (a) Routine (b) Exception (c) Key indicator (d) Comparative ✓Ans. : (b)
- Q.30** Adhoc reports are classified as
- (a) Drill-down, Key indicator, Comparative (b) Exception, Key indicator, Comparative
 (c) Key indicator, comparative, Routine (d) Routine, Drill down, Exception ✓Ans. : (a)

Q.31 The organization's strategic plan aims to

- (a) maximize the long term profitability of the organization.
- (b) identify the firm's overall mission
- (c) identify the goals that follow from the mission and the steps to reach those goals.
- (d) All of above

✓Ans. : (d)

Q.32 An analysis of the costs that will be incurred and benefits that will be achieved by implementing the IT solution is termed as

- | | |
|----------------------------|---------------------------|
| (a) Impact analysis | (b) Cost-Benefit analysis |
| (c) Profitability Analysis | (d) Profit-Loss Analysis |

✓Ans. : (b)

Q.33 Variable Costs do not include

- (a) maintenance cost (b) development cost (c) electricity cost (d) internet cost

✓Ans. : (b)

Q.34 Fixed Costs include

- | | |
|----------------------|------------------------|
| (a) maintenance cost | (b) electricity cost |
| (c) internet cost | (d) salary of employee |

✓Ans. : (d)

Q.35 Tangible Benefits include

- | | |
|----------------------|---------------------|
| (a) profits gained | (b) sales increased |
| (c) errors minimized | (d) All of above |

✓Ans. : (d)

Q.36 Which of these is an example of Intangible benefit?

- | | |
|---------------------------|----------------------|
| (a) profits gained | (b) sales increased |
| (c) customer satisfaction | (d) errors minimized |

✓Ans. : (c)

Q.37 Which of these is not amongst the Cost-Benefit Analysis methods?

- | | |
|-----------------------|--------------------------|
| (a) Swot analysis | (b) Return on Investment |
| (c) Net Present Value | (d) Break even Analysis |

✓Ans. : (a)

Q.38 What are the primary business benefits of an ERP system?

- (a) Sales forecasts, sales strategies, and marketing campaigns
- (b) Market demand, resource and capacity constraints, and real-time scheduling
- (c) Forecasting, planning, purchasing, material management, warehousing, inventory, and distribution
- (d) All of the above

✓Ans. : (c)



- Q.39** _____ is a method of delivering software in which a vendor hosts the applications and provides them as a service to customers over a network, typically the Internet
- System-as-a-service.
 - Platform-as-a-service
 - Infrastructure-as-a-service
 - Software-as-a-service
- Q.40** Acquiring IT solutions from outside contractors or external organizations is called _____
- Insourcing
 - Outsourcing
 - Contracting
 - Offtracking
- Q.41** Which of these is not a system development model.
- SDLC
 - COCOMO
 - Prototyping
 - RAD
- Q.42** One approach to agile development is
- scrub development.
 - adaptive development
 - rapid development
 - scrum development
- Q.43** Which model needs that the requirements be stated clearly well in advance?
- Rapid Application Development model
 - Traditional system development life cycle model
 - Prototyping model
 - Agile model
- Q.44** Which model restricts the development to 60-90 days?
- Fast Application Development Model
 - Swift Application Development Model
 - Quick Application Development Model.
 - Rapid Application Development Model
- Q.45** Smaller working version of actual system is called
- prototype
 - stereotype
 - mock model
 - increment
- Q.46** Duration of a sprint is usually
- 8-12 weeks
 - one year
 - 6-12 weeks
 - 2-4 weeks
- Q.47** Web ERP is suitable for _____. .
- Both small and big organisations
 - Only big organisations
 - Medium scale organisations
 - Only small organisations.
- Q.48** What is at the heart of any ERP system?
- Information
 - Employees
 - Customers
 - Database



Q.49 Which of the following is not a myth about ERP systems

- (a) ERP means more work and procedure
- (b) ERP makes many employees redundant
- (c) ERP integrates and automates organization processes
- (d) ERP is sole responsibility of management

✓Ans. : (c)

Q.50 An effective _____ should result in a high quality system that meets customer expectations, reaches completion within time and cost evaluations, and works effectively and efficiently in the current and planned Information Technology infrastructure.

- (a) Historical cycle (b) System Development Life cycle
- (c) Machine cycle (d) Execution cycle

✓Ans. : (b)

Q.51 SDLC doesn't include the following activity

- (a) design (b) evaluation (c) testing (d) analysis

✓Ans. : (b)

Chapter Ends...

