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Information Technology and Strategic Management

Board of Studies
The Institute of Chartered Accountants of India
(Set up by an Act of Parliament)

PAPER 7

INFORMATION TECHNOLOGY AND STRATEGIC MANAGEMENT

BOARD OF STUDIES
THE INSTITUTE OF CHARTERED ACCOUNTANTS OF INDIA

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PREFACE TO INFORMATION TECHNOLOGY

Computers are an inherent part of the life today. Virtually, in every walk of life, a person is expected to be able to use computers. The impact of information technology in several aspects of accounting profession and practice has been pronounced over the last two decades in India. An accountant who does not understand computer-based accounting system is likely to be left high and dry in the profession. A working knowledge of contemporary information technology is a basic bread and butter requirement of Chartered Accountants today. Hence, the knowledge acquired by the student through the study of the subject "Information Technology" will be very helpful in the current dynamic business scenario.

Though the level of knowledge required for Information Technology paper is only "working knowledge", students are advised to make an early start of this study material. Chapters 1 covers the basic concepts relating to computer hardware, its functioning and the software. Chapter 2 covers Data storage , Retrieval and Data Base Management Systems. Chapter 3 is devoted to discussion on Computer Networks and Network Security. In chapter 4, we have discussed various aspects of Internet, E-Commerce and other technologies.

Students possessing no previous exposure to computers would find it difficult to understand these topics in the very first reading. Hence, one should give repeated and intensive reading to each chapter over a period of time. During the course of study, keep preparing notes on important terms covered under each topic. Students will sometimes encounter certain technical terms, which are not explained in the initial chapters, but such terms would have been explained under appropriate heading in the subsequent chapters. Students are advised to make a note of such items and try to understand the concepts when they find the explanation of these items in the study material. A conceptual clarity of the subject would help the students in understanding the topics on development tools viz. flowcharting and decision tables which are discussed in chapter 5 and chapter 6. It is very easy to acquire good marks in flow-charting and decision table if the algorithm of the problem is clearly understood. However, students generally flounder in these two areas. Merely cramming of solutions of various problems given in the study material is not going to help you. Before preparing a flow-chart, it is very important to understand the logic of the problem clearly. First of all, prepare an algorithm (a list of steps to be followed to arrive at the solution) for the given problem. Once the algorithm is clear in the mind, it can be easily depicted in the form of a flowchart. The accuracy of the answer should also be tested using a set of test data as explained in the study material.

Once a topic is thoroughly understood, write answers to self-examination questions given at the end of each chapter. Further, inculcate the habit of referring to some of the prescribed text books Under this scheme, students are required to undergo Information Technology Training for 100 hours. A practical hands-on-experience on computer will help the students in understanding the technicalities of the subject easily.

Few important points for the Examination

1. Don't indulge in "selective reading". All the topics covered in the syllabus should be prepared thoroughly.

2. Instead of writing lengthy essay-type answers, break your answer into number of points covering all the aspects of the question asked. Before you start attempting a question, read it carefully, visualise clearly what is expected to be answered. Don't attempt a question in haste.

3. Answer should be specific and to the point according to the weightage of marks allotted. If a question carries only two to three marks, a precise definition or stating important points will be sufficient. However, if the question carries more marks, a brief description of each point should be given. Avoid giving unnecessary details. It will not fetch you extra marks.

4. Wherever possible, try to include relevant diagrams, rough sketches etc. but don't waste time in drawing very neat pictures.

5. It is always better to adopt the standard terminology. In case you are following a different methodology from the one given in the study material, clearly specify it in your answer sheet.

6. Any assumptions made while answering a question should be clearly stated.

If the students follow the above guidelines, we are sure that they will not find any difficulty in preparing themselves for the examination. In case of any specific problem, they are always welcome to write to us.

Happy reading and Best of Luck.

PREFACE TO STRATEGIC MANAGEMENT

Strategic management is important for Chartered Accountants. With the changing scope of the Chartered Accountancy profession and the multifarious nature of the work profile of professionals the students need to learn newer and different concepts and acquire multidimensional skills. With this focus the subject of Strategic Management in chartered accountancy is included in the education and training. Chartered Accountants reaching high in the corporate ladder also need to be sound in the concepts and principles of strategic management.

As a student of Chartered Accountancy course, you must be keenly going through financial newspapers, reading, inter alia, about mergers, acquisitions, divestments and corporate successes or failures. An inquisitive mind will have several questions. How does a company become successful? How a company remains at the top? How a company identifies its potential and is able to deliver its best? How an organisation is able to cope up and gain command over the dynamic and turbulent environment? Answers to these simple questions are really difficult. The turbulence in the environment forces business organisations to find newer ways to function. Business organisations to perform and excel need a clearer sense of strategic vision and improved understanding of a rapidly changing environment. They need to strategically manage their enterprises. It is interesting to see that businesses compete by selling products that are similar in nature to the same group of customers. They differentiate their products in order to sell. Business organisations that are able to exploit some form of advantage are more profitable than their rivals. With the help of this self-study material on Strategic Management the student are expected to get some insight in the tools and techniques of strategic management.

The world of business organisations and their strategic management is wonderful, exciting and the literature on this world is even more so. The knowledge in the field and its quality is ever-growing. Numerous books are being written on the subject and hundreds of journals are publishing research and other articles on emerging strategical issues in business organisation. The coverage and treatment of the subject in the study material is just a fraction of the available body of knowledge. The study material is meant to be a small window to watch and enjoy the world of business organisations. You are advised to take a keen interest in the subject not merely for passing the examination but for making your own professional career path more manageable and meaningful.

Bringing out study material on the subject requires efforts of many. Dr. Saroj Datta, has meticulously prepared a draft of the study material. Acknowledgements are also due to Dr. Sanjeev Shukla and Dr. Sudhir Dikshit who have also contributed in some of the chapters with their writings on selected topics. Last but not the least the efforts taken by Mr. Shaleen Suneja, Assistant Director and Dr. Ruchi Gupta, Executive Officer are well appreciable, who has helped in giving the final shape to this study material.

In case you find any problem or have any observation on the subjects or study material, you are welcome to write a letter to the Institute at A-94/4, Sector -58, Noida, 201301. Students, staying in (or visiting) New Delhi and NCR may drop-in and take benefit of personally meeting the concerned faculty in the Board of Studies. You will get the needed help provided you are clear what do you want.

Wish you all the best in your study endeavours.

SYLLABUS

PAPER – 7 : INFORMATION TECHNOLOGY AND STRATEGIC MANAGEMENT

(One paper – Three hours – 100 Marks)

Level of Knowledge: Working knowledge

Section A : Information Technology (50 Marks)

Objective:

To develop an understanding of Information Technology and its use by the business as facilitator and driver.

Contents

1. Introduction to Computers

(a) Computer Hardware

Classification of Computers - Personal computer, Workstation, Servers and Super computers

Computer Components - CPU, Input output devices, Storage devices

(b) BUS, I/O CO Processors, Ports (serial, parallel, USB ports), Expansion slots, Add on cards, On board chips, LAN cards, Multi media cards , Cache memory, Buffers, Controllers and drivers

(c) Computer Software

Systems Software - Operating system, Translators (Compilers, Interpreters and Assemblers), System utilities

General Purpose Software/ Utilities - Word Processor, Spread Sheet, DBMS, Scheduler / Planner, Internet browser and E-mail clients

Application Software - Financial Accounting, Payroll, Inventory

Specialized Systems – Enterprise Resource Planning (ERP) , Artificial Intelligence , Expert Systems, Decision Support Systems – An Overview

2. Data Storage, Retrievals and Data Base Management Systems

(a) Data and Information Concepts: Bits, Bytes, KB, MB, GB, TB

(b) Data organization and Access

Storage Concepts : Records, Fields, Grouped fields, Special fields like date, Integers, Real, Floating, Fixed, Double precision, Logical, Characters, Strings, Variable character fields (Memo); Key, Primary key, Foreign key, Secondary key, Referential integrity, Index fields.

Storage techniques: Sequential, Block Sequential, Random, Indexed, Sequential access, Direct access, Random access including Randomizing

Logical Structure and Physical structure of files

(c) DBMS Models and Classification:

Need for database, Administration, Models, DML and DDL (Query and reporting); Data Dictionaries, Distributed data bases, Object oriented databases, Client Server databases, Knowledge databases

(d) Backup and recovery – backup policy, backup schedules, offsite backups, recycling of backups, frequent checking of recovery of backup

(e) Usage of system software like program library management systems and tape and disk management systems – features, functionalities, advantages

(f) Data Mining and Data Warehousing - An overview

3. Computer Networks & Network Security

(a) Networking Concepts – Need and Scope, Benefits

Classification: LAN, MAN, WAN, VPN; Peer-to-Peer, Client Server

Components- NIC, Router, Switch, Hub, Repeater, Bridge, Gateway, Modem

Network Topologies– Bus, Star,, Ring, Mesh, Hybrid, Architecture :Token ring, Ethernet

Transmission Technologies and Protocols – OSI, TCP/IP, ISDN etc.

Network Operating System

(b) Local Area Networks- Components of a LAN, Advantages of LAN

(c) Client Server Technology

Limitation of Single user systems and need for Client Server Technology

Servers - Database, Application, Print servers, Transaction servers, Internet servers, Mail servers, Chat servers, IDS

Introduction tier architectures

(d) Data centers: Features and functions, Primary delivery centre and disaster recovery site

(e) Network Security

Need; Threats and Vulnerabilities; Security levels; techniques

4. Internet and other technologies

(a) Internet and world-wide web, Intranets, Extranets, applications of Internet, Internet protocols

(b) E-Commerce - Nature, Types (B2B, B2C, C2C), Supply chain management, CRM, Electronic data interchange (EDI), Electronic fund transfers (EFT), Payment portal, E-Commerce security;

(c) Mobile Commerce, Bluetooth and Wi-Fi

5. Flowcharts

6. Decision Tables.

Section B : Strategic Management (50 Marks)

Objectives:

(a) To develop an understanding of the general and competitive business environment,

(b) To develop an understanding of strategic management concepts and techniques,

(c) To be able to solve simple cases.

Contents

1. Business Environment

General Environment — Demographic, Socio-cultural, Macro-economic, Legal/political, Technological, and Global; Competitive Environment.

