across the Internet with students from other campuses and from other countries. Networking and the Internet are being used as cost-effective tools for improving learning opportunities for students, faculty development, supporting professional development, increasing productivity of members of the learning community and improving the efficiency of schools, district and state administration.

The power of the computers is used for complex mathematical and statistical calculations and number crunching which is crux of any scientific and technological research. IT is also used in wide ranging research activities ranging from astrophysics and space travel to nuclear science and microbiology for complex calculations, simulations and studying the patterns.

It is being increasingly realized that the 21st century will be the century of Information Technology and medical sciences. Biotechnology is merger of IT with medical science. A number of entrepreneurs are looking to use India's strength in Information Technology as leverage for entering in the field of biotechnology. Biotech/DNA parks are envisaged with a focus to provide the right infrastructure and space for R&D and to enhance the growth of the biotechnology sector in India. The government plans to set-up of Bio-Informatics parks, Genome Data Centre and Super Computing support in the country.

With the help of IT, more and more students will be able to access courses or even entire academic programmes without ever setting foot inside a campus. The advocates of IT suggest that as time and space barriers to an education are removed, it is no longer necessary for students, faculty, and administrators to gather at the same time or in the same place for teaching and learning to occur. Accessibility to higher education will be expanded because, according to these advocates, any person who is qualified will no longer be excluded because of time and place constraints. Hardly any aspect of student support services remains untouched by technology. For example, it will be possible at some institutions for students to seek admissions information, apply for admission, and be admitted entirely on-line. Telephone, on-line, or web registration for courses will be commonplace on many campuses. Academic advising will be done using multiple technologies.

IT has a more pronounced impact in the field of educational, scientific and technological research. The introduction of Educational and Research Network (ERNET) in India has enabled linking of computers of academic institutions like universities, educational and research institutions with each other thereby giving information on research activities undertaken around the world. The Government of India believes that Information Technology (IT) is India's future. Hence, the educational institutions are using IT for educating and teaching the students. Educational institutions in India are using the latest hardware and software and the latest computer languages and packages are being taught to the students. IT education is not only imparted to the students of computer science, but also to the students of other disciplines at under-graduate and graduate level.

1.5.2 Manufacturing and Engineering

Information Technologies (IT) in the form of computers and communications have been among the fastest growing innovations in both production and use during the past four decades, and the prospects for future growth appear equally bright. The IT is used in manufacturing industry for designing and process control besides other management related activities like inventory control, financial analysis, project management, development of MIS, etc.

IT has altered the techniques of engineering by its tools called Computer Aided Designing. The CAD tools enable the engineers to automating the design and drafting process and build different graphics. The tools are used for designing, modeling and proto-typing of new products, graphics and

architectural designs, studying impact of design changes on overall design of product, material and cost estimation for new products, etc. This helps the design of most suitable engineering product with minimum manual efforts thereby maximize the human ingenuity in product development.

Nano-technology is an emerging technology of manipulating matter at the atomic scale. It will make most products lighter, stronger, cleaner, less expensive and more precise. Nano-technology is expected to usher in the next industrial revolution. Nano-technology research is being strongly supported by the countries like USA, Japan, China etc. The research in this area would greatly depend upon availability of trained manpower and resources. The Indian government plans to develop this area in cooperation with leading academic and R&D institution in the country.

IT also has played a great role in the area of manufacturing activity viz. the production and process control. This is known as Computer Aided Manufacturing or CAM. The microprocessor chips are used in wide ranging gadgets such as microwave ovens, automobiles, power plants, security systems, chemical industries for controlling the process. The abnormal behavior or occurrence can be detected and pre-programmed decisions like switching off the plants can be taken with the help of these microprocessors based process controllers. Occurrence of an event such as reaching particular temperature level, next activity can be triggered automatically. The use of programmed devices like industrial robots have been used in hazardous industries where prolong exposure of any human being is not advisable. There is increasing trend towards automation of such processes which would improve the working conditions as well as reduce the cost of production.

1.5.3 Defense and National Security

IT is extensively used to gather geographical information, analyze the data, carry out operations research for the purpose of logistic support, and plan the movements. IT provides very essential navigational support for aircrafts and naval ships. The image-processing capabilities of IT along with satellite telecommunication are used for gathering information on geographical details and terrestrial movements such that almost all man made products like aircrafts, missiles, guns, and ships can be identified by the surveillance system with their possible trajectories and paths.

The role of IT has been instrumental in the development of powerful guided missiles which have completely altered the concept of defense and security. Missiles like Patriot, Agni or Trishul could only be developed using IT which enables the missiles to sense and lock their targets, scan the territory and change trajectory so as to hit the targets.

IT is also used for encrypting and decrypting the strategic information for secured communication between defense agencies. IT also plays a very important role in training of the defense personnel with specialized simulators which can simulate the conditions in the sea or air. It can also simulate different war games so as to train the soldiers for actual combat conditions.

IT is also used for storing data on the crime events and the modus operandi used in various crimes, processing the images of the criminals, the fingerprints, and handwriting so as to match the available records.

Government Administration and Other Services

Today, governments throughout the world are expected to provide a welfare state to their citizens and have a wide-ranging responsibility towards their citizens. States have responsibility towards the health, education, employment, security, and welfare of their citizens. For discharging these duties, governments need huge data on their citizens for planning for health services, education, transport

facilities, etc. Weather forecast and early warning systems for calamities such as cyclones, floods etc., are some of the essential social services which are heavily dependent on IT support. E-Governance enables use of Information Technology and communication technologies to improve efficiency, convenience, accessibility and transparency in government. The major emphasis today both at central and state government levels is to focus on these objectives from the perspective of the citizens and businesses. Various IT activities such as development of software applications packages, creation of e-governance infrastructure, National ID, Citizen Databases, GIS/GPS, Smart card and Digital/ Educational Content, etc., in E-Governance domain are being taken up on pilot scale basis.

The census data is the largest data which has direct bearing on the society and impact of IT on this is too evident. Today, the government and social services sector are the largest users of IT. Even where the IT is not widely used in government sector, there is pressure on the authorities to use IT for their activities and welfare schemes to improve the governance.

Taxes being the main revenue, the government require huge data about the taxpayers, as well as need to watch the tax compliance. Similarly, governments are largest spenders in any country with expenditures on wide ranging activities. These activities of the government are dispersed all over the country requiring a good network of computers for speedy data compilation.

E-mail has revolutionized our day-to-day work communications. Information needed for administrative functions that were once carefully secured and mostly unavailable are now only a keystroke away for most of us. Budgets are projected, administered, and accounted for by information technology. IT also paves way for online shopping. Websites like baazi.com, amazon.com, e-bay.com etc. provide online shopping facilities. Online hundi system has been introduced by some of the leading temples in India. With the help of online hundi system, those interested in donating amount to these temples can remit their amount with the help of credit card numbers through Internet.

1.5.4 Medical Science

In the last few years, we have seen not only the convergence of different technologies but also deep penetration of one technology into another. The information technology and life science have merged together into bio-informatics.

IT is extensively used in medical research for developing new combinations of drugs. Genetic engineering and information technology are two tools which are set to bring very important changes in medical technology in coming decades.

Now, it is possible to design new drugs using computers. The designed molecules can be then developed and tested in laboratory and then can be sent for ultimate testing on animal. The sequencing of human genome through Human Genome Project (HGP) and proteomics has opened new vistas for application of IT in life sciences. Now, detecting the root cause of certain diseases will be possible using gene sequence analysis and a permanent cure may be found through gene therapy. The modification of gene sequence of plants has yielded better crops in terms of nutrition value as well as water requirement, thus providing tremendous growth potential for bio-informatics.

