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Introduction to Information Systems (IS)

Syllabus

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

1.1 Introduction

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

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

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

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

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

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

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

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

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

1.1.1 Information : Concept & Relevance

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

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

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

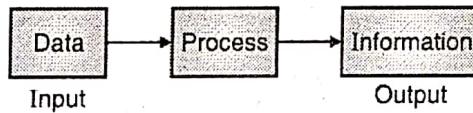


Fig 1.1.1 : Data processing system

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

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

The above characteristics bring many benefits such as :

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

1.2 Information System (IS)

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

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

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

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

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

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

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

It offers many advantages such as :

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

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

1.2.1 Elements of Information System

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

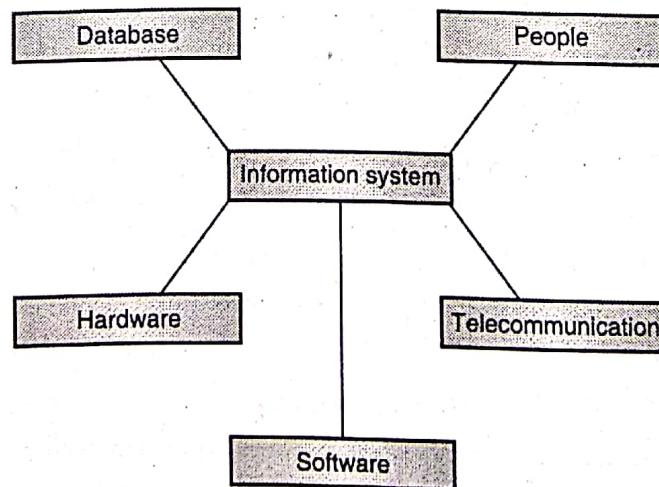


Fig. 1.2.1: Elements of IS

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

1.2.2 Objectives of Information System

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

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

1.2.3 Advantages of Information System

An information system gives many advantages to every organization:

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

1.3 Types of Information System

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

1. Operations Support System
2. Management Support System

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

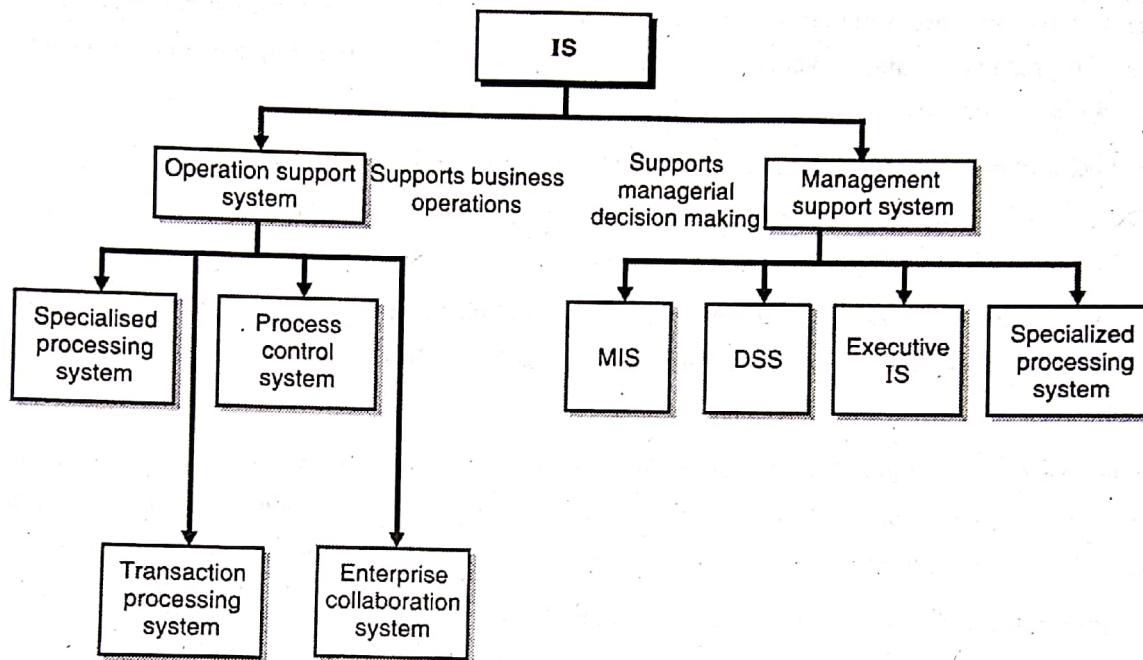


Fig. 1.3.1: Types of IS

1.3.1 Operations Support System

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

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

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

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

1.3.2 Management Support System

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

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

1.3.3 Information System Activities

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

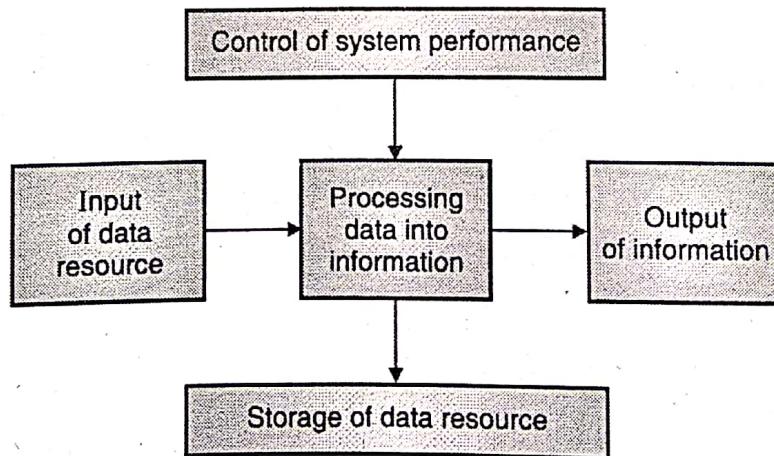


Fig. 1.3.2 : Information system activities

Input activity :

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

Processing :

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

Output activity :

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

Storage of data :

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

Control of system performance :