2. Business Policy and Strategic Management

Meaning and nature; Strategic management imperative; Vision, Mission and Objectives; Strategic levels in organizations.

3. Strategic Analyses

Situational Analysis – SWOT Analysis, TOWS Matrix, Portfolio Analysis — BCG Matrix.

4. Strategic Planning

Meaning, stages, alternatives, strategy formulation.

5. Formulation of Functional Strategy

Marketing strategy, Financial strategy, Production strategy, Logistics strategy, Human resource strategy.

6. Strategy Implementation and Control

Organizational structures; Establishing strategic business units; Establishing profit centers by business, product or service, market segment or customer; Leadership and behavioural challenges.

7. Reaching Strategic Edge

Business Process Reengineering, Benchmarking, Total Quality Management, Six Sigma, Contemporary Strategic Issues.

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SECTION A : INFORMATION TECHNOLOGY

CHAPTER 2 – DATA STORAGE, RETRIEVAL AND DATA BASE MANAGEMENT SYSTEMS

CHAPTER 3 – COMPUTER NETWORKS & NETWORK SECURITY

CHAPTER 5 – INTRODUCTION TO FLOWCHARTING

CHAPTER 6 – DECISION TABLE

GLOSSARY 1 – IMPORTANT COMPUTER TERMS

GLOSSARY 2 – INTERNET RELATED TERMS

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SOURCES/REFERENCES

SECTION B : STRATEGIC MANAGEMENT

CHAPTER 1 – BUSINESS ENVIRONMENT

CHAPTER 2 – BUSINESS POLICY AND STRATEGIC MANAGEMENT

SECTION : A

INFORMATION TECHNOLOGY

CHAPTER 1

INTRODUCTION TO COMPUTERS

Learning Objectives of this chapter are-

Unit 1:

By the end of this Chapter, Student will be able to know:

- Different Generations of Computers and their evolution.
- Classification of computers.
- Features of computers, their advantages and limitations
- Basic components of a computer system.
- Types of Storage devices, their use and capacity.
- Types of RAM and their working.

Unit 2:

- Different types of input devices available and how to use them.
- Where to use the right kind of input device.
- Add-ons required for the input Devices.

Unit 3:

- Meaning of software
- Different classifications of software.
- Available system software in the market with their usage and limitations
- Utility of the software.

In this Chapter we shall discuss what we understand by the term 'computer', its functions and various generations through which computer technology has advanced. Various categorizations of computers according to their purpose and size etc. shall also be discussed in this study paper. We will also overview hardware and software requirements. Hardware consists of the mechanical and electronic components, which one can see and touch. Computer hardware falls into two categories: processing hardware, which consists of the central processing unit, and the peripheral devices. The software comprises of system and application programs, the operating systems and various other general purpose software.

1.1 HISTORICAL DEVELOPMENT OF COMPUTERS

The modern computer with the power and speed of today was not a solitary invention that sprang completed from the mind of a single individual. It is the end result of countless inventions, ideas, and developments contributed by many people throughout the last several decades. The history of automatic data processing begins with Charles Babbage's attempt to build an automatic mechanical calculator at Cambridge, England, in 1830. By the 1930's punched cards were in wide use in large business, and various types of punched card handling machines were available. In 1937, Howard Aiken, at Harvard, proposed to IBM that a machine could be constructed which would automatically sequence the operations and calculations performed. This machine used a combination of Electro-mechanical devices, including relays.

First Generation computers : UNIVAC (Universal Automatic Computer) was the first general purpose electrical computer to be available and marks the beginning of the first generation of electrical computers. The first generation electrical computers employed vacuum tubes. These computers were large in size and required air conditioning. The input and output units were the punched card reader and the card punches. Because of the inherently slow speed of these input/output units, the power of the CPU was subjugated to their speed. IBM-650 was however, the most popular first generation computer and was introduced in 1950 with magnetic drum memory and punched cards for input and output. It was intended for both business and scientific applications.

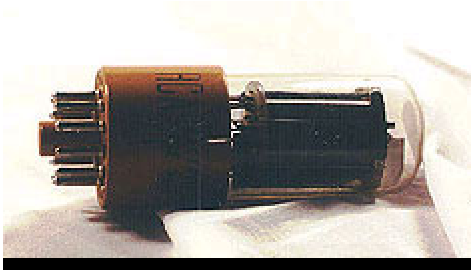


Fig-1.1.1 Transistor

Second generation computers: These computers employed transistors (see figure 1.1.1) and other solid state devices. Their circuits were smaller than the vacuum tubes, and generated less heat. Hence the second-generation computers required less power, were faster and more reliable. IBM 1401 was the most popular second-generation computer. There were two distinct categories of the second-generation computers for business and scientific applications. They employed magnetic tape as the input/output media. Second generation computers successfully displaced the unit record equipment on cost benefit grounds in many installations.

Third generation computers: These employed integrated circuits in which all the elements of an electronic circuit are contained in a tiny silicon wafer. The third generation computers are much cheaper and more reliable than the second-generation computers. They are speedier with much vaster capacity and admit connection of a wide variety of peripherals particularly magnetic disk units. They are based on the principles of standardisation and compatibility. The core storage of a given model of a computer can be expanded by adding modules and it still permits the use of order program. The third generation computers can be used for both scientific and business applications.

The third generation computers permit multi-programming which is interleaved processing of several programmes to enhance the productivity of the computer, time-sharing which is the use of the computer by several customers at a time, operating systems which optimise the man-machine capabilities and such data communications facilities as remote terminals. They also permit use of such high level languages as FORTRAN and COBOL. The mini computers are also one of the developments in the third generation computers.

Each generation of computers has an effect on the MIS centralization and decentralization issue. The first generation computers were high in costs and large in size; therefore information systems were sought to be centralized to serve benefits of hard ware economies. The second-generation computers were substantially cheaper and the trend was towards MIS decentralization. Third generation computers however, offered communication capabilities and the use of remote terminals and the trend was reversed to centralization.

Fourth Generation Information Systems : Fourth generation machines appeared in 1970's utilizing still newer electronic technology which enabled them to be even smaller and faster than those of the third generation. Many newe types of terminals and means of computer access were also developed at this time.

One of the major inventions, which led to the fourth generation, was the large scale Integrated Circuit (LSI) The LSI is a small "chip" which contains thousands of small electronic components which function as a complete system. In effect an entire computer can be manufactured on a single chip of size less than 1/3 inch square. A single chip may perform the functions of the entire computer, calculator or control device. Research into future developments promises the manufacture of large computer systems with enormous memory capacity on small chips. This will reduce the cost and increase the speed of new systems still further.

Micro computers : In July, 1977, at National Computer Conference in Dallas, Commodore Ltd. startled the computing world by announcing a fully assembled microcomputer in a single housing called the Personal electronic Transactor (PET) The machine consisted of keyboard, processor unit, CRT and built in cassette tape recorder for $595. The programming language BASIC was built into the system. Thus, for less than $600, a fully programmable, powerful computer system was available for home or personal use. Later in 1977, Radio Shack Corporation announced the TRS 80 computer.

The IBM family of personal computers: In [1981] International Business Machines (IBM) made its first appearance in the field of microcomputer with the announcement of the IBM Personal Computers. The term personal computer captured the notion that an individual can have her or his own computer. With the advent of IBM PC, computers had stepped out of large organisations and entered into the home. However, instead of adopting 8-bit microprocessor, IBM selected Intel 8088 - a 16 - bit microprocessor which made the IBM PC “an overnight success”. In [1983], IBM’s first addition to the PC-family - XT model was introduced, which added a high capacity hard disk storage facility to the PC. In [1984], IBM introduced two new high powered models of PC *viz* Compaq Desk Pro, the first member of the PC family to have more basic computing power than the original PC and the IBM PC

Fig 1.1.3 IBM PC

AT model, which had a much greater computing speed than the PC and XT or even the new Desk Pro. When software vendors began to orient their products to the IBM PC, many microcomputer manufacturers created and sold clones of it. These clones called IBM PC compatibles, run most or all the software designed for the IBM PC. Therefore, whatever IBM does in the personal computer erana has immediate and far-reaching effects on PC market. The successor to the IBM PC, the IBM personal system/2, or IBM PS/2 (introduced in 1987), have almost certainly become a milestone in PC history. With IBM’s products, the microcomputer took its place as an important tool for use in solving the information processing needs of both large and small businesses.

Other Significant Contributions: Several other personal computers have established their place in PC history. Introduced in [1982], the Commodore-64 was significant because it signaled the buying public that powerful micros could be manufactured and sold at a reasonable cost $599. In the same year, Compaq Computer Corporation bundled the equivalent of an IBM PC in a transportable case and named it the Compaq Portable. Thus began the era of the portable computer. In [1984], Apple Computer introduced the Macintosh with a very “friendly” graphical user interface - proof that computers can be easy and fun to use.

Microcomputers have many of the features and capabilities of the larger system. The cost of microcomputers has dropped substantially since their introduction. Many now sell a microcomputer for as low as Rs. 15,000. This reduction in cost will bring about a significant increase in the number of microcomputers in use. The major application for microcomputer lies in the field of industrial automation, where they are used to monitor and control various manufacturing processes. Their low cost and lightweight make it feasible to carry them on site or into a field or to package them with other portable equipments as part of larger system.

The second decade (1986- present) of the fourth generation observed a great increase in the speed of microprocessors and the size of main memory. The speed of microprocessors and the size of main memory and hard disk went up by a factor of 4 every 3 years. Many of the mainframe CPU features became part of the microprocessor architecture in 90s. In 1995 the most popular CPUs were Pentium, Power PC etc. Also RISC (Reduced Instruction Set Computers) microprocessors are preferred in powerful servers for numeric computing and file services.

The hard disks are also available of the sizes up to 80 GB. For larger disks RAID technology (Redundant Array of Inexpensive Disks) gives storage up to hundreds of GB. The CDROMs (Compact Disk-Read Only Memory)and DVDs(Digital Video Diks) are have become popular day by day. The DVDs of today can store up to 17 Giga bytes of information.

The computer networks came of age and are one of the most popular ways of interacting with computer chains of millions of users. The computers are being applied in various areas like simulation, visualization, Parallel computing, virtual reality, Multimedia etc.