IT is also being applied in the hospital management. Beginning from the reception by recording a patient's name, the information technology has been used everywhere in a hospital. It is increasingly used in hospital administration to keep information on patient's health record for the doctors to trace case history. A patient's record comprising his name, age, sex, disease, blood group, height, weight, blood pressure level, etc. can be maintained as database in a computer in the hospital. So, whenever the patient arrives his previous record can be verified.

In addition, the data on health symptoms and possible diseases is also stored so that the computer can identify the health conditions with the different symptoms in the database and help the doctor with possible cause and also suggest the treatment. Similarly, when the surgeries take place, the hospitals use computers and specialized software for judgment of diseases/problems and for curing the diseases. For billing purposes also the computers have been used widely in hospitals. Computers are also used for on line systems for monitoring patient's health for any medical emergency. The microprocessor controlled devices are used for heart patients to control the working of heart and trigger timely action. Similarly, such devices are also used in the artificial limbs provided to physically handicapped persons.

IT has also been applied in pharmaceutical and drug shops. Whenever any medicine enters the shop, all the information related to the medicine – its name, quantity, manufacturing date, expiry date, its content, price and other information can be entered into a computer system. Whenever the sales take place, computerized billing is provided to the customers. The bill usually carries plenty of information for the benefit of customers indicating the name of the medicine, quantity purchased by them, its price, manufacturing and expiry date. Whenever any medicine is sold the software created also provides indications to the supervisor of a pharmaceutical shop related to the quantity sold, quantity available in the shop and the computer also warns them regarding the date of expiry.

1.5.5 Transportation

The application of IT has provided various benefits for the transporters and passengers. In India, with the issue of computerized railway tickets, the errors have been minimized. A passenger can book the train ticket from any part of the country. A passenger can also book the train ticket at his convenient place, as the online reservation system has been introduced in our country. In the same way, nowadays reservations for film shows take place through online ticket booking. The cinema theatres in order to avoid queues and unnecessary rush follow the system of online ticket booking so that through the Internet anyone can book tickets at their convenient places. In order to reduce queues, computerization takes place in petrol bunks also. Computerization ensures speedier billing and reduces the queue in petrol bunks. In the same way in Regional Transport Offices, computerization ensures prompt and quick delivery of service to the people. Let us discuss the application of IT in the two most important transports namely railways and air transport.

Railways

Indian Railways have the second largest railway network in the world. Indian Railways has the maximum number of employees and it is the largest employer in the public sector. For easy operations and management, Indian Railways has been divided into 15 zones and each zone manages its own local affairs. As compared to Western nations, nothing of note has been done to automate Indian railways. IT has been used extensively in the area of railway transport by the developed nations only.

IT has led to the development of computerized wagons, locomotives and train reporting systems that tracks cargo and wagons throughout their movement. This has enhanced the efficiency and speed of freight operations, enabling railways to plan the movement of wagons much more effectively since they always know where the wagons are and whether they are empty, loaded and fit for running.

IT has also improved considerably short-term train planning. Now, it is now possible to know when the empty wagons will be available for rolling stock and motive power can be maintained on the basis of up-to-date records of equipment use. It is also possible to monitor the fuel consumption of each and every locomotive in the railway system per driver and per issuing depot for a particular period. The

system can also produce predefined reports. These reports can either be viewed on the screen or printed on the printer.

When a person wants to travel from one place to another by train, he has to plan for the shortest route, minimum traveling time or cost-effective route and must have the detailed information of trains operating on that route, for the comfort of his journey. Railways can now publish automated time tables giving details of trains operating between different stations, train-timings etc. IT has also enabled the railways to satisfy customers' requests for information about the whereabouts of their goods at any given time. Railway customers can monitor the whereabouts of their consignments/goods by connecting to the rail tracker system from their homes using a modem and telephone line. The information, which the customer receives, is filtered so that he can see only his own consignments. The automated system enables the viewing on the Internet from anywhere in the world at any time. In addition, it can generate statistics and performance indicators for decision-making. Policy-makers can also use these indicators to formulate both short-term and long-term plans for the transport sector.

Air Transport

IT applications are also very useful to airport functions. Major developments through IT has been made in airport applications and management. Airports Authority of India is considering some of the applications discussed below. The business value of IT application in airport is in the form of cost cutting, increased operational efficiency and enhanced security among the benefits that IT offers. The pre-integrated solutions with IT eliminate the information overload. This reduces risk of integration of multiple different systems and improves the flow of passenger and baggage.

The concept of e-tickets is also beneficial for both the customer and the carrier. There are vast opportunities of e-business in airport environment. The installation of proper Information and Communication Technology (ICT) base at airports, integrates the installed base of mobile phones as well as Internet access by the travellers. It is important to develop business solutions based on the SPT (Simplifying Passenger Travel) concepts and to tighten the customer relationship in order to improve non-aeronautical revenues.

The old business model is being discarded and the key to improving the passenger logistic is to provide information ahead of the logistical flow. Wireless communication can enable airport processes to be effected earlier in the travel chain without any physical service desk. This increases the processing capacity of the terminal while reducing the costs of passenger processing. Though wireless systems are certainly important, they should be treated as utilities and not as revenue generators. The wireless systems should have common standards. At present, airports are focusing more on internal operations and less on providing public Internet access. IT applications in facilities management and construction programmes encourage financial saving in construction projects. One of the key factors is the use of extranets to exchange information and communication among all the parties involved in a project.

The Geographical Information System (GIS) adds value and offers considerable cost benefits. The GIS is not just a computer system for map making but a set of tools for identifying spatial relationships or cross data themes. GIS is employed together with noise monitoring software and permanent noise monitors as well as a long-range radar.

The Decision Support Systems (DSS) are essential tools of airport management. IT can help in planning airport capacity by analyzing planning of current and future schedules, improving productivity by better allocation of slots, runways, gates, stands, security check points, baggage systems etc. The knowledge management system also helps in the airport operations. The limited

knowledge of what data was available and that such knowledge was often lost as people left or retired. The knowledge management system offers prompt decision-making, easy data accessibility and security. It also does not allow any unauthorized changes or deletion and offers a common data warehouse. The system offers a single access point to all official project data. The typical applications of knowledge management system are building permits analysis, producing noise contours, space management, key and access management, fire scenarios and cable management.

1.5.6 Banking and Financial Sector

As the Internet and the information technology revolution sweeps across the old economy, the players in the Indian financial sector are increasingly realizing the need to adapt to the changes taking place. In today's competitive world, customer loyalty can no longer be taken for granted, and that forces banks to constantly seek innovative ways to attract and retain customers. Tremendous improvement has taken place in the Indian banking sector because of the IT revolution. All the private and foreign banks have gone for 100% computerization. At a rapid pace, the government owned nationalized banks are also improving their number of computerized branches. With the help of computerization, the transaction takes place at a faster rate and the waiting time of a customer in a queue is getting minimized. To adapt to the new business environment, Indian banks need to proactively harness technology to handle distributed operations, high-volume transactions and data management. This will allow banks to enhance profitability through tighter fiscal and operational control, and achieve customer delight – a critical requirement in today's Internet driven market. E-Banking is emerging in the Indian banking sector. The banks provide the facility of Internet banking, phone and mobile banking with the help of IT. All the branches of a bank can be networked. The networking takes place between two or more branches in order to provide easy accessibility for a customer. The cost incurred on infrastructure, furniture and employees has got decreased because of the application of IT.