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

1.3.4 The Expanding Role of Information System in Business Organizations

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

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

Electronic business and commerce: 1990s–2000s

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

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

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

Decision support: 1970s–1980s

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

Management reporting: 1960s–1970s

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

Data processing: 1950s–1960s

Electronic data processing systems

Transaction processing, record keeping, and traditional accounting applications

1.4 Impact of Information System on Organizations

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

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

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

1.5 Impact of Information System on Society

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

Positive impact

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

Negative Impact

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

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

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

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

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

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

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

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

1.7 Characteristics of a Good Information System

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

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

Exercises

Answer the following questions in short

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

Answer the following questions in long

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

Data and Knowledge Management

Syllabus

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

2.1 Introduction

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

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

2.1.1 Data

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

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

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

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

Data today are available in many forms such as

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

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

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

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

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

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

2.1.2 Fundamental Concepts of Data

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

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

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

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

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

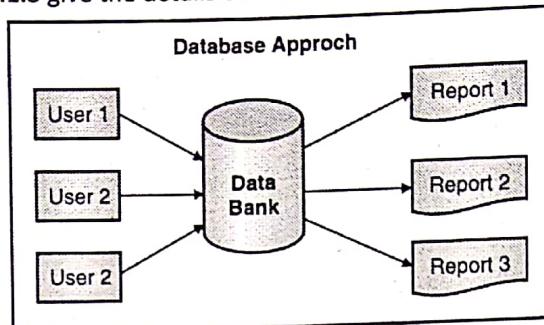


Fig. 2.1.1

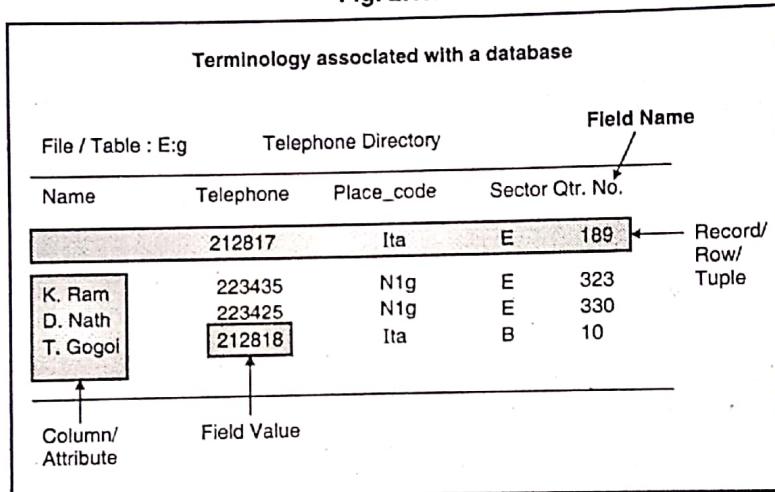


Fig. 2.1.2

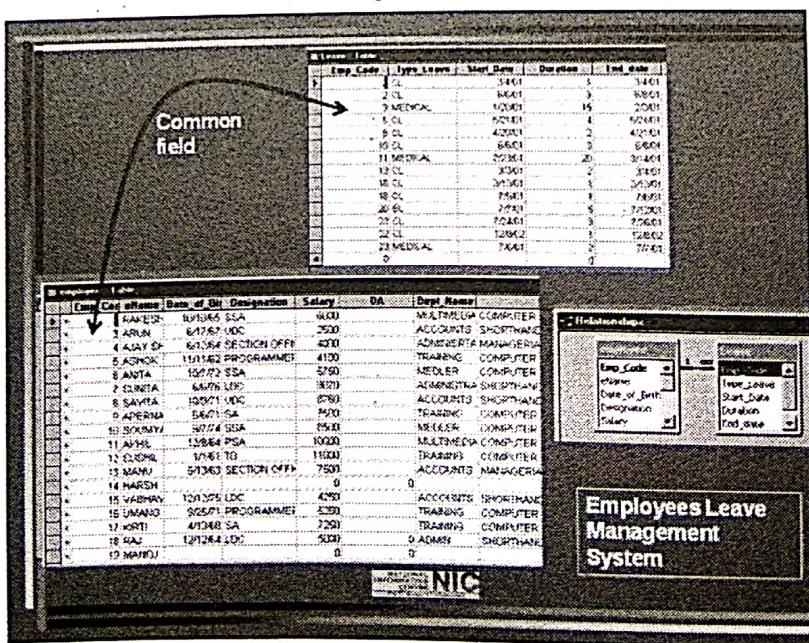


Fig. 2.1.3

2.2 Database Management System (DBMS)

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

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

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

DBMS building blocks

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

Modelling language

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

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

Data structure

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

Database query language

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

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

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

Transaction mechanism

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

2.2.1 Functions of a DBMS

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

2.2.2 Managing Data Resources (Data management)

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

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

2.2.3 Types of Databases

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

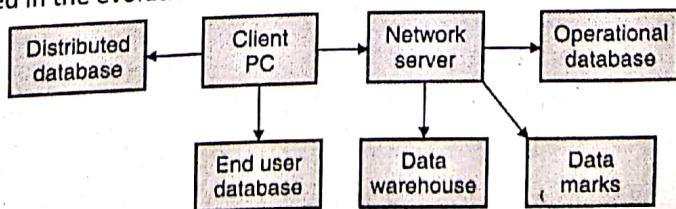


Fig. 2.2.1

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

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

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

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

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

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

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

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

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

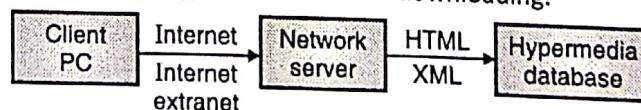


Fig. 2.2.2

2.3 Data warehouses

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

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

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

How it works

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

2.3.1 Types of Data Warehouses

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

2.3.2 Components of Data Warehouses

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

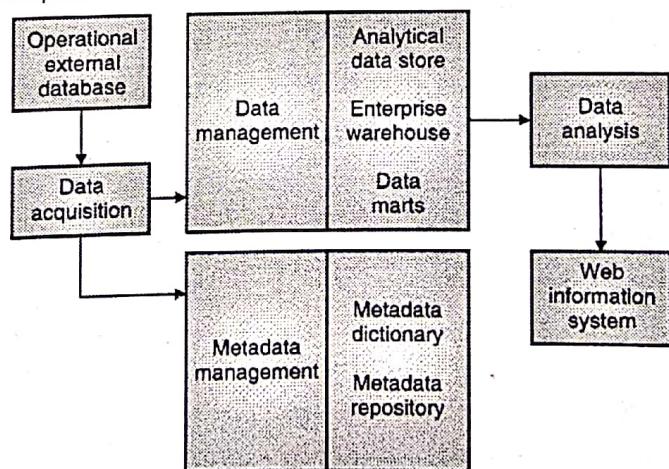


Fig. 2.3.1

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

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

2.3.3 Who needs Data Warehouse

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

2.3.4 Application Areas of Data Warehouse

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

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

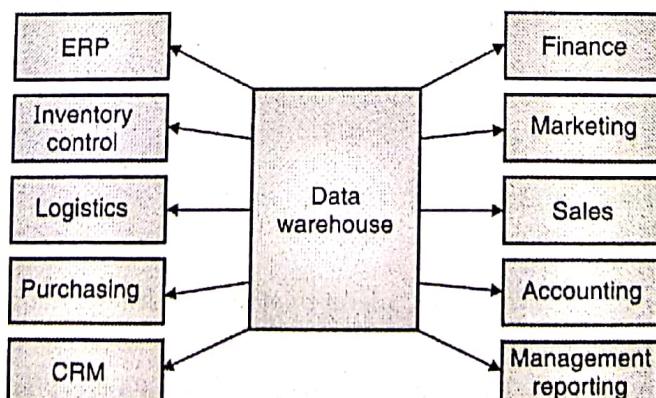


Fig. 2.3.2

2.3.5 Advantages of Data Warehouse

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

2.3.6 Disadvantages of Data Warehouse

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

2.3.7 Data Mining

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

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