Fifth Generation : Defining the fifth generation of computers is somewhat difficult because the field is in its infancy. The most famous example of a fifth generation computer is the fictional HAL9000 from Arthur C. Clarke’s novel, 2001: A Space Odyssey. HAL performed all of the functions currently envisioned for real-life fifth generation computers. With artificial intelligence, HAL could reason well enough to hold conversations with its human operators, use visual input, and learn from its own experiences. (Unfortunately, HAL was a little too human and had a psychotic breakdown, commandeering a spaceship and killing most humans on board.)

Though the wayward HAL9000 may be far from the reach of real-life computer designers, many of its functions are not. Using recent engineering advances, computers are able to accept spoken word instructions (voice recognition) and imitate human reasoning. The ability to translate a foreign language is also moderately possible with fifth generation computers.

This feat seemed a simple objective at first, but appeared much more difficult when programmers realized that human understanding relies as much on context and meaning as it does on the simple translation of words.

Many advances in the science of computer design and technology are coming together to enable the creation of fifth-generation computers. Two such engineering advances are parallel processing, which replaces von Neumann's single central processing unit design with a system harnessing the power of many CPUs to work as one. Another advance is superconductor technology, which allows the flow of electricity with little or no resistance, greatly improving the speed of information flow. Computers today have some attributes of fifth generation computers. For example, expert systems assist doctors in making diagnoses by applying the problem-solving steps a doctor might use in assessing a patient's needs. It will take several more years of development before expert systems are in widespread use.

1.2 SIZE OF COMPUTERS

Computer systems are often categorized into super computers, mainframes, minis, and micros. These days computers are also categorized as servers and workstations.

1.2.1 Super computers - These are the largest and fastest computers available but are typically not used for commercial data processing. Instead they are used in specialized areas such as in Defence, aircraft design and computer generated movies, weather research etc. Predicting the weather involves analyzing thousands of variables gathered by satellites, aircrafts and other meteorological stations on the ground. This analysis has to be done in a vary short time. A super computer can handle such situations efficiently. In the medical field, super computers are used to study the structure of viruses, such as those causing AIDS. Designing an aircraft involves simulating and analyzing the airflow around the aircraft. This again requires a super computer. The first super computer was the ILLIAC IV made by

Figure 1.2.1.1 :Super Computer(NEC)

Burroughs. Other suppliers of super computers are CRAY, CDC, Fujit su, Intel Corporation, Thinking Machine Corporation, NEC, SGI, Hitachi, IBM and Sun Microsystem, etc.

In past, a high clock rate was one of the characteristics that distinguished super-computers from ordinary machines. For instance, the high clock rate of Cray processors made them the fastest available during the 1980s. However, microprocessor clock rates have now matched, and even in some cases surpassed the clock rates of super-computers. What distinguishes the super-computer of today from ordinary computers is their high degree of parallelism, i.e., their ability to perform a large number of operations simultaneously. All modern super-computers contain several processors, which can cooperate in the execution of a single program. Each processor can execute instructions following a program path independently of the others. Parallelism is achieved by decomposing programs into components, known as tasks or threads, which can be executed simultaneously on separate processors. Cray SVI super-computer introduced in 1998 can support 1,024 microprocessors, the cycle time is 4 nano seconds and has maximum memory size of 1024 gigabytes. On the other hand, Intel ASCI Red, introduced in 1997 which is a microprocessor-based super-computer, can support upto 9216 processors, Pentium Pro CPU and 584 MB of memory.

Super computers can process 64 bits or more at a time. Their processing speed ranges from 10,000 million instructions per second (MIPS) to 1.2 billion instructions per second. They can support up to 10,000 terminals at a time.

1.2.2 Mainframe computers: Mainframes are less powerful and cheaper than Super computers. However, they are big general-purpose computers capable of handling all kinds of scientific and business applications. Mainframes can process at several million instructions per second. A Mainframe can support more than 1,000 remote terminals.

Fig:1.2.2.1 Mainframe

Mainframes have large on-line secondary storage capacity. A number of different types of peripheral devices like magnetic tape drive, hard disk drive, visual display units, plotters, printers and telecommunication terminals can be attached with main-frame computers. They have high-speed cache memory which enables them to process applications at a faster rate than mini or microcomputers. They also offer the facility of multiprogramming and time-sharing.

Prices of Mainframe computers range between 1 crore to 5 crores depending upon the configuration. It is customary of Mainframe computer manufacturers to produce models ranging in size from small to very large, under a family designation. Computers belonging to a family are compatible *i.e.,* program prepared for one model of a family can run on another bigger model of the family. Major suppliers of Mainframe computers are IBM, Honey well, Burroughs, NCR, CDC and Sperry etc. Mainframes can be used for a variety of applications. A typical application of these computers is airline reservation or railway reservation system. The airlines have a mainframe computer at their head office where information of all flights is stored. Various terminals located at the booking offices are attached to the central date bank and up-to-date information of all flights can be obtained at any terminal.

1.2.3 Mini Computer - This type of computer performs data processing activities in the same way as the mainframe but on a smaller scale. The cost of minis is lower. Data is usually input by means of a keyboard. As the name implies, a minicomputer is small compared with a mainframe and may be called a scaled-down mainframe as the processor and the peripherals are physically smaller.

Minicomputers cost about Rs. 5 lacs to Rs. 50 lacs. The most popular minicomputer or minis, are the Data General Nova, DEC, PDP-11 and the IBM series/1. These systems can serve as information processors in small-to-medium sized firms or as processors in computer networks for large firms. Primary storage capacity starts at about 640K and can go as high as few mega bytes (MB) A minicomputer system consists of a CPU, several disk drives, a high-speed printer, perhaps a few magnetic tape units, and number of terminals. Programming languages include BASIC, PASCAL COBOL, C and FORTRAN. Much prewritten application software is also available.

Originally minicomputers were developed for process control and system monitoring etc. They were complicated to program and had minimal input/output capabilities as they were mainly concerned with "number crunching" rather than handling large amounts of data relating to business transactions. However, they are now fully developed, powerful computers with a wide range of peripherals to perform a wide range of data processing and computing activities. Minicomputer systems can be equipped with most of the input/output (I/O) devices and secondary storage devices that the large mainframe systems can handle, such as terminals and rigid disks. They are also making possible the installation of distributed data processing systems. Instead of a company having one large mainframe computer, it may have mini-computer at each of its remote locations and connect them to each other through telecommunications.

Minis certainly overlap mainframes. As minis become more powerful, they tend to perform with equal efficiency the jobs for which mainframes were used in the very near past, and the same is true for micros in relation to minis. Therefore, there is no definite delineation among the three types of computer systems, and the lines of demarcation are constantly changing.

1.2.4 Microcomputers: A microcomputer is a full-fledged computer system that uses a microprocessor as its CPU, these are also called personal computer systems. Microcomputers were first available for widespread use in the 1970s, when it became possible to put the entire circuitry of computers (CPU) onto a small silicon chip called microprocessor. A microprocessor is a product of the microminiaturization of electronic circuitry; it is literally a “computer on a chip”. Chip refers to any self-contained integrated circuit. The size of chips, which are about 30 thousandths of an inch thick, vary in area from fingernail size (about 1/4 inch square) to postage-stamp size (about 1-inch square) These days, relatively inexpensive microprocessors have bean integrated into thousands of mechanical and electronic devices-even elevators, band saw, and ski-boot bindings. In a few years, virtually everything mechanical or electronic will incorporate microprocessor technology into its design.

The microprocessor is sometimes confused with its famous offspring, the microcomputer. A microprocessor, however, is not a computer. It only provides a part of CPU circuitry. This chip must be mounted together with memory, input and output chips on a single circuit board to make it a microcomputer. Thus, a microcomputer often called a micro is a small computer consisting of a processor on a single silicon chip which is mounted on a circuit board with other chips containing the computer’s internal memory in the form of read-only-memory (ROM) and random-access-memory (RAM) It has a keyboard for the entry of data and instructions and a screen for display purposes. It has interface for the connection of peripherals in the form of mouse, plotters, printers, cassette units, disk drives and light pens etc. IBM PC, APPLE II, TENDY TRS-80 are some of the popular microcomputers.

When people use the terms personal computers and microcomputers, they mean the small computer that are commonly found in offices, classrooms, and homes. Personal computers come in all shapes, and sizes. Although most models reside on desktops, others stand on the floor, and some are even portable.

The terms *microcomputer* and *personal computer* are interchangeable; however, PC - which stands for personal computer has a more specific meaning. In 1981, IBM called its first microcomputer the IBM PC. Within a few years, many companies were copying the IBM design, creating “clones” or “compatible computers” that aimed at functioning just like the original. For this reason, the term PC has come to mean that family of computers that includes IBM and compatibles. The Apple Macintosh computer, however, is neither an IBM nor a compatible. It is another family of microcomputers made by Apple computers. Apple computers are mainly used in Multimedia.

The earliest microcomputers were capable of supporting only a *single user at a time*. Now-a-days, multi-user microcomputer systems are also available and are becoming more prevalent. In multi-user systems, a powerful microcomputer may be used to substitute for Mainframe or minicomputer. single-user personal computers are also being connected to one another to form network. Multi-user microcomputers play key roles in some of the networks that are developed.

Currently IBM and Apple are the two most prominent manufacturers of microcomputers. A typical microcomputer consists of a processor on a single silicon chip mounted on a circuit board together with memory chips, ROM and RAM chips etc. It has a keyboard for the entry of data and instructions and a screen for display purposes. It has interfaces for connecting peripherals such as plotters, cassette units, disc drives, light pens, a mouse and joysticks.

A microcomputer including optional peripherals and other add-on-units may consist of the elements listed below.

(a) 8, 16, or 32 bit processor,

(b) Internal memory 256 MB expandable to 512 MB and more;

(c) Backing storage-cassette, floppy disc, microfloppy discs, micro-drive, silicon disc or hard disc, CD-ROMS, DVDs, pen drives etc.;

(d) Keyboard and screen (input and output);

(e) Interface (for the connection of peripherals);

(f) Bus (communication and control channels);

(g) Printer and/or plotter (multicolour text and graphics);

(h) Pulse generator (clock);

(i) Light pens, mouse, paddles/joysticks, Multimedia (graphics and games);

(j) Software (programs)

Microcomputer systems are used by even the smallest of business, however their primary market is the personal home computer market. In the home, these computers can be used for a wide variety of tasks-from keeping track of the family budget to storing recipes to monitoring the home burglar alarm system. Currently, a small microcomputer system can be purchased for approximately Rs. 30,000. A more sophisticated microcomputer system with a 80 Giga bytes hard disk and 256 MB of primary storage can be purchased for approximately Rs. 25,000 to Rs. 40,000. With high-quality printer and additional memory (up to 512 MB), these microcomputer systems can cost in the vicinity of Rs. 50,000 to Rs. 75,000.