Financial institutions today face competition from several fronts. New, non-traditional financial players are entering the market, often with huge cost advantages and wider delivery channel options. Traditional banks are, therefore, facing increased pressure on margins. Customers have a huge variety of options in terms of vendors, products, services and delivery channels. This means that banks need to bring down transactional and operational costs to retain customers, which has proven to be five times less expensive than getting new customers. The most effective way of doing this is by strategically investing in IT. Foreign and new private sector banks in the country have led the way in automating the financial services industry. Indian public sector banks, however, have been slow in following. The situation, however, is changing and the initial resistance to technology is fading as top management of several Indian banks are viewing IT as a business enabler and a vital part of their strategy. Various banks are now committing to substantial IT investments in core and Internet technologies.

In the financial sector, other services such as Insurance, leasing companies, mortgage companies, investment consultancy, stock exchanges, share registry and custodial services like depositories process large volume of data. These services have got a big boost with the advent of Information Technology.

The banking and insurance companies use the IT to keep track of their customers transactions and financial needs, stock markets use IT for on line trading with the help of computer-based terminals connected to 'trading servers', depositories and custodial services maintain computerized records of shares and securities held by them on behalf of their customers and investment consultancy services use computer based systems for analysis of the financial positions, investment opportunities available to their customers, risk factors Involved and so on.

Gone are the days when stock brokers used to shout at the trading hall of a stock exchange quoting their prices. Now-a-days with the help of computer terminals and Internet connection, purchasing and selling of share takes place everywhere. A client can look at the transactions taking place through the computers. The volume of the shares traded and the turnover has got consistently improved because of the online share trading.

The impact of IT on financial services has been most significant in payment services wherein ATM, Credit cards, Debit cards, Smart cards and other modes of payment have revolutionized the payment mechanism. This has been made possible by making cash available anytime during twenty-four hours of the day at any place in the world and has also obviated the need for physical cash. IT is changing the very concept of cash and credit throughout the world. The following technological advancements have taken place in world of business payments:

Electronic Fund Transfer (EFT)

Electronic Fund Transfer, sometimes wrongly described as a 'paperless payment', is a system of transferring funds on request using a wide area network. Electronic funds transfer covers a wide range of transaction services, such as:

- Banking services
- Funds transfer between accounts at the same bank or at different banks
- Stockbrokerage services like placement of orders for stocks
- Retail ATM services
- Business transactions involving funds transfer between accounts, investments and overdraft arrangements
- EFT provides various advantages
- Immediate or overnight transfer of funds from the consumer's bank account to the service provider's bank account
- Online credit authorization, hence reducing bad-debt and cheque problems
- Reduced need for customers to carry cash or cheque.

Automatic Teller Machine (ATM)

Banking organizations have been very quick to take the advantage of the EFT (Electronic Funds Transfer) environment, as evidenced from a growing number of ATM networks. The wide spread acceptance of ATMs by the public as a means of doing banking transactions provides a major indicator of what customers want. The success of EFT depends heavily on networks to provide reliable and efficient interconnections. ATMs are specialized terminals that dispense cash and require wide area network communication with the central banking computer. The volume of information flow is small; typically 20 to 40 characters each way are required to verify a customer's identity and debit the account. ATM terminals are often connected to a concentrator which in turn is connected to the central banking computer. All these interconnections require a highly and secure data network.

Electronic Cash

This is another form of automation of cash into electronic form. It addresses circumstances in which the payer is not present at the point of sale or service, but has electronic communications facilities

available, e.g., it is connected to the Internet, or to some other form of global information infrastructure, such as a cable-TV installation with enhanced capabilities. Electronic Cash or the Digital Cash is a system of transferring funds through a network such as the Internet. The digital equivalent form of cash is known as E-cash. In a digital cash system, cash exists in the form of validated tokens represented by a string of digits. E-cash can be purchased from online currency server usually a bank or Financial Institution (FI). This bank or FI uses a digital signature algorithm for its clients or customers. Clients or customers can use this e-cash to purchase items over the Internet.

Credit and Debit Cards

Credit cards in their present form emerged in the United States in 1960s. However, it was not until more recently that credit card usage has expanded significantly throughout the world. Debit cards have been introduced more recently and together they represent the most rapidly growing method of payments in many countries.

Credit and debit cards are rapidly growing in significance as the preferred method of settling small value payments associated with the purchase of specific goods and services. Separate electronic clearing and settlement systems have been established by the major credit card companies. Both MasterCard and Visa have established their own networks which are used for verifying transactions world-wide. Electronic point of sale terminals permit card details to be verified in less than 15 seconds with networks linking the merchant, the credit card processor and the card issuer worldwide. These networks are growing rapidly as the trend for consumers to make payments by credit card in place of writing a cheque continues to grow.

Credit cards are distinguished from debit cards by having access to a line of credit made available to the cardholder by the card issuer. They generally require four separate parties to each transaction, the cardholder, the merchant selling the goods or services, the merchant acquirer processing the credit card payment and the card issuer. In certain cases the merchant acquirer and credit card issuer will be the same company although generally trading under a different legal entity.

Smart Cards

Smart cards are just like credit cards, same size and shape, and can be carried in pocket or in wallet but they serve different purpose. A smart card contains a chip which has a processor and memory unit. A smart card generates encrypted random numbers with a lifetime of around one minute. The user enables the card by entering a PIN and then it generates a response or one time password. The response or password is calculated using data encryption which is stored in the card. This provides a means for storing passwords, private keys or digital cash on the card. These cards have become popular due to the limitations of pure password-based systems. This is indicative of the move away from passwords (what the user can remember) to tokens (what the user can carry). These cards are also known as PCMCIA cards as they are also designed to fit in the PCMCIA slots of a computer.

Electronic Data Interchange (EDI)

Electronic Data Interchange (EDI) is the exchange of structured data between the computer systems of trading partners. It is predicted that this method of 'paperless' trading will change the existing pattern of doing business. So EDI or Electronic Data Interchange is defined as the interchange of standard formatted data between computer application systems of trading partners with minimal manual intervention. EDI communicates information relevant for business transactions between the computer systems of business organizations, government organizations, small business houses, banks and FIs.

EDI covers interchange of business data like invoices, purchase orders, shipping notices, delivery instructions, and other standard business correspondence between trading partners. EDI can be used to electronically transmit documents such as purchase orders, invoices, shipping notices and other standard business correspondence between trading partners. EDI speeds up the trading cycle, enabling a faster response to customer orders and requests. In addition, by data interchange, EDI simplifies the customer's data processing task by supplying only that desired amount of data that is required by the customer. In addition EDI also facilitates transmission of financial information and payments in electronic form. When used for making payments, EDI is referred to as Financial EDI (FEDI) and Electronic Funds Transfer (EFT). EDI is a way of substituting electronic transactions for paper transactions. However, it is much more than mere substitution. It is a means to streamline procedures and improve efficiency and productivity.

Check Your Progress
1. What is Strategic Business Challenge?
2. What is electronic fund transfer?

1.6 LET US SUM UP

Information Literacy is more than just clicking a mouse, pounding the computer keyboard, or surfing the Web. It's about integrating various elements of an organization, technical and non-technical, into a successful enterprise. As a successful manager you must concentrate on all the three parts of the Information Systems triangle (hardware, software, and liveware) and integrate them into a single, cohesive system that serves the needs of the organization, the wants of the customer, and the desires of the employees. The more complex, the harder to manage, but the greater the payoff. Information systems are so essential to business, government and daily life that organizations must take special steps to ensure that they are accurate, reliable and secure. A firm invites disaster if it uses systems that don't work as intended, that don't deliver information in a form that people can interpret correctly and use, or that have control rooms, where control don't work or where instruments give false signals. Information systems must be designed so that they function as intended and so that humans can control the process.

1.7 KEYWORDS

Information System: A collection of elements that capture data and convert it in information and disseminate to the decision-makers in an organization.