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

Many companies use data mining to:

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

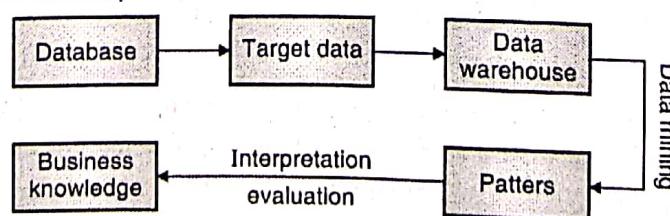


Fig. 2.3.3

2.4 Knowledge Management Approach

2.4.1 Knowledge and Its Relevance

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

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

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

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

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

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

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

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

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

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

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

2.4.2 Knowledge Management

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

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

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

2.4.3 Driving Forces behind Knowledge Management

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

External forces:

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

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

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

Internal forces:

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

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

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

2.4.4 Benefits of Knowledge Management

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

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

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

2.4.5 Challenges of Knowledge Management

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

2.4.6 Working of Knowledge Management

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

There are three main ways that people approach knowledge management:

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

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

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

2. Why is data important for an organization?

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

3. What is the difference between data and information?

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

4. Describe the logical organization of data.

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

5. Describe database.

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

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

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

7. Define data structure

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

8. What is a query language?

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

9. State any two functions of DBMS.

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

10. What do you mean by data management?

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

11. What is a distributed database?

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

12. What is data warehouse?

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

13. What is data mart?

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

14. Define metadata.

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

15. State any two application areas of data warehouse.

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

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

16. What is data mining?

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

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

17. Describe knowledge.

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

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

18. What is knowledge management?

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

19. What are the types of knowledge?

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

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

20. What are the benefits of knowledge management?

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

It optimizes a culture of knowledge sharing within the organization.

The repository of knowledge as a central database protects intellectual capital

21. State any two challenges of knowledge management.

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

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

Answer the following questions in detail

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

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

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

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

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

2. Explain the organization of data.

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

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

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

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

DBMS building blocks

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

Modeling language

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

Data structure

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

Database query language

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

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

Transaction mechanism

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

4. Write the importance of data management.

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

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

5. Explain different type of databases in detail.

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

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

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

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

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

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

Types of data warehouses

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

7. Describe data warehouse components.

Components of data warehouses

Following are the components of a complete data warehouse system.