Examples of microcomputers are IBM PCs, PS/2 and Apple's Macintosh

1.2.5 Workstations : Between minicomputer and microcomputers - in terms of processing power - is a class of computers known as WORKSTATIONS. A workstation looks like a personal computer and is typically used by one person. Although workstations are still more powerful than the average personal computer, - the differences in the capabilities of these types of machines are growing smaller.

Workstations differ significantly from microcomputer in two areas. Internally, workstations are constructed differently than microcomputers. They are based on different architecture of CPU called *reduced instruction set computing* (RISC), which results in faster processing of instructions.

The other difference between workstations and microcomputers in that most microcomputers can run any of the four major operating systems* - DOS, Unix, OS/2, and Microsoft Windows NT), but workstations generally run the Unix operating systems or a variation of it. The biggest manufacturer of workstations is Sun Microsystems. Other manufacturers include IBM, DEC, Hewlette Packard and Silicon Graphics.

Many people use the term workstation to refer to any computer or terminal that is connected to another computer. Although this was once a common meaning of the term, it has become outdated. These days, a workstation is powerful RISC - based computer that runs the Unix Operating System and is generally used by scientists and engineers.

1.2.6. Server : A **server** is a computer system that provides services to other computing systems—called clients—over a network. The term is most commonly applied to a complete computer system today, but it is also used occasionally to refer only to the hardware or software portions of such a system. Servers occupy a place in computing similar to that occupied by minicomputers in the past, which they have largely replaced. The typical server is a computer system that operates continuously on a network and waits for requests for services from other computers on the network. Many servers are dedicated to this role, but some may also be used simultaneously for other purposes, particularly when the demands placed upon them as servers are modest. For example, in a small office, a large desktop computer may act as both a desktop workstation for one person in the office and as a server for all the other computers in the office.

Servers today are physically similar to most other general-purpose computers, although their hardware configurations may be particularly optimized to fit their server roles, if they are dedicated to that role. Many use hardware identical or nearly identical to that found in standard desktop PCs. However, servers run software that is often very different from that used on desktop computers and workstations.

Servers should not be confused with mainframes, which are very large computers that centralize certain information-processing activities in large organizations and may or may not act as servers in addition to their other activities. Many large organizations have both mainframes and servers, although servers usually are smaller and much more numerous and decentralized than mainframes.

Servers frequently host hardware resources that they make available on a controlled and shared basis to client computers, such as printers *(print servers)* and file systems *(file servers)* This sharing permits better access control (and thus better security) and can reduce costs by reducing duplication of hardware.

1.3 ADVANTAGES AND LIMITATIONS OF COMPUTERS

1.3.1 Advantages of Computer System : In a nutshell, computers are fast, accurate, and reliable; they don't forget anything; and they don't complain. We will now describe them in detail.

Speed: The smallest unit of time in the human experience is, realistically, the second. Computer operations (for example, the execution of an instruction, such as multiplying the hours worked times the rate of pay) are measured in **milliseconds, microseconds, nanoseconds, and picoseconds** (one thousandth, one millionth, one billionth, and one trillionth of a second, respectively)

Accuracy:. is the degree to which information on a map or in a digital database matches true or known values. Accuracy is an issue pertaining to the quality of data and the number of errors contained in a dataset or map. In discussing a GIS database, it is possible to consider horizontal and vertical accuracy with respect to geographic position, as well as attribute, conceptual, and logical accuracy.

- The level of accuracy required for particular applications varies greatly.
- Highly accurate data can be very difficult and costly to produce and compile.

Reliability: Reliability can be defined as the ability of a person or system to perform and maintain its functions in routine circumstances, as well as in hostile or unexpected circumstances.

The IEEE defines it as ". . . the ability of a system or component to perform its required functions under stated conditions for a specified period of time."

Reliability may refer to:

Reliability (statistics), of a set of data and experiments

High reliability is informally reported in "nines"

Data reliability, a property of some disk arrays in computer storage

Reliability engineering ensures a system will be reliable when operated in a specified manner

Reliability theory, as a theoretical concept, to explain biological aging and species longevity

Reliability (computer networking), a category used to describe protocols

Memory Capability: Computer systems have total and instant recall of data and an almost unlimited capacity to store these data. A typical mainframe computer system will have many billions of characters stored and available for instant recall. High-end PCs have access to about a billion characters of data. To give you a benchmark for comparison, a 15-page report contains about 50,000 characters.

1.3.2 Limitations of Computer systems : The computer is one of the most powerful tools ever developed. But we've all read articles similar to the one about the man who was treated for pneumonia and then charged by the hospital's computer for the use of the delivery room and nursery. Such "computer failures" may be amusing, but most such foul-ups happen because people fail to consider some basic computer limitations. Without reliable programs and sound logic, no computer system will perform adequately.

Program must be reliable: The computer does what it's programmed to do *and nothing else*. A clever program can be written to direct the computer to store the results of previous decisions. Then, by using the program's branching ability, the computer may be able to modify its behavior according to the success or failure of past decisions. But a program that has operated flawlessly for months can suddenly produce nonsense. Perhaps some rare combination of events has presented the system with a situation for which there's no programmed course of action. Or perhaps the course of action provided by the programmer contains an error that's just being discovered. Of course, a reliable program that's supplied with incorrect data may also produce nonsense.

Application logic must be understood: The computer can only process jobs which can be expressed in a finite number of steps leading to a specify goal. Each step must be clearly defined. If the steps in the solution cannot be precisely stated, the job cannot be done. This is why the computer may not be helpful to people in areas where subjective evaluations are important. For example, it may not be able to tell a sales manager if a new product will be successful. The market decision may hinge on educated guesses about future social, political, technological and economic changes. But the computer can tell the manager how the product will fare under assumed price, cost, and sales volume conditions. These assumed values could be fed into the computer. An analysis program can then manipulate them in response to a series of "what if" questions to project the effects that the manager's questions will have on profits.

Even if program steps are finite and understood, there are still some tasks whose execution could take millions of years, even on a supercomputer. Joseph Weizenbaum, a computer scientist at MIT observed that a program could be written to try every legal chess move in a given situation. Every response to a move could then be evaluated, and the subsequent moves and countermoves could all be identified until the computer found a move, which, if suitably pursued, would guarantee a win. Weizenbaum notes that this program would certainly be finite, but the time needed to execute it would be unimaginably large. Although in principle the computer could do the job, in practice it cannot. The term **combinatorial explosion** is used for this type of problem where a finite number of steps generate an impossibly large number of computer operations.

1.4 COMPONENTS OF A COMPUTER SYSTEM- CPU

The hardware are the parts of computer itself including the Central Processing Unit (CPU) and related microchips and micro-circuitry, keyboards, monitors, case and drives (floppy, hard, CD, DVD, optical, tape, etc.) Other extra parts called peripheral components or devices include mouse, printers, modems, scanners, digital cameras and cards (sound, colour, video) etc... Together they are often referred to as a personal computers or PCs.

The schematic diagram of a computer is given below :

Fig. 1.4.1 Processor of Computer

We will now briefly discuss each of the above components.

1.4.1 Central Processing Unit: The Central Processing Unit (CPU)—also known as the processor—is the heart, soul and brain of the computer. In a microcomputer, the entire CPU is contained on a tiny chip called a microprocessor. Though the term relates to a specific chip or the processor a CPU's performance is determined by the rest of the computer's circuitry and chips. Currently the Pentium chip or processor, made by Intel, is the most common CPU though there are many other companies that produce processors for personal computers. One example is the CPU made by Motorola which is used in Apple computers. It is the most important component on the system's motherboard. The processor computes and processes data and delivers the results based on the instructions that are fed to the PC. Every CPU has at least two basic parts, the control unit and the arithmetic logic unit.

(i) The Control Unit

All the computer's resources are managed from the control unit. One can think of the control unit as a traffic cop directing the flow of data. It is the logical hub of the computer.

The CPU's instructions for carrying out commands are built into the control unit. The instructions, or instruction set, list all the operations that the CPU can perform. Each instruction in the instruction set is expressed in microcode- a series of basic directions that tell the CPU how to execute more complex operations. Before a program can be executed, every command in it must be broken down into instructions that correspond to the ones in the CPU's instruction set. When the program is executed, the CPU carries out the instructions, in order, by converting them into microcode. Although the process is complex, the computer can accomplish it at an incredible speed, translating millions of instructions every second.

Different CPUs have different instruction sets. Manufacturers, however, tend to group their CPUs into "families" that have similar instruction sets. Usually, when a new CPU is developed, the instruction set has all the same commands as its predecessor plus some new ones. This allows software written for a particular CPU to work on computers with newer processors of the same family – a design strategy known as **upward compatibility**. Upward compatibility saves consumers from having to buy a whole new system every time a part of their existing system is upgraded. The reverse is also true. When a new hardware device or piece of software can interact with all the same equipment and software its predecessor could, it is said to have **downward**, or backward, compatibility.

(ii) The Arithmetic Logic Unit

Because computers store all the data as numbers, a lot of the processing that takes place involves comparing numbers or carrying out mathematical operations. In addition to establishing ordered sequences and changing those sequences, the computer can perform only two types of operations: arithmetic operations and logical operations. Arithmetic operations include addition, subtraction, multiplication, and division. Logical operations include comparisons, such as determining whether one number is equal to, greater than, or less than another number. Also, every logical operation has an opposite. For example, in addition to "equal to" there is "not equal operation has an opposite. For example, in addition to "equal to" there is "not equal to".

Some of the logical operations can be carried out on text data. For example, a word is required to be searched in a document, the CPU carries out a rapid succession of "equals" operations to find a match for the sequence of ASCII codes that make up the word being searched.