Information Technology: Hardware and software that perform data processing tasks, such as capturing, transmitting, storing, retrieving, manipulate

1.8 QUESTIONS FOR DISCUSSION

1. How IT provides help in the design of organization?

2. What are the roles of information technology on the emergence of new organizational system?

3. What are the key management challenges involved in building, operating and maintaining information systems today?

4. Discuss the applications of IT in various sectors.

5.   Write a note on the following:

   (a)   Electronic Fund Transfer (EFT)

   (b)   Automatic Teller Machine (ATM)

   (c)   Electronic Cash

   (d)   Smart Cards

6.   What are the emerging trends in Information Technology? Discuss.

Check Your Progress: Modal Answers

1.   Creating a digital firm and obtaining benefit is a long and difficult journey for most organizations. Despite heavy information technology investments, many organizations are not realizing significant business value from their business systems, nor or they become digitally enabled.

2.   Electronic Fund Transfer, sometimes wrongly described as a 'paperless payment', is a system of transferring funds on request using a wide area network.

1.9 SUGGESTED READINGS

Ashok Arora & Akshaya Bhatia, *Management Information Systems*, Excel Books.

G. V. Satya Sekhar, *Management Information Systems*, Excel Books.

Bharihoke, Deepak. *Fundamentals of IT*. Excel Books, New Delhi. 2006.

Turban, Rainer, Potter, *Introduction to Information Technology*, John Wiley & Sons, Inc

LESSON

2

INFORMATION SYSTEM

CONTENTS

2.0 AIMS AND OBJECTIVES

After studying this lesson, you will be able to:

- Understand information systems
- Discuss concept of system
- Discuss working of system

2.1 INTRODUCTION

Management Information System is an old management tool, which has been long used by people for better management and scientific decision-making.

Management Information System is mainly dependent upon information, which is a vital ingredient of any Management Information System. Information is the most critical resource of Management Information System. We all know that information is a vital factor for our existence. Just as our body needs air, water and clothes, we are as much dependent upon information. To make life more interesting and to achieve the feeling of being a part of the social system, we want to know our surroundings and for that we need information. Information is an important input for achieving our goals such as learning to help each other and to become integral part of society.

Actually, information system is not a new concept; it is as old as the hills. From biblical times, humans have been making the use of information generated through information systems in all times. There have been systems that generated and communicated information. Kings and rulers had their own ways of designing information systems to retrieve information. The main objective of these information systems was to ascertain the well being of their people in the kingdom and to effectively and efficiently manage the kingdom. The church had its own information system. In India, Tainali Rama, Akbar and many others had impressive management information systems in operation. Similarly, the merchants of Venice had their own fully functional appropriate management information system in place.

2.2 INFORMATION SYSTEM

Now, it is time to see the real meaning and concept of Information Systems. Too often you hear someone say, "Oh yeah, I know how to use a computer. I can surf the Web with the best of them and I can play Solitaire for hours. I'm really good at computers." Okay. So that person can pound a keyboard, use a mouse at lightning speed, and has a list of favorite Web sites a mile long. But the real question is "Is that person's information literate?" Just because you can pound the keyboard it doesn't necessarily mean that you can leverage the technology to your advantage or the advantage of your organization. An organization can gather and keep all the data on its customers that a hard drive can hold. You can get all the output reports that one desk can physically hold. You can have the fastest Internet connection created to date. But if the organization doesn't take advantage of customer data to create new opportunities, then all it has is useless information. If the output report doesn't tell the management that it has a serious problem on the factory floor, then all that's been accomplished is to kill a few more trees. If you don't know how to analyze the information from a Web site to take advantage of new sales leads, then what have you really done for yourself today?

Most of us think only of hardware and software when we think of an Information System. There is another component of the triangle that should be considered, and that's the people side, or "liveware."

We talk about the input, processing, output and feedback processes. Most important is the feedback process; unfortunately it's the one most often overlooked. Just as we discussed above, the hardware (input and output) and the software (processing) receive the most attention. With those two alone, you have computer literacy. But if you don't use the "liveware" side of the triangle to complete the feedback loop, you don't accomplish much. Add the "liveware" angle with good feedback and then you have the beginnings of information literacy.

An information system differs from other kinds of systems in that its objective is to monitor/document the operations of some other system, which we can call a target system. An information system cannot exist without such a target system.

Example: Production activities would be the target system for a production scheduling system, human resources in the business operations would be the target system of a human resource information system, and so on. It is important to recognize that within a vending machine there is a component/sub-system that can be considered an information system. In some sense, every reactive system will have a subsystem that can be considered an information system whose objective is to monitor and control such a reactive system.

Need for Information Systems

Ask managers to describe their most important resources and they'll list money, equipment, materials, and people – not necessarily in that order. It's very unusual for managers to consider information an important resource and yet it is. This chapter will help explain why you need to manage this resource as closely as any other in your organization.

Competitive Business Environment

For many years computer technology was relegated to the backrooms or basements of a corporation. Only the "techies" worried about it and were often the only ones who really knew how it all worked. Now computers are all over the organization - one on every desk. It's not enough for you to know how to pound a keyboard or click a mouse. It is not even enough for you to know how to surf the Web. Now every employee, including you, must know how to take advantage of Information Systems to improve your organization and to leverage the available information into a competitive advantage for your company.

2.3 CONCEPT OF SYSTEM

We often use the word system in our day to day life, viz. education system, solar system, road transport system, business system etc. to describe the various things regarding a particular subject.

The term system denotes various characteristics, components, merits and demerits of a particular subject that may be biological like human body as a system or commercial like a business organization and natural like solar system etc.

Every system has certain objectives to be achieved. To achieve these objectives, for example it takes help of various sub-system elements. The objective of the computer system is to process the data and give out meaningful information. To achieve this objective, it has certain elements like input, output, processing devices such as a compiler, s/w packages and operating system and of course a human being also.

Every system is engaged according to certain rules, regulations, principles and policies. Also, the arrangement depends upon some logic and objectives, e.g., if we have to computerize a small business organization, then we need data entry devices, a CPU, a disk and a memory, application software and

output device like printer, tape, screen etc. But in an engineering organization like architecture where designing is an important area of work, it needs a graphic work station, the graphic processor, specific application software like AutoCAD and plotters and the out put device.

If we go through any system, it will be observed that any type of system has basically three parts. We can show these as a model which is represented in Figure below.

Input	Process	Output
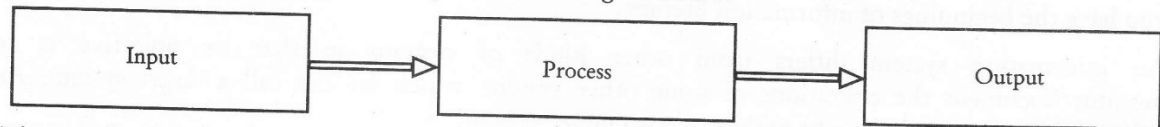
The relationship of input and output in a system may be different from others. A system may have a single input but various outputs and vice versa or in any other combinations. A business organization that processes raw material into a finished product has many outputs viz., earning profit, survival, growth service to the society or it has only one output i.e. to earn profit. We have more example, i.e., of university accepting different students as input in their different departments. After various methods of teaching, they give output in the form of Management Professionals, Computer Experts, Scientist etc. However the method of processing an input can vary. Like in case of IIT's and IIM's, they take only meritorious students as input to produce quality professionals as output. This might not be the same with all the educational institutions.