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

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

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

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

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

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

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

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

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

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

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

External forces

The forces in external environment are the following:

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

Internal forces

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

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

10. Describe the challenges faced by KM.

Challenges of knowledge management

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

Unsolved Questions

Answer in short

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

Long Questions

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

Business Intelligence

Syllabus

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

3.1 Introduction

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

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

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

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

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

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

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

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

3.2 What is Business Intelligence?

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

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

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

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

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

BI is made up of several related activities like:

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

3.3 Purpose of using Business Intelligence

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

3.4 Benefits of Business Intelligence

The following are the benefits of business intelligence programs:

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

3.5 How is BI used in Organizations?

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

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

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

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

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

3.6 Tools and Techniques of BI

3.6.1 Online Analytical Processing (OLAP)

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

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

3.6.2 Market Basket Analysis

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

3.6.3 Data Mining

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

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

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

Many companies use data mining to:

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

3.7 Process of BI System Creation

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

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

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

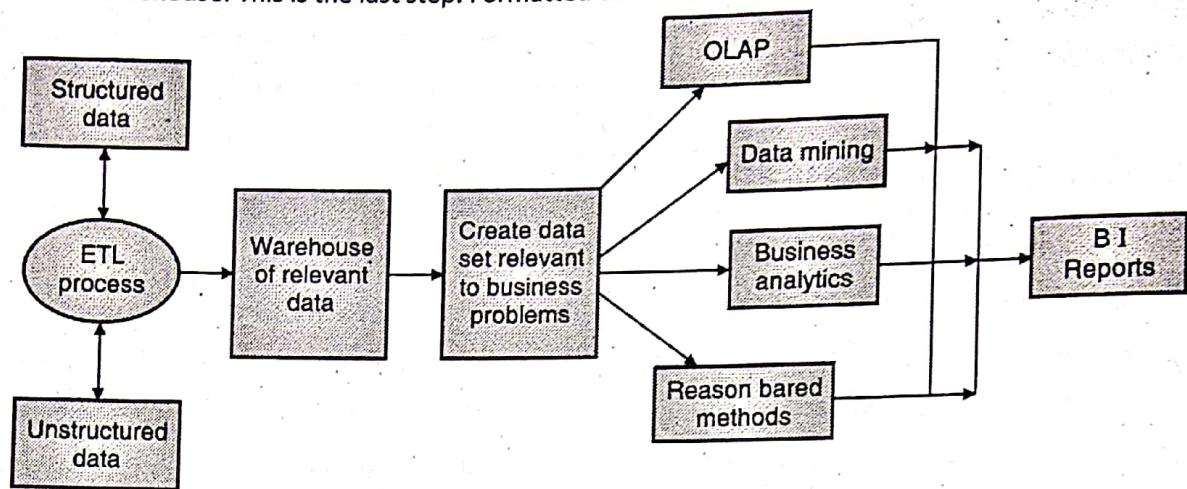


Fig. 3.7.1 : Process of converting data into BI

3.8 Impact of Business Intelligence on Functional Units

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

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

3.8.1 Impact of Business Intelligence on Decision Making

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

1. Improving interactivity

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

2. Data visualization

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

3. Connection to databases

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

4. Predictive analytics

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

5. Application integration

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

6. Mobile business intelligence

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

3.9 Business Intelligence Tools

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

3.9.1 Business Intelligence Software

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

Some of the popular BI software are the following:

1. Sisense

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

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

2. Looker

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

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

3. Datapine

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

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

4. Zoho Analytics

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

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

3.9.2 How to Choose the Right Software

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

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

3.10 Steps to Implement BI System

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

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

3.11 Problems Faced in BI Implementation

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

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

Exercises

Answer the following questions in short

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

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

Answer the following questions in long

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

Ethical Issues and Privacy

Syllabus

Information Security, Threats to IS, and Security Controls

4.1 Introduction

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

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

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

4.1.1 What are Business Ethics?

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

4.1.2 Ethics and Information System

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

4.1.3 Ethical Issues

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

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

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

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

4.2 Introduction to Information Security

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

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

4.2.1 Information Security

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

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

4.2.2 Principles of Information Security

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

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

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

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

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

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

4.3 Security Threats

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



- Destruction
- Deletion
- Bug infections
- Theft
- Corruption

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

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

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

4.4 Controlling Security Threats to Information

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

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

4.4.1 Objectives

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

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

4.4.2 Security Threats Control Measures

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

Develop a data security plan/policy

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

Secure the IT infrastructure

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

Know and protect your most important data

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

Manage file access permissions

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

Use stronger passwords

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

Regularly backup data

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

Regular audits

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

Staff awareness courses should be conducted annually

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

4.5 Information Security in E-commerce

4.5.1 E-commerce

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

4.5.2 Security Needs in E-commerce

The six security needs in E-commerce applications are :

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

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

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

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

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

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

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

4.5.3 Threats to E-commerce

1. Authentication attacks

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

2. Integrity attacks

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

3. Confidentiality attacks

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

4. Virus

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

5. Database threats

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

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

4.5.4 Security Technologies

1. Symmetric encryption

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

2. Asymmetric encryption

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

3. Secure socket layer

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

4. Digital signature

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

5. Digital certificates

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

4.6 Information Security in Applications

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

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

- data security
- database security
- application security

4.6.1 Data Security

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

4.6.2 Database Security

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

1. Data tampering

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

2. Data theft

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

3. Falsifying user identity

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

4. Password related threats

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

5. Unauthorized access to data

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

4.6.3 Security Techniques

Database authentication

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

Backup and recovery plan

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

Auditing of relevant information

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

Secured operating system

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

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

4.7 Security Management in a Network

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

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

A networked system is vulnerable for continuing attacks if

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

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

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

How does network security work?

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

How do I benefit from network security?

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

4.7.1 Network Security Threats

Network security threats fall into two categories

1. Passive threats

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

2. Active threats

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

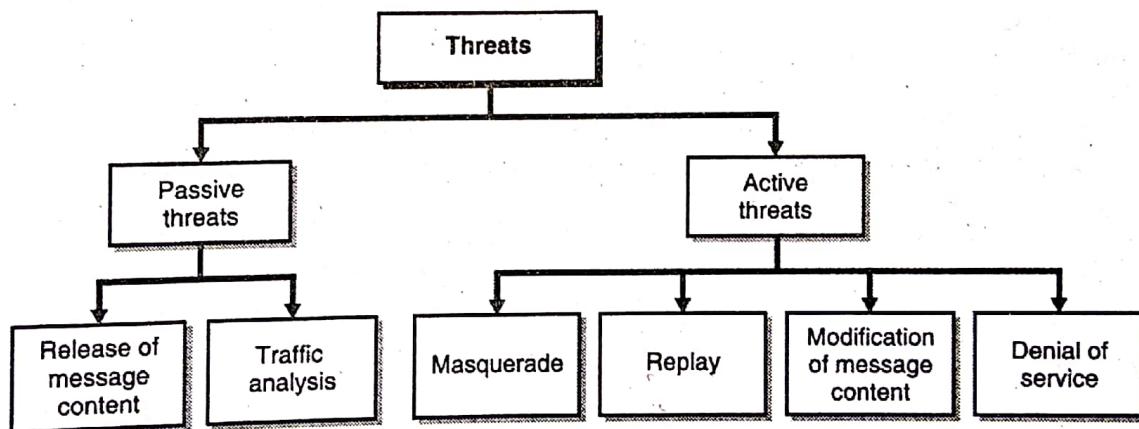


Fig. 4.7.1 : Passive threats

Passive threats

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

a. Release of message contents

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

b. Traffic analysis

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

Active threats

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

a. Masquerade

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

b. Replay

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

c. Modification of message

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

d. Denial of service

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

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

4.7.2 Network Security Methods

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

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

4.8 Cyber Security

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

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

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

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

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

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

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

4.8.1 Types of Cyber Security Threats

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

4.8.2 Cyber Security Measures

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

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

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

Exercises

Answer the following questions in short

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

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

Answer the following questions in short

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