Many instructions carried out by the control unit involve simply moving data from one place to another – from memory to storage, from memory to the printer, and so forth. However, when the control unit encounters an instruction that involves arithmetic or logical operation, it passes that instruction to the second component of the CPU, the arithmetic logical unit, or ALU. The ALU includes a group of registers – high-speed memory locations built directly into the CPU that are used to hold the data currently being processed. For example, the control unit might load two numbers from memory into the registers in the ALU. Then, it might tell the ALU to divide the two numbers (an arithmetic operation) or to see whether the numbers are equal (a logical operation)

1.4.2 Various features of the Central Processing Unit : Over a period of time, the processor has evolved from slow 286s or 386s running at speeds as low as 20 MHz to present day Pentium III and IV running at a whooping 3 GHz (3000 MHz.) Now we take a closer look at the various features that the Central Processing Unit of a PC offers.

Clock Speed: The clock speed is the speed at which the processor executes instructions. Clock speed is measured in megahertz (MHz)—which is a million cycles per second. Therefore, a 450 MHz processor performs 450 million instructions per second. Higher the clock's speed, the faster the processor, the better the system performance. Also, some microprocessors are super scalar, which means that they can execute more than one instruction per clock cycle.

Cache: Processors incorporate their own internal cache memory. The cache acts as temporary memory and boosts processing power significantly. The cache that comes with the processor is called Level One (L1) cache. This cache runs at the processor's clock speeds, and therefore is very fast. The L1 cache is divided into 2 sections—one for data, the other for instructions. Generally, more the L1 cache, faster the processor.

Additionally, PCs also include a much slower secondary, or Level Two (L2) cache. This cache resides on the motherboard and delivers slower performance when compared with the L1 cache. To overcome this limitation, newer chips (Pentium II and Pentium III) house the L2 cache in a cartridge along with the CPU.

Architecture: The CPUs architecture determines the manner in which it processes data. New CPUs employ multi-staged pipelines for transmitting data. To ensure proper data flow through these lines, the CPU includes a kind of prediction and error correction mechanism.

Slot: Different processors use different sockets or slots to fit onto the motherboard. Based on the type of processors, there are two main types of slots for connecting to the motherboard—Socket 7 and Slot 1.

Socket 7 is a 321-pin socket for Pentium class CPUs—Pentium MMX, K5, and K6—ranging from 75 MHz to 200 MHz processors. However, the Pentium II/III CPUs use Slot 1 for connecting to the motherboard.

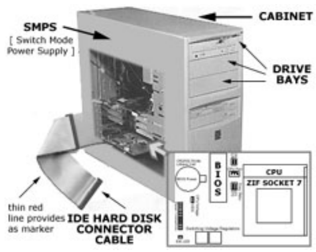


Fig 1.4.2.1 CPU

Instead of the usual manner in which a CPU fits onto the motherboard, Slot 1 CPUs fit onto the motherboard as a daughter card, allowing for faster communication between the CPU and the L2 cache.

Density: A CPU is made up of millions of small transistors. A CPU performs all the calculation and manipulation operations by synchronising between the transistors. Therefore, the shorter the distance between two transistors on a CPU, the faster the performance. Older CPUs had a distance of one micron between the transistors. But, newer CPUs have a distance as small as 0.35 micron between two transistors, delivering faster performance.

MMX: MMX stands for Multimedia Extensions—a set of instructions built in to the CPU, specifically intended for improving the performance of multimedia or graphic applications—mainly games. However, one needs to have applications specifically designed to take advantage of MMX.

CPU generates lots of heat when in operation. If the CPU is not cooled properly, then it might lead to all sort of errors, including system crashes. Therefore, the CPU is usually covered by a heat sink and a small cooling fan to dissipate the heat generated by the processor.

The microprocessor, is not made by the manufacturers of micro computers but by companies, such as Motorola and Intel, that specialise in the development and manufacture of microprocessors. All the Apple's Macintosh-series micros use Motorola chips : the Motorola 68000 in earlier models, the Motorola 68020 in the Machintosh II, and the Motorola 68030 in recent models. The system board for IBM Personal Computer uses Intel Processors.

When someone talks about a "286", "386", "486" or Pentium machine, he or she is referring to a micro that uses an Intel 80286, 80386, 80486 or Pentium chip.

1.4.3 Types of Microprocessors - Currently three classes of microprocessors are used for personal computers: 8-bit, 16-bit and 32-bit. Basically, an 8-bit machine can process 8-bits (1 character) of data at a time, and each instruction will be represented by an 8-bit code. A 16-bit machine can process two bytes (or 16 bits) of data at a time, and the number of instructions is increased over that 8-bit machine.

All the microprocessors use a bus-type design to transfer bits within the computer and to input/output devices. The electric path or lines that transfer these bits are called **buses**. An 8-bit machine usually has 8-data buses that transfer 8-bits at a time between components of a computer.

A personal computer transfers data to its I/O devices through input/output ports connected to a bus. A **port** is a hardware device that allows a series of bits to be transferred to a bus for data input or, inversely, the transfer of data from a bus to the port for data output.

The 8-bit personal computers were based on two types of 8-bit microprocessors viz 8080/Z80 and the 6502. The industry standard operating system CP/M ran on 8080/Z80, and therefore many personal computers including Zenith, Tandy, TRS80, Morrow, Northstar, etc. were based on this microprocessor. Apple II, and Commodore computers were based on the 6502 microprocessor, and each used its own proprietary operating system.

The 16-bit personal computers were based on two classes of microprocessors: the 8086/8088 (Intel) and MC 68000 (Motorola) The industry standard MS-DOS operating system for IBM -PC is built around the 8088 microprocessor. Apple's Macintosh is built around the MC 68000 as is the AT&T UNIX PC. IBM AT used Intel 80286 microprocessor. Most of the PCs made during the 1980s had 16-bit processors. The 16-bit systems have provided many sophisticated functions such as colour graphics, database features etc. once limited to mini computers.

Personal computers based on the Intel 80386 and 80486 DX, SX are 32-bit processors and can process four 8-bit bytes at a time. The 32-bits microprocessors have tied the personal computers into more sophisticated information handling functions. The 386 processor used a new mode of operation called virtual 86 mode. This allowed operating systems such as Unix and OS/2, and special programs such as Microsoft Windows, to run several DOS programs at the same time. This feature is specially important for DOS-based control programs such as Microsoft Windows, because it allows software to simulate multitasking with DOS operating system which otherwise cannot perform true multitasking.

The 486 processor combined a 386 DX processor, a maths coprocessor and a cache memory controller onto a single chip. This increased the speed of the processor drastically. The SX versions of Intel chips, such as the 386SX and 486SX, are less expensive and less powerful than the processors upon which they are based.

For the moment, the most powerful member of the Intel family of microprocessors is the Pentium. With the Pentium processor, Intel broke its tradition of numeric model names. The speed and powers of the Pentium dwarf those of all its predecessors in the Intel family. The 486 has approximately 1.2 million transistors, the Pentium has over 3 million and can process 100 million instructions to 200 million instructions per second.

Introduced in 1993, the Pentium processor allowed computers to more easily incorporate "real world" data such as speech, sound, handwriting and photographic images. The name Pentium, mentioned in the comics and on television talk shows, became a household word soon after introduction.

Released in the fall of 1995 the Pentium Pro processor is designed to fuel 32-bit server and workstation-level applications, enabling fast computer-aided design, mechanical engineering and scientific computation. Each Pentium Pro processor is packaged together with a second speed-enhancing cache memory chip. The powerful Pentium pro processor boasts 5.5 million transistors.

The 7.5 million-transistor Pentium II processor launched in 1997 incorporates Intel MMX technology, which is designed specifically to process video, audio and graphics data efficiently. It was introduced in innovative Single Edge Contact (S.E.C) Cartridge that also incorporated a high-speed cache memory chip. With this chip, PC users can capture, edit and share digital photos with friends and family via the Internet; edit and add text, music or between-scene transitions to home movies; and, with a video phone, send video over standard phone lines and the Internet.

In 1998, Intel introduced Pentium II Xeon processors designed to meet the performance requirements of mid-range and higher servers and workstations. Consistent with Intel's strategy to deliver unique processor products targeted for specific markets segments, the Pentium II Xeon processors feature technical innovations specifically designed for workstations and servers that utilize demanding business applications such as Internet services, corporate data warehousing, digital content creation, and electronic and mechanical design automation. Systems based on the processor can be configured to scale to four or eight processors and beyond.

Continuing Intel's strategy of developing processors for specific market segments, the Intel Celeron processor (1999) is designed for the Value PC market segment. It provides consumers great performance at an exceptional value, and it delivers excellent performance for uses such as gaming and educational software.

The Pentium III processor (1999) features 70 new instructions—Internet Streaming SIMD extensions— that dramatically enhance the performance of advanced imaging, 3-D, streaming audio, video and speech recognition applications. It was designed to significantly enhance Internet experiences, allowing users to do such things as browse through realistic online museums and stores and download high-quality video. The processor incorporates 9.5 million transistors, and was introduced using 0.25-micron technology.

The Pentium III Xeon processor (1999) extends Intel's offerings to the workstation and server market segments, providing additional performance for e-Commerce applications and advanced business computing. The processors incorporate the Pentium III processor's 70 SIMD instructions, which enhance multimedia and streaming video applications. The Pentium III Xeon processor's advance cache technology speeds information from the system bus to the processor, significantly boosting performance. It is designed for systems with multiprocessor configurations.

The Intel Pentium 4 Processor is designed to deliver performance across usages—such as image processing, video content creation, games and multimedia—where end-users can truly appreciate the performance. With a PC based on the Intel Pentium 4 Processor with HT

Technology, one gets advanced performance and multitasking capabilities for today's digital home and digital office applications. Hyper-threading enables multi-threaded software applications to execute two software threads in parallel, thereby improving system responsiveness. Intel Pentium 4 Processors enabled with HT Technology deliver performance and multitasking gains that result in increased productivity and efficiency. It allows the operating system to adjust the processor clock down when running applications that require less power. Increased power efficiency brings savings.

Intel Extended Memory 64 Technology can improve performance by allowing the system to address more than 4 GB of both virtual and physical memory. Intel EM64T also provides support for 64 bit computing to help handle the applications of tomorrow.

1.4.4 Processor Speed - As mentioned earlier, a crystal oscillator paces the execution of instructions within the processor of a microcomputer. A micro’s processor speed is rated by its frequency of oscillation, or the number of clock cycles per second. Earlier personal computers rated between 5 and 50 megahertz, or MHz (millions of clock cycles) . Normally several clock cycles are required to retrieve, decode, and execute a single program instruction. The shorter the clock cycle, the faster the processor.