Every system exists in a congenial environment. There is interdependence between the system and its environment. Both influence each other. The environment may influence its system in its design and performance. The system may influence the environment by its output when a system is designed to achieve certain specific objective. It puts boundaries around itself. Boundaries are basically in the form of features, area or constraints. In other words, boundaries mean limits that identify its components, processes and inter relationships when it interfaces with another system. If a system wants to add or delete certain objectives, it may not be possible because of the boundaries or they are beyond the scope of the system. For example, if a garment manufacturer wants to provide garments at low cost to serve a large part of the society, then he cannot claim quality in his/her products.

In order to achieve the set objectives successfully, the system must put certain check in the control systems or filter around its system, e.g., minimum qualification for entrance test. As we all know that the quality of output in computer system depends upon quality of input and program instructions, so one must put certain check while selecting input of the system. The generalized model of the system in an environment will be as shown in Figure 2.1.
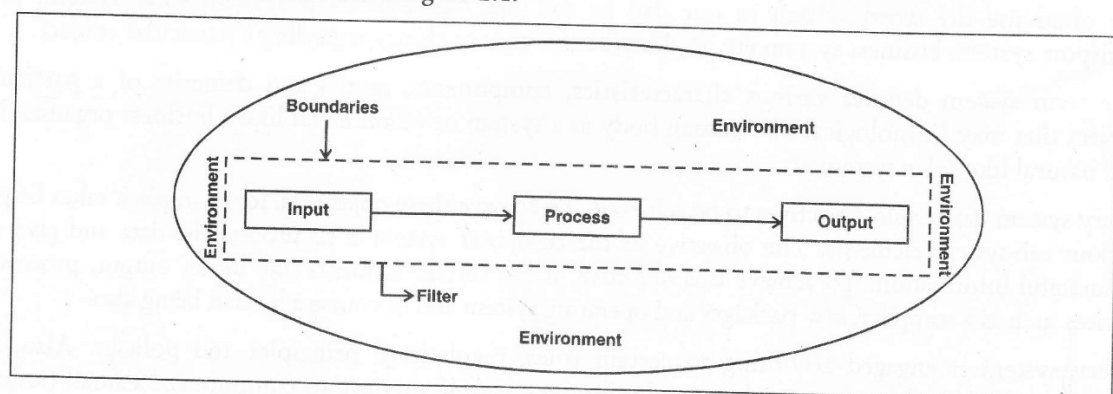

Figure 2.1: Generalized Model of a System

So, the success or failure of any system mainly depends upon three factor; selection of input, selection of method and selection of appropriate filters.

In other words, boundaries mean the limits that identify its component processes and interrelationships when it interfaces with system.

2.3.1 Definition of System

The term 'system' is derived from Greek word *system* which means an organized relationship among functioning units or components. There are so many ways to define system. Some of the definitions of system are as follows:

1.   A combination of a group of interrelated or interacting elements that form a unified whole.

2.   A system can also be defined as a set of elements joined together for a common goal.

3.   A group of interrelated components working together towards common goal by accepting input thereby producing output in an organized transformation process.

2.3.2 Characteristics of System

Every system has certain common characteristics. Understanding of these characteristics is must as it provides a structure or skeleton for working with the systems. The characteristics are:

- Goals are the basis for which a system is constituted, e.g., Business organizations has profit as a goal, human body has a goal to live etc.

- Components means modules or sub-system or parts within the system. Business organizations has different sub-systems like finance, marketing etc.

- Structure denotes the relationship between different components of the system.

- Systems behaviour denotes the manner in which the system reacts to its environment. For example open system is adaptive to its environment.

- Life cycle denotes the phases or stages in the life of the existence of a system. It includes initiation, expansion, control integration, data administration and maturity.

2.3.3 System Stakeholders—Major Players of System

System stakeholder means any person who has an interest in an existing or proposed information system. Stakeholders may include technical and non-technical workers as well as internal and external workers.

There are a number of persons, who have their own views about a system as well as have their own role to develop the system.

In real life situation, any individual may play more than one of these roles. For example, a system owner might also be a system user; similarly system analyst might also be a project manager, so any combination of these may work. Broadly, there are five major system stakeholders as shown in Figure 2.2 and others are external service providers and project managers.

All the above stakeholders have one thing in common - they all are information workers. Information workers mean any person whose work is to create, collect, process, distribute and use information. So now, we briefly examine the each stakeholder separately.

System Owners

Any information system can have one or more owners. Usually, system owners are the managers of the organization. If a system is large then the system owners are middle level or top level managers. If the system is small then the system owner may be middle manager or the supervisor of the organization.
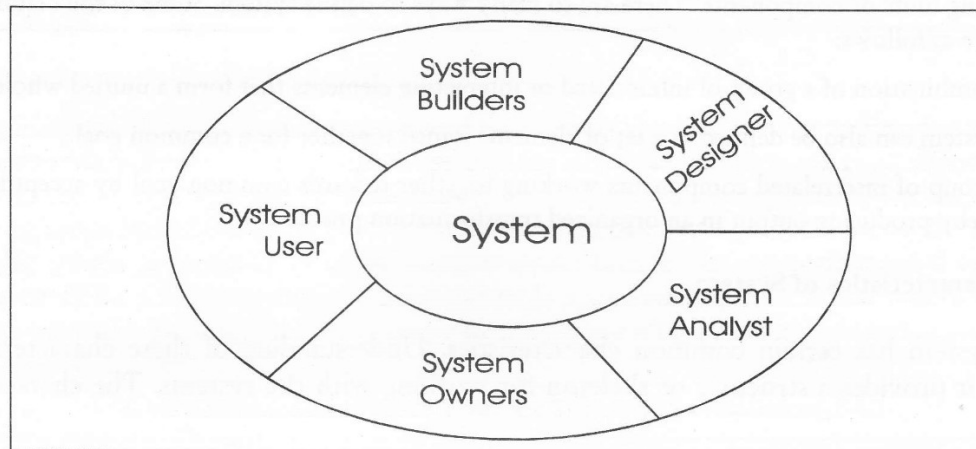

Figure 2.2: System Stakeholders

System owner has to pay for the system to be built, so they are the persons who set the vision and priorities for the system. Hence, they view an information in terms of cost and benefits to solve problems and exploit opportunities.

System Analyst

System owners, users, designers and builders have different perspective on information system. Some of them are technical person and others are non technical, one owner may be interested in overall or general view of the information while the designer is interested in each and every detail of the system. This situation represents the gap that has always existed when one wants to use the benefits of information technology or computer based solution to their business problem. Only a system analyst would be able to fill up these gaps. System analyst is a specialist who studies the problems and needs of an organization to determine how people, data, process and information technology can best accomplish improvements for the business. The system analyst is a unique stakeholder because he serves as a facilitator, bridges the communication gaps that can naturally developed between the technical system designer and builder and non technical system owners and users.

Hence, they view an information system in terms of identifying the needs and requirements of system and providing technical solutions to them and develop the information system through interaction with the other stakeholders.

A successful system analyst is one who posses following skills, knowledge and traits:

- He must have a working knowledge of information technology. This knowledge could be acquired in college courses, seminars, workshops etc.

- System analyst needs to be proficient in one or more higher level programming languages.

- He must know the general knowledge of business processes, and terminologies.

- He must have problem-solving skills.

- An analyst must be able to communicate effectively, both orally and in writing.

- Being a facilitator, a system analyst must have good interpersonal relations skills.

- He should be flexible.