To properly evaluate the processing capability of a micro, one must consider both the processor speed and the word length. A 32-bit micro with a 25 - MHz processor has more processing capability than a 16-bit micro with a 25 - MHz processor.

The Pentium II processors can process in the range of 233 MHz to 300 MHz. The latest Pentium-III and Pentium 4 processors can run at a speed of 2.1 GHz and even higher.

1.5 MOTHERBOARDS

The motherboard or the system board is the main circuit board on the computer. It acts as a direct channel for the various components to interact and communicate with each other. There are various types of motherboards available (depending on the processors that are used) We now provide with an overview of the system motherboard, and about the various components that fit on it.

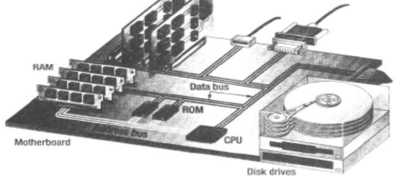


Fig. 1.5.1 Motherboard

1.5.1 Processor slot: The processor slot houses the processor. Based on the type of processors used, there are two main types of slots—Socket-7 and Slot-1.

BIOS: BIOS stands for Basic Input Output System—a small chip on the motherboard that loads the hardware settings required to load various devices like keyboards, monitors, or disk drives. Most new PCs come with a Flash BIOS—these BIOS can be software upgraded to support new devices.

CMOS: The PC uses the CMOS memory to store the date, time and system setup parameters. These parameters are loaded every time the computer is started. A small Lithium Ion battery located on the motherboard powers the CMOS as well as the BIOS.

Power supply connectors: The power supply connectors allow the user to connect the power supply unit to the motherboard and provide power for the functioning of the various components that fit on to the motherboard.

1.5.2 Expansion Slots and Boards : PCs are designed so that users can adapt, or configure the machines to their own particular needs. PC motherboards have two or more expansion slots, which are extensions of the computer's bus that provide a way to add new components to the computer. The slots accept circuit board, also called cards, adapters, or sometimes-just boards. Modern notebook computers are too small to accept the same type of cards that fit into desktop models. Instead, new components for notebooks come in the form of PC cards, small devices – about the size of credit cards – that fit into a slot on the back or side of the notebook. Figure –1.5.2.1 shows a PC expansion board being installed. The board is attached to the motherboard – the main system board to which the CPU, memory, and other components are attached.

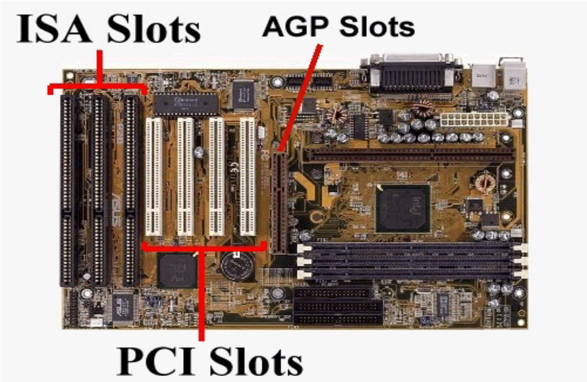


Fig. 1.5.2.1 : Expansion Slots

The expansion slots on the motherboard are used for three purposes:

1. To give built –in devices such as hard disks and diskette drives access to the computer's bus via controller cards.
2. To provide I/O (input/output) ports on the back of the computer for external devices such as monitors, external modems, printers, and the mouse (for computers that do not have a built-in mouse port)
3. To give special-purpose devices access to the computer. For example, a computer can be enhanced with an accelerator card, a self contained device that enhances processing speed through access to the computer'' CPU and memory by way of the bus.

The first and second of these are input/output (I/O) functions. Adapters that serve these purposes provide a port to which devices can be attached and serve as a translator between the bus and the device itself. Some adapters also do a significant amount of data processing. For example, a video controller is a card that provides a port on the back of the PC into which one can plug the monitor. It also contains and manages the video memory and does the processing required to display images on the monitor. Other I/O devices that commonly require the installation of a card into an expansion slot include sound cards, internal modems or fax/modems, network interface cards, and scanners. The third type, the accelerator cards, are often installed to speed up the CPU or the display of video. Some of the slots and connectors are briefly discussed below:

SIMM/DIMM slots: SIMM stands for Single Inline Memory Modules, while DIMM stands for Dual Inline Memory Module. SIMM/DIMM slots are used to house RAM modules.

PCI slots: The PCI (Peripheral Component Interface) slots are used for connecting PCI-based devices like graphics accelerator cards, sound cards, internal modems or SCSI cards.

AGP slot: All Celeron and Pentium-III motherboards come with an AGP (Accelerated Graphics Port) slot. AGP is a dedicated slot meant to provide faster access to AGP-based graphic accelerator cards, thus enhancing the visual experience for the user.

SCSI : It is a device interface that is used to solve the problem of a finite and possibly insufficient number of expansion slots. It is called *small computer system interface (SCSI pronounced "scuzzy")* Instead of plugging interface cards into the computer's bus via the expansion slots, SCSI extends the bus outside the computer by way of a cable. In other words, SCSI is like an extension cord for computer bus. IBM developed SCSI in 1970s. The current standard is SCSI - 3, which allows upto seven devices to be chained on a single SCSI port. Now-a-days many devices support the SCSI interface. Fast, high-speed hard disk drives often have SCSI interfaces, so do scanners, tape drives and optical storage devices.

1.5.3 Cards: Cards are components added to computers to increase their capability. When adding a peripheral device one should ensure that the computer has a slot of the type needed by the device. **Sound cards** allow computers to produce sound like music and voice. The older sound cards were 8 bit then 16 bit then 32 bit. Though human ear can't distinguish the fine difference between sounds produced by the more powerful sound card they allow for more complex music and music production. Colour cards allow computers to produce colour (with a colour monitor of course) The first colour cards were 2 bit which produced 4 colours [CGA]. It was amazing what could be done with those 4 colours. Next came 4 bit allowing for 16 [EGA and VGA] colours Then came 16 bit allowing for 1064 colours and then 24 bit which allows for almost 17 million colours and now 32 bit is standard allowing monitors to display almost a billion separate colours. **Video cards** allow computers to display video and animation. Some video cards allow computers to display television as well as capture frames from video. A video card with a digital video camera allows computers users to produce live video. A high speed or network connection is needed for effective video transmission. **Network cards** allow computers to connect together to communicate with each other. Network cards have connections for cable, thin wire or wireless networks.

1.5.4 Ports and connectors : Ports and connectors let the user connect external devices like printers, keyboards or scanners and let them interface with the PC. The physical interfaces for the ports and connectors are located on the outside—typically at the back of the PC, but they are directly or indirectly (using a connector card) connected to the motherboard. There are various types of ports or connectors, each providing different data transfer speeds to connect various external peripherals.

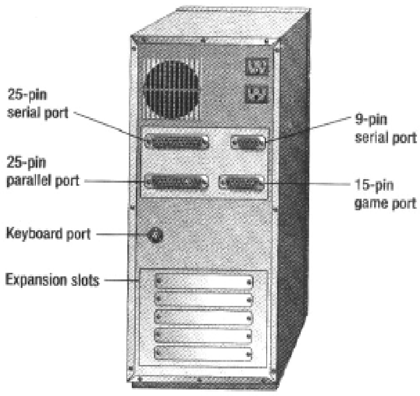


Fig. 1.5.4.1 (Ports and Connectors)

Parallel ports: Parallel ports are used to connect external input/output de dvices like scanners or printers. Parallel ports facilitate the parallel transmission of data, usually one byte (8 bits) at a time. Parallel ports use 25 pin RS-232C.

Com/Serial ports: They are used for connecting communication devices like modems or other serial devices like mice. There are two varieties of Com ports—the 9-pin ports and 25-pin ports. Serial Ports facilitate the serial transmission of data, i.e. one bit at a time.

IDE drive connector: IDE devices like CD-ROM drives or hard disk drives are connected to the motherboard through the IDE connector.

Floppy drive connector: The floppy drive connectors are used for connecting the floppy drive to the motherboard, to facilitate data exchange.

USB connectors: USB stands for Universal Serial Bus. These ports provide the user with higher data transfer speeds for different USB devices like keyboards, mice, scanners or digital cameras.

PS/2 Connectors: PS/2 stands for Personal System/2. PS/2 connectors are used to connect PS/2 based input devices like PS/2 keyboards or mice.

In addition to the common components that are found on the motherboard, newer motherboards also come with integrated graphics accelerator cards or sound cards-there is no need to install a separate card to get the work done.

1.5.5 The bus : If one takes a close look at the system motherboard, one will notice a maze of golden electric circuits etched on both sides of the motherboard. This very maze of circuits etched on the motherboard forms the bus of the PC. A bus acts as the system's expressway - it transmits data between the various components on the motherboard. Theoretically, a bus is a collection of wires through which data is transmitted between the various components of a PC. A bus connects the various components of the PC with the CPU and the main memory (RAM) Logically, a bus consists of two parts—an address bus and a data bus.

The Data Bus : The Data Bus is an electrical path that connects the CPU, memory, and the other hardware devices on the motherboard. Actually, the bus is a group of parallel wires. The number of wires in the bus affects the speed at which data can travel between hardware components, just as the number of lanes on a highway affects how long it takes people to get to their destinations. Because each wire can transfer one bit at a time, an eight-wire bus can move eight bits at a time, which is a full byte. A 16-bit bus can transfer two bytes, and a 32-bit bus can transfer four bytes at a time.

PC buses are designed to match the capabilities of the devices attached to them. When CPUs could send and receive only one byte of data at a time, there was no point in connecting them to a bus that could move more data. As microprocessor technology improved, however, chips were built that could send and receive more data at once, and improved bus designs created wider paths through which the data could flow.

When IBM introduced the PC-AT in 1984, the most dramatic improvement was an enhanced data bus that was matched with the capabilities of a new microprocessor, the Intel 80286. The data bus of the AT was 16 bits wide and became the de facto standard in the industry. It is still used for PC devices that do not require more than a 16 -bit bus. The AT bus is commonly known as the Industry Standard Architecture, or ISA, bus.