The nature of the system analyst's job requires a strong character and a sense of right and wrong.
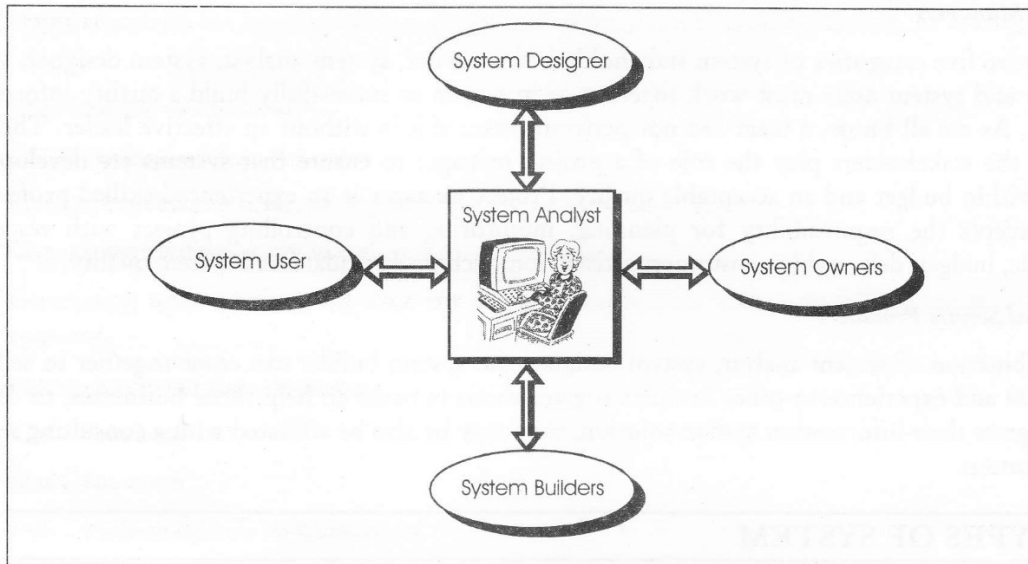

Figure 2.3: System Analyst as a Facilitator

System Designers

A technical expert is someone who translates system users, business requirements and constraints into technical solutions. They design the computerized data base, input, output, software that will fulfill these requirements. A System designer can be a database administrator, network architect, web architect, graphics artists, security experts and technology specialists. System designers translate the business requirement into a feasible technical solution. Hence, they view an information system in terms of a design blueprint to guide the construction of the final system.

System Builders

System builder is a technical specialist who constructs information system and components based on the design specifications generated by the system designers. System builders construct, implement and maintain the information system. Hence, they tend to view an information system in terms of actual working hardware and software to implement the system.

System Users

System user is a person who will use or is affected by an information system on a regular basis. They are the person who are involved in capturing, validating, entering, and exchanging data and information.

There are broadly two categories of system users:

1. **Internal System Users:** They are employees of business for whom information system is built. Internal system users are clerical and service workers, technical and professional staff, supervisors, middle managers and top managers.

2. **External System Users:** They are also known as remote user (a user who is located at a distant place but needs the information). Mobile user (a user whose location is constantly changing but who is required to access information system from any location).Example of external users are customers, suppliers, partners, employees etc.

Project Managers

The above five categories of system stakeholders viz., owner, system analyst, system designer, system builder and system users must work together or in a team to successfully build a quality information system. As we all know, a team can not perform better if it is without an effective leader. Therefore one of the stakeholders play the role of a project manager to ensure that systems are developed on time, within budget and an acceptable quality. Project manager is an experienced skilled professional who accepts the responsibility for planning, monitoring and controlling project with respect to schedule, budget, deliverables, customers satisfaction, technical standard and system quality.

External Service Providers

A combination of system analyst, system designer and system builder can come together to sell their expertise and experience to other business organizations in order to help those businesses, to develop or integrate their information system solution, they may be also be affiliated with a consulting services organization.

2.4 TYPES OF SYSTEM

There is a long list of various types of system. Some of them are enlisted in the Figure 2.4
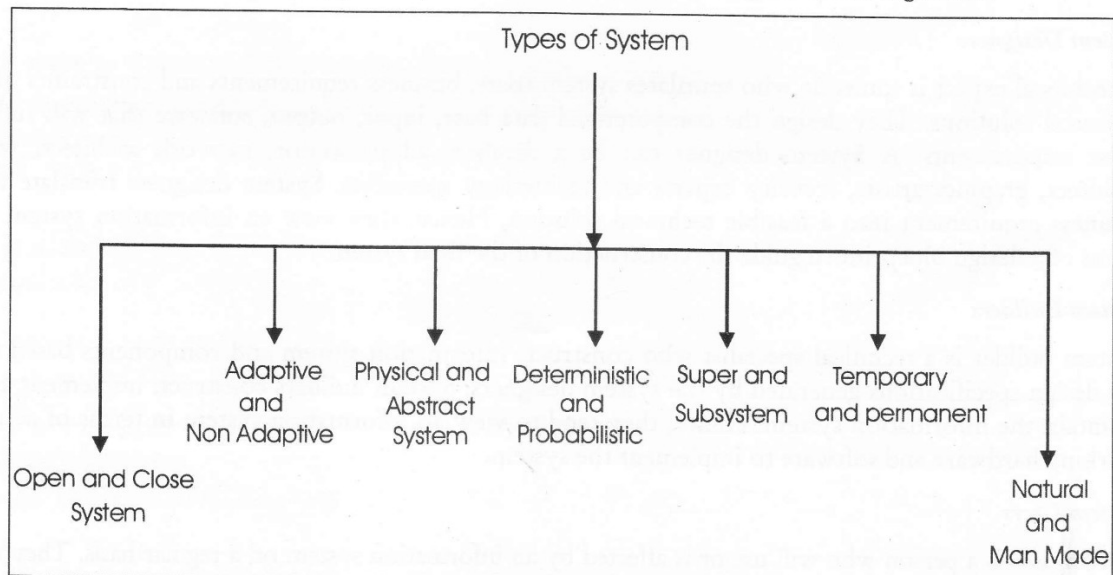

Figure 2.4: Types of System

2.4.1 Open and Closed System

Open system is one which is interactive in nature. Interactive means they want to communicate with their environment. So they exchange data, material, information etc. with the environment. Examples of open system are human beings, plants etc. Most of the organization are open system because they can not work in isolation.

Closed system is one which does not interact with its environment. Actually, there is no system which is completely closed but they are relatively isolated from the environment. In a way, relatively closed system is one which control its inputs, processes and output and is protected from the environmental threats. Example of such system is a computer program, which accepts and processes previously defined inputs and provides output in a predefined format. Another example is an accounting system which works on predefined principles and practices of accounting theory.

2.4.2 Physical and Abstract System

Physical systems are tangible entities that may be static or dynamic in operation. Physical systems are generally concrete operational systems made up of people, material, equipment, machine and other tangible things. Physical systems are static means which cannot change like the physical parts of a class room means, desk, table, chair, black board etc. In contrast, the lecture delivered by the teacher is dynamic system because it varies every time. Other example of dynamic system is fashion industry in which the style, size and stuff of the dress changes according to the change in need and preference of the customer.

Abstract systems are conceptual or non physical entities. An abstract or conceptual system is an orderly arrangement of interdependent ideas which may or may not have any existence in the real world. A system of theology is an example of abstract system, which is an orderly arrangement of ideas about God and the relationship of God to human being, another example is a system of scientific theory.

2.4.3 Super and Subsystem

Some systems are form a part of a large system. Hence, they are known as sub-system. For example, in business organization, there are marketing, finance, production departments. Other example is the respiratory system, nervous system of a human body that is considered as the sub-system. They are inter interactive and dependent to each other. They work together to achieve a common goal. The entire output of a sub-system is the input of the next sub-system.

Super system is a large and complex system. It may or may not have a number of parts known as it's sub-system. Super system is always complex and difficult to understand. For example, education system is a super system in which we have universities, colleges, schools etc.

2.4.4 Deterministic and Probabilistic System

A deterministic system is one in which the occurrence of all the event is certain. In other words, we can say that a deterministic system is a system which operates in accordance with predefined set of rules. Every step and order of their performance is known. For example, Billing system of a departmental store.