Two years later, however, when the first 80386 chips (commonly abbreviated as the 386) began shipping, a new standard was needed for the 386's 32-bit bus. The first contender was Micro Channel Architecture, or the MCA bus, from IBM. Then came the Extended Industry Standard Architecture (EISA) bus from a consortium of hardware developers who opposed IBM's new standard because it was not backward compatible. The winner of the bus wars was neither MCA nor EISA. It was the Peripheral Component Interconnect, or PCI, bus. Intel designed the PCI bus specifically to make it easier to integrate new data types, such as audio, video, and graphics.

The Address Bus : The second bus that is found in every microcomputer is the address bus. The address bus is a set of wires similar to the data bus that connects the CPU and RAM and carries the memory addresses. (Remember, each byte in RAM is associated with a number, which is the memory address)

The reason the address bus is important is that the number of wires in it determines the maximum number of memory addresses. For example, recall that one byte of data is enough to represent 256 different values. If the address bus could carry only eight bits at a time, the CPU could address only 256 bytes of RAM. Actually, most of the early PCs had 20-bit address buses, so the CPU could address 220 bytes, or 1 MB, of data. Today, most CPUs have 32-bit address buses that can address 4 GB (over 4 million bytes) of RAM. Some of the latest models can address even more.

One of the biggest hurdles in the evolution of PCs was that DOS, the operating system used in the vast majority of PCs for more than a decade, was designed for machines that could address only 1 MB of RAM. When PCs began to contain more RAM, special software had to be devised to address it. Programmers came up with two devices called expanded memory and extended memory. Windows 95 largely did away with these, although extended memory still exists in the operating system for purposes of backward compatibility.

1.6 STORAGE DEVICES

The CPU contains the basic instructions needed to operate the computer, but it does not have the capability to store programs or large sets of data permanently. Just like the human brain, which helps to determine what to do and when, computers need blocks of space that it can address from time to time to help in processing arithmetical and logical operations and also hold programs and data being manipulated. This area is called memory or storage.

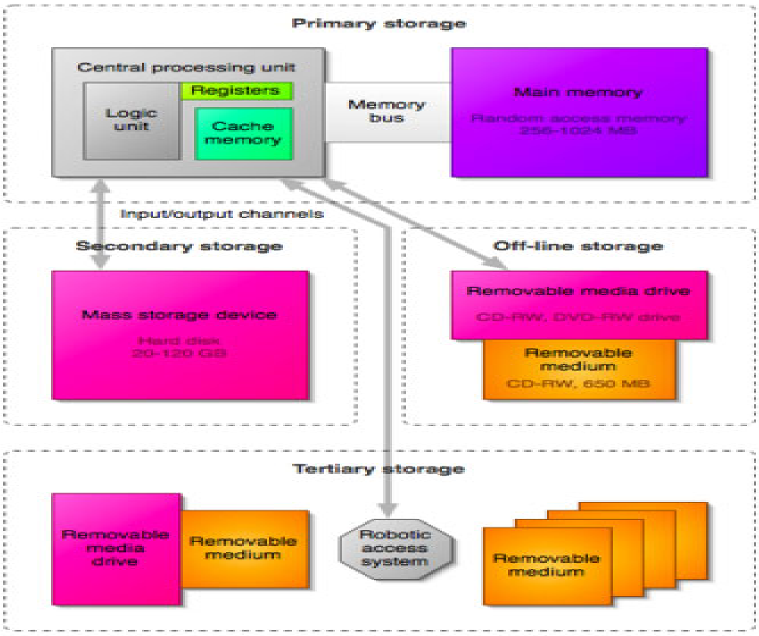


Fig. 1.6.1 Types of Storage

1.6.1 Types of storage : Various forms of storage, based on various natural phenomenon, have been invented. So far, no practical universal storage medium exists, and all forms of storage have some drawbacks. Therefore a computer system usually contains several kinds of storage, each with an individual purpose, as shown in Fig. 1.6.1.

(i) *Primary storage* : Primary storage is directly connected to the central processing unit of the computer. It must be present for the CPU to function correctly, just as in a biological analogy the lungs must be present (for oxygen storage) for the heart to function (to pump and oygenate the blood) As shown in the fifure, primary storage typically consists of three kinds of storage:

Processor registers are internal to the central processing unit. Registers contain information that the arithmetic and logic unit needs to carry out the current instruction. They are technically the fastest of all forms of computer storage, being switching transistors integrated on the CPU's silicon chip, and functioning as electronic "flip-flops".

Main memory contains the programs that are currently being run and the data on which the programs are operating. The arithmetic and logic unit can very quickly transfer information between a processor register and locations in main storage, also known as a "memory addresses". In modern computers, electronic solid-state random access memory is used for main storage, and is directly connected to the CPU via a "memory bus" (shown in the diagram) and a "data bus". The memory bus is also called an address bus or front side bus and both buses are high-speed digital "superhighways". Access methods and speed are two of the fundamental technical differences between memory and mass storage devices. (Note that all memory sizes and storage capacities shown in the diagram will inevitably be exceeded with advances in technology over time)

Fig 1.6.1.1 : Main Memory

Cache memory is a special type of internal memory used by many central processing units to increase their performance or "throughput". Some of the information in the main memory is duplicated in the cache memory, which is slightly slower but of much greater capacity than the processor registers, and faster but much smaller than main memory. Multi-level cache memory is also commonly used - "primary cache" being smallest, fastest and closest to the processing device; "secondary cache" being larger and slower, but still faster and much smaller than main memory.

(ii) *Secondary, tertiary and off-line storage :* **Secondary storage** requires the computer to use its **input/output** channels to access the information, and is used for long-term storage of persistent information. Nowadays most computer **operating systems** also use secondary storage devices as **virtual memory** - to artificially increase the apparent amount of main memory in the computer. Secondary storage is also known as "mass storage", as shown in the **figure 1.6.1**. Secondary or mass storage is typically of much greater capacity than primary storage (main memory), but it is also very much slower. In modern computers, **hard disks** are usually used for mass storage. The time taken to access a given byte of information stored on a hard disk is typically a few thousandths of a second, or milliseconds. By contrast, the time taken to access a given byte of information stored in random access memory is measured in thousand-millionths of a second, or nanoseconds. This illustrates the very significant speed difference which distinguishes solid-state memory from rotating magnetic storage devices: hard disks are typically about a million times slower than memory. Rotating optical storage devices (such as CD and DVD drives) are typically even slower than hard disks, although their access speeds are likely to improve with advances in technology. Therefore the use of virtual memory, which is about million times slower than "real" memory, significantly degrades the performance of any computer.

Tertiary storage is a system where a robotic arm will "mount" (connect) or "dismount" off-line mass storage media (see the next item) according to the computer operating system's demands. Tertiary storage is used in the realms of enterprise storage and scientific computing on large computer systems and business computer networks, and is something a typical personal computer user never sees firsthand.

Off-line storage is a system where the storage medium can be easily removed from the storage device. Off-line storage is used for data transfer and archival purposes. In modern computers, floppy disks, optical discs and flash memory devices including "USB drives" are commonly used for off-line mass storage purposes. "Hot-pluggable" USB hard disks are also available. Off-line storage devices used in the past include magnetic tapes in many different sizes and formats, and removeable Winchester disk /drums.

(iii) *Network storage :* Network storage is any type of computer storage that involves accessing information over a **computer network**. Network storage arguably allows to centralize the **information management** in an organization, and to reduce the duplication of information. Network storage includes:

Network-attached storage is secondary or tertiary storage attached to a computer which another computer can access over a local-area network, a private wide-area network, or in the case of online file storage, over the Internet.

Network computers are computers that do not contain internal secondary storage devices. Instead, documents and other data are stored on a network-attached storage.

1.6.2 Characteristics of storage : The division to primary, secondary, tertiary and off-line storage is based on **memory hierarchy**, or *distance from the central processing unit*. There are also other ways to characterize various types of storage.

(i) Volatility of information

Volatile memory requires constant power to maintain the stored information. Volatile memory is typically used only for primary storage.

Non-volatile memory will retain the stored information even if it is not constantly supplied with electric power. It is suitable for long-term storage of information, and therefore used for secondary, tertiary, and off-line storage.

Dynamic memory is volatile memory which also requires that stored information is periodically *refreshed*, or read and rewritten without modifications.

(ii) Ability to access non-contiguous information

Random access means that any location in storage can be accessed at any moment in the same, usually small, amount of time. This makes random access memory well suited for primary storage.

Sequential access means that the accessing a piece of information will take a varying amount of time, depending on which piece of information was accessed last. The device may need to *seek* (e.g. to position the read/write head correctly), or *cycle* (e.g. to wait for the correct location in a constantly revolving medium to appear below the read/write head)

(iii) Ability to change information

Read/write storage, or **mutable storage**, allows information to be overwritten at any time. A computer without some amount of read/write storage for primary storage purposes would be useless for many tasks. Modern computers typically use read/write storage also for secondary storage.

Read only storage retains the information stored at the time of manufacture, and **write once storage** (WORM) allows the information to be written only once at some point after manufacture. These are called **immutable storage**. Immutable storage is used for tertiary and off-line storage. Examples include CD-R.

Slow write, fast read storage is read/write storage which allows information to be overwritten multiple times, but with the write operation being much slower than the read operation. Examples include CD-RW.

(iv) Addressability of information

In **location-addressable storage**, each individually accessible unit of information in storage is selected with its numerical memory address. In modern computers, location-addressable storage usually limits to primary storage, accessed internally by computer programs, since location-addressability is very efficient, but burdensome for humans.

In **file system storage**, information is divided into *files* of variable length, and a particular file is selected with human-readable directory and file names. The underlying device is still location-addressable, but the operating system of a computer provides the file system abstraction to make the operation more understandable. In modern computers, secondary, tertiary and off-line storage use file systems.

In **content-addressable storage**, each individually accessible unit of information is selected with a hash value, or a short identifier with no pertaining to the memory address the information is stored on. Content-addressable storage can be implemented using software (computer program) or hardware (computer device), with hardware being faster but more expensive option.

(v) Capacity and performance

Storage capacity is the total amount of stored information that a storage device or medium can hold. It is expressed as a quantity of bits or bytes (e.g. 10.4 megabytes)

Storage density refers to the compactness of stored information. It is the storage capacity of a medium divided with a unit of length, area or volume (e.g. 1.2 megabytes per square centimeter)

Latency is the time it takes to access a particular location in storage. The relevant is typically nanosecond for primary storage, millisecond for secondary storage, and second for tertiary storage. It may make sense to separate *read latency* and *write latency*, and in case of sequential access storage, *minimum*, *maximum* and *average latency*.