A probabilistic system is one in which the occurrence of the event cannot be perfectly predicted. The results of such system can not be pre-determined. An element of probability is always there. When

they are probabilistic then the degree of error can always predict the behaviour of the system. For example, in the examination system of an educational institution, we cannot predict the result with certainty. Another example is sales forecasting, weather forecasting etc.

2.4.5 Temporary and Permanent

Temporary systems are those which are made to achieve certain objective or to perform specific task, for example, project to construct a shopping mall. When the purpose of that system is achieved, it has lost its existence.

Permanent systems are those system which has relatively long time span. Actually in real life nothing is permanent, but when the system is last for a period of 15 to 20 years, it is said to be permanent, for example, course curriculum of a subject in the university.

2.4.6 Natural and Man-made System

Natural systems are abound in nature. Natural system are god gifted or their existence is because of the nature. For example solar system, galaxies etc. Man made system were formed when people first gathered in group to live and hunt together. Man-made system may be defined as a set of devices, procedures, people and operating system designed to achieve a common goal. For example, business organization, industries etc.

2.4.7 Adaptive and Non-adaptive

A system that reacts to its environment in such a way as to improve its functioning, achievement or probability of survival is called an adaptive system. Adaptive system is open in nature, they always want to change according to changes in their surroundings. For example, most of the business organizations on adaptive system.

A system which does not react to their environment is called non-adaptive.

They are basically closed system. For example, Management Information System of an organization, Indian Marriage System etc.
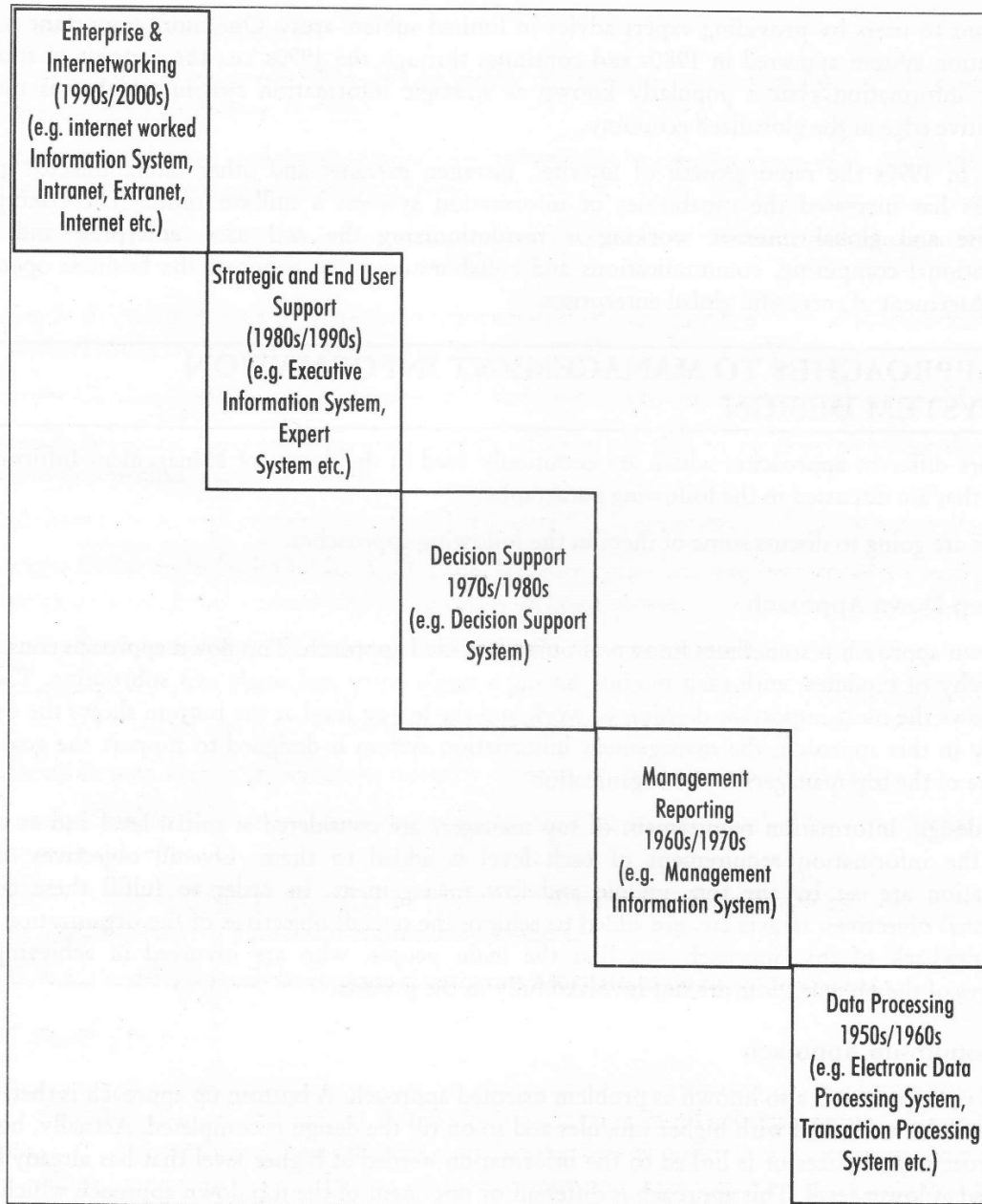
2.4.8 Evolution of Information System

The historic development of this information system is depicted in Figure 2.5. Before 1950s, most of the organizations maintained their records manually. During 1950s, the computer with commercial data processing was introduced in the business world. At that time the role of information system was simple that is restricted to transaction processing, record keeping, high volume billing and other all type of electronic data processing applications.

In 1960s another concept of management reporting emerged. With this new concept, there is a new role of Information system, i.e., to provide information to decision making purpose. This information is provided with the help of managerial reports.

By the 1970s, it was realized that the information provided by Management Information System is not much useful for manager o meet all their information need for decision making. So one more type of information system, i.e., Decision Support system was born. These new information system provide *ad-hoc* and interactive support to managerial end user and meet the challenges of decision making processes.

Enterprise &
Internetworking
(1990s/2000s)
(e.g. internet worked
Information System,
Intranet, Extranet,
Internet etc.)

Strategic and End User
Support
(1980s/1990s)
(e.g. Executive
Information System,
Expert
System etc.)

Decision Support
1970s/1980s
(e.g. Decision Support
System)

Management
Reporting
1960s/1970s
(e.g. Management
Information System)

Data Processing
1950s/1960s
(e.g. Electronic Data
Processing System,
Transaction Processing
System etc.)

Figure 2.5: Evolution of Information System

In the 1980s, several new types of information systems has appeared due to the changes in technology advancement in the field of computers as well as change in business processes. First, the telecommunication networks etc. gave birth to the concept of end user computing. This prompted the management to expect exceptional reporting rather than routine work. This requirement can not be served by decision support system and Management Information System. So, the executive information system was developed. Thirdly, the concept of artificial intelligence technique was collaborated with business information system and this gave birth to expert systems which serve as a

consultant to users by providing expert advice in limited subject areas. One more important role of information system appeared in 1980s and continues through the 1990s i.e., the concept of strategic role for information system popularly known as strategic information system which was used as competitive edge in the globalized economy.

Finally, in 1990s the rapid growth of internet, intranet, extranet and other interconnected global networks has increased the capabilities of information systems a million times. The concept of enterprise and global internet working is revolutionizing the end user, enterprise and inter organizational computing, communications and collaborations that supports the business operation and management of successful global enterprises.

2.5   APPROACHES TO MANAGEMENT INFORMATION SYSTEM DESIGN

There are different approaches which are commonly used in the design of Management Information System that are discussed in the following paragraphs.

Here we are going to discuss some of them in the following approaches.

2.5.1 Top Down Approach

Top down approach is sometimes known as object oriented approach. Top down approach consists of a hierarchy of modules, with each module having a single entry and single exit subroutine. The top level shows the most important division of work and the lowest level at the bottom shows the details. Actually in this approach, the management information system is designed to support the goals and objective of the top managers in the organization.

In this design, information requirement of top managers are considered at initial level and as we go down, the information requirement of each level is added to them. Overall objectives of the organization are set by the top, middle and low management. In order to fulfill these certain operational objectives, targets etc. are added to achieve the overall objectives of the organization. The main drawback of this approach was that the main people, who are involved in achieving the objectives of the organization, are not involved fully in the process.

2.5.2 Bottom-up Approach

Bottom up approach is also known as problem oriented approach. A bottom up approach is that when small modules are linked with higher modules and so on till the design is completed. Actually, bottom up approach synthesizes or is linked to the information needed at higher level that has already being generated at lower level. This approach is different or opponent of the top down approach which is an analytic process of breaking down information requirements into more and more detailed component. Bottom up design first satisfies operational processing requirements, then summarizes that information in the form of managerial reports to middle level manager, and so on, until all levels are satisfied. This approach is not used by a group of top managers because their particular needs can not be synthesized with transaction information.

2.5.3 By-product Approach

As we all know in the early stage of Management Information System, the role of information system is just to atomize the manual work to make the organization paperless. So at that time, all the working

or office activities like payroll, billing and other related data processing are made computerised. A very little attention is paid toward information needs of the management. However, it is understood that every level of management require information to take decisions. Information needs are the by products which is generated from the reports of electronic data processing. The drawback of this approach is that no analysis of information requirement at each level of management is done. Information produced by the management information system is generally in the form of voluminous reports and to find relevant information is a very tedious task.

2.5.4 Null Approach

In Null approach, the shortcomings of the by product approach are usually overcome. This approach lays little emphasis on the production of formal information for management by the management information system. According to Mintzberg, most of top managers gather information through verbal and informal communication rather than information through formal reports. But while supporting this designing approach, one must keep in mind that management information system best serve the information needs of managers at middle and lower level. Finally with the new system that serves more adhoc and interactive queries, makes the production of information according to changing information requirement of the top management.

2.5.5 Key Variable

In this approach, Management Information System provide information related to key variables only. These key variables are crucial attributes of the organization to access its performance, taking decision and planning. There are a number of key variables such as total cash available, profit earning ratio of each unit etc. So, according to this approach key variables are identified and Management Information System is designed to produce reports on the effective management of these variables.

A new concept of exception reporting is emerged in business scenario now a days. In this concept only variation from actual performance is reported. The main strength of this approach lies in its recognition that effective information must be provided selectively.

2.5.6 Total Study Approach

In this approach, a comparison between the information requirement of management and the information supply by the current management information system is done. This process can be done by taking interviews from all the managers regarding their key decisions, objectives and information needs. So in this approach, main emphasis is to find out the organization's information needs as well as to find out the shortcomings of present Management Information System and to take effective measure, to fill the gaps so arrived. Being comprehensive, this approach is costly and also voluminous data is collected which can not be analyzed properly.

2.5.7 Critical Success Factor

This approach is based on the assumption that an organization has certain specific goals. For example, the general goal of a university is to provide quality education, get a maximum accreditation grade as well as the goal to ensuring success of its new courses. In order to achieve these goals, the critical factors for success are quality students, better pedagogy and tight control on teaching cost.

There are certain additional goals also which are specific to each industry, organization etc. These in turn will determine critical success factors based on geographical location, past history of the

organization, local competition and so on. These factors are also determined by interviewing top managers. On the basis of these critical success factors, management highlights those areas where it is crucial to have good management information. So, Management Information System should be such which is designed to serve these factors.

This approach mainly deals with the controlling of information.

From the above discussion it is concluded that there is not a universally accepted approach for Management Information System design. There is a long list of approaches. The primary aim of Management Information System design is to identify the information at each level and effectively serve different information needs at different level of management. This is not an easy task. However, as we already suggest this is an area in which the specialist in organizational behavior, the management scientists, psychologist as well as the system analyst can make valuable contributions.

2.6   A FRAMEWORK FOR MANAGEMENT INFORMATION SYSTEM ARCHITECTURE

In modern times, we can deal with the complexities of Management Information System by using architecture. A Management information System architecture comprises data architecture, hardware architecture, software architecture, network architecture and so on. In general management information system, architecture serves as a higher level framework for understanding different views of the fundamental building blocks of an information system. Actually, information system architecture provides a foundation for organizing the various components of any information system like data, people, information etc.

Now, we are going to discuss a framework for information system architecture that was initially inspired by the work of John Zachman and later on by Whitten, Bentley and Dittman.

According to Whitten, Bentley and Dittman, different system stakeholders have different perspective or views regarding system architecture. System owners and system users have three common goals from information system such as:

- To improve business knowledge.
- To improve business process and services.
- To improve business communication and people collaborations.

But the role of system designer and builders is more technology oriented. Their focus in an information system is as follows:

- The database technologies that support business accumulation and use of business knowledge.
- The software technologies that automate and support business processes and services.
- The interface technologies that support business communications and collaborations.

So, now we are going to discuss each goal and views of different system stake holders.

2.6.1 Knowledge

Business knowledge is derived from data information. Basically, data is converted into information and information leads to knowledge. In the prospect of information system, knowledge means the business

knowledge that helps management to make intelligent decisions. So, knowledge is what enables a company to achieve its mission and vision. Improving business knowledge is a fundamental goal of an information system.

In order to improve knowledge by the information system, system stakeholder has their own perspective which in discussed in following paragraphs:

The system owner is interested in information rather than raw data that adds new business knowledge. Business knowledge helps owners to take intelligent decisions that acts as a competitive edge and supports achieving goals of business.

Business knowledge may be defined in terms of business rules and business entities. System owner's role in information system development should be to define the scope and vision of this system. For knowledge, scope can be defined in simple terms to give the list of business rules and business entities. System owners define project vision and expectations in terms of their insight into problem, opportunities and constraints as they relate to the business entities and rules.

As information workers and system users capture, store, process, edit and use data available in the organization, they deal with data requirements of organization. The challenge in system development is to correctly identify and verify the data requirements of the system users. Data requirements are an extension of the business entities and business rules that are prescribed by the system owners. System user identifies additional entities and rules. Moreover they specify exact data attributes to be stored and give business rules for maintaining that data. The data provided by system users is used to create information and subsequent business knowledge.

System Designer's View of Knowledge is different from the system owner and user because they dealt with Data technology used by information systems to support business knowledge. They are responsible to convert data requirement given by system user into database design which is used by system builders to develop a computerized database used in information system. So, system designers view of knowledge consists of data structures, database schemes, fields and other technology-dependent components.

They focus on the actual database management system technology used to store the business data that will support business knowledge. They may use database technology as well as other technologies such as flat files into the development of information system.

2.6.2 Process

The other fundamental goal of management information system is to improve its business and service process. Processes represent the working of the information system. In information system, people perform some processes and other processes are performed by machines and computers.

Views of different system stakeholder in terms of improvement of processes are as follows: system owner are interested in the business functions and the groups of related processes that supports a business. Functions can be further divided into sub-functions and eventually into processes that do specific task. For each function, a separate information system is developed. There are cross functional information systems also. Cross functional information system is that which supports relevant business processes from several business functions without regards to traditional organizational boundaries.