Throughput is the rate at which information can read from or written to the storage. In computer storage, throughput is usually expressed in terms of *megabytes per second* or *MB/s*, though bit rate may also be used. As with latency, *read rate* and *write rate* may need to be differentiated.

1.6.3 Primary Storage

(a) Semi-conductor memories or integrated circuits : As they are often called, are based on the principle of storage chips. The very thin silicon chip contains a number of small storage cells that can hold data. Instead of being made up of a series of discrete components, these units are constructed as integrated circuits, meaning that a number of transistors are integrated or combined together on a thin silicon wafer to form a complete set of circuits. The faster and more expensive bipolar semi conductor chips are often used in the arithmetic-logic unit and high-speed buffer storage sections of the CPU, while the slower and less expensive chips that employ metal-oxide semi-conductor (MOS) technology are used in the main memory section.

Both *volatile* and *non-volatile* forms of semiconductor memory exist. In modern computers, primary storage almost exclusively consists of dynamic volatile semiconductor memory or dynamic random access memory. A back-up uninterruptible power system is thus desirable in installations with volatile semi-conductor storage. In spite of the volatile storage characteristic, these memory chips have found their way into the newer model of most computers due to several very good reasons.

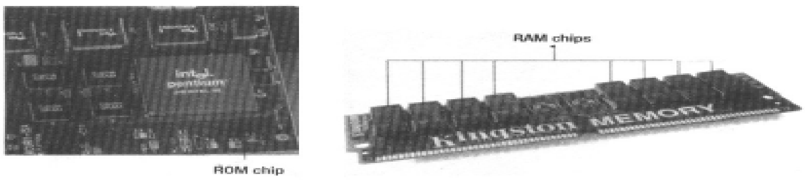


Fig. 1.6.3.1 RAM Chips

(ii) Random-Access-Memory (RAM) : The memory system constructed with metal-oxide semi conductor storage elements that can be changed is called a random access memory (RAM) When people talk about computer memory in connection with microcomputer, they usually mean the volatile RAM memory. The purpose of RAM is to hold programs and data while they are in use. It is called random access memory since access time in RAM is independents of the address of the word, that is, each storage location (address) inside the memory is as easy to reach as any other location and takes the same amount of time. One can reach into the memory at random and insert or remove numbers in any location at any time. A random access memory is extremely fast but can also be quite expensive.

RAMs can be further divided according to the way in which the data is stored, into dynamic RAMs and static RAMs. The computer designer's decision which to use where depends on what their function is to be, and on their speed and cost.

Dynamic RAM: Dynamic RAM (DRAM) is the most common type of main memory. It is dynamic because each memory cell quickly loses its charge so it must be refreshed hundreds of times each second to prevent data from being lost. Here are some of the types of DRAM that have been or will be popular in most desktop systems (listed from oldest to newest):

– Fast Page Mode (FPM) DRAM was used in most computers until EDO RAM came along.

– Extended Data Out (EDO) DRAM is slightly faster than FPM. One variation called burst EDO (BEDO) DRAM assumes that the next data - address to be requested by the CPU follows the current one so it sends that also.

– Synchronous DRAM (SDRAM) can synchronize itself with the clock that controls the CPU. This makes data transfers more reliable and faster because timing delays are eliminated. It is anticipated that this form of memory will replace EDO as the most common form of memory.

– Rambus DRAM (RDRAM) is the latest design and Intel has announced that all of their future systems will require it. RDRAM is very fast, but the system must be slightly redesigned to use it. RDRAM sends data down a high-band width "channel" 10 times faster than standard DRAM.

Static RAM: Static RAM (SRAM) is like DRAM but it's a lot faster, larger, and more expensive. It's static because it doesn't need to be continually refreshed. Because of its speed, SRAM is used mainly in a special area of memory called a cache.

The Static RAM retains the stored data as long as the power remains in, whereas with dynamic RAM, the stored information disappears after a few milliseconds have elapsed. The data must, therefore be repeatedly refreshed before it disappears. The power consumption of a dynamic RAM is less than that of a static RAM, which has the advantage of making a higher degree of integration possible. The computer does the refreshing process itself, taking time out from other chores every few milliseconds. It will read all the RAM memory positions while they are still readable and put appropriate new charge on each capacitor. Some dynamic RAM memory circuits include built-in "refresh circuits" to relieve the computer.

(iii) Read-Only-Memory (ROM) : Another type of computer memory is the read-only-memory (ROM) It is used for microprograms not available to normal programmers. The term read-only means that the storage cannot be altered by regular program instructions. The information is stored permanently in such memory during manufacture. The information from the memory may be read out but fresh information cannot be written into it. The microprograms in read-only-memory may be used for a variety of purposes, but a common use is to hold a set of instructions that are needed frequently, for executing small, extremely basic operations, which are not otherwise available in the computer circuitry. One set of instructions found in ROM is called the ROM-BIOS which stands for Read-only Memory Basic Input Output services. These programs perform the basic control and supervisory operations for the computer. For example, it ensures that if a user pressed 'one' on the keyboard, the digit 1 appears on the, screen. ROM may be used for code converter, function generator (e.g. sine, consine, Arctangent etc.) and character generators (e.g. characters displayed in dot matrix form) It also handles the basic needs of the hardware involved, which include all I/O devices.

PROM: Programmable Read Only Memory is a non-volatile memory which allows the user to program the chip with a PROM write. The chip can be programmed once, there after, it can not be altered.

EPROM: EPROM stands for Erasable Programmable Read Only Memory. EPROM chips can be electrically programmed. Unlike ROM and PROM chips, EPROM chips can be erased and reprogrammed. Erasure is performed by exposing the chip to Ultra-violet light.

EEPROM: Electrically Erasable Programmable Read Only Memory is EPROM. However, the data can be erased by applying electrical charges.

(iv) Bubble Memory : Bubble memory is composed of small magnetic domains (bubbles) formed on a thin single-crystal film of synthetic garnet. These magnetic bubbles, which are actually magnetically charged cylinders, only a few thousandths of a centimeter in size, can be moved across the garnet film by electric charges. The presence or absence of a bubble can be used to indicate whether a bit is "on" or "off".

Since data stored in bubble memory is retained when power to the memory is turned off, it can be used for auxiliary storage. Bubble memory has high potential because of its low production costs and its direct access capabilities, thus it may become widely employed as a main memory technology. Since it is small, lightweight, and does not use very much power, bubble memory is finding a great deal of use as an auxiliary storage in portable computers. It is expected that as more portable computers are developed, bubble memory will become more widely used.

(v) Flash memory: Flash memory chips are one of the latest storage devices. These chips, a form of static RAM (SRAM) chips, store data much like those used in the computer's primary storage. However, the data stays recorded even when the power is turned off-flash memory is non-volatile. Since flash memory devices have no moving parts, and are therefore very fast, they may eventually replace slower, mechanical hard disk drives.

(vi) Video RAM: Video RAM (VRAM) is used to accelerate the display of graphics on the screen. It does this by using two "ports," one connected to the CPU and the other to the screen. Data flows in one port and out the other very smoothly. A variation of this is Window RAM (WRAM) that supports memory.

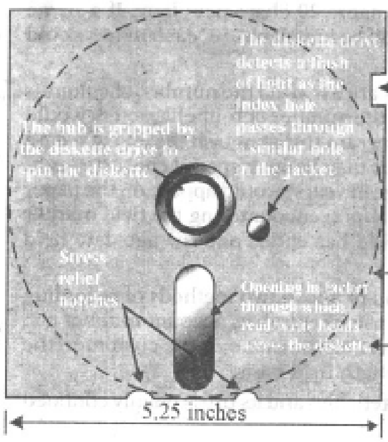
1.7 SECONDARY STORAGE DEVICES

As discussed in section 1.6.1, there are different types of computer storage. Primary storage is built into the CPU whereas secondary storage or auxiliary storage is usually housed in a separate unit or units. Primary storage is very fast-its contents can be accessed in millionth or billionths of a second. But primary storage has a limited capacity. Although the cost per byte has continued to decrease, there is not enough capacity to store all of firms' files. Secondary storage supplements the capacity of primary storage. Secondary storage has an almost infinite capacity measured in millions and billions of bytes. Some secondary storage media (such as magnetic storage) offer direct access to data whereas tape devices offer sequential access. The access speed of secondary storage is slower than that of primary storage. It may be noted that these auxiliary storage media such as floppy disk, magnetic disk etc. can be used for both input and output purpose. We will now discuss these auxiliary storage media and devices.

1.7.1 FLOPPY DISKETTES

In the early 1970's IBM introduced a new medium for storing data. This medium consisted of a circular piece of thin plastic material, approximately eight inches in diameter, that was coated with an oxide material. The circular piece of plastic, called a disk, is enclosed in a square protective jacket with a cut out so that the magnetic surface is exposed. When inserted in the appropriate hardware device, the disk is rotated inside the protective jacket, allowing keyed data or data from main computer memory to be stored on the rotating disk. Once data is stored on the disk, it can be read from the disk into main computer. This medium for input and auxiliary storage is called *a floppy disk or diskette* (*see* figure 1.7.1.1 and 1.7.1.2)

Diskettes are available in a number of different sizes. The original diskette was of the size of 8 inches. During the 1980, most PCs used 5.25-inch diskettes. Today, the 3.5-inch diskette has largely replaced its 5.25-inch cousin. The size refers to the diameter of the disk, not to the capacity.



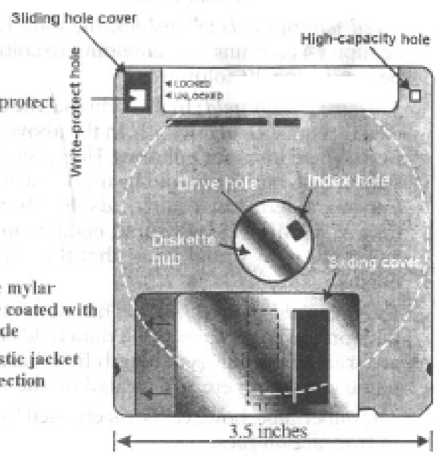


Fig. 1.7.1.1 5.25" Floppy **Fig. 1.7.1.2 3.5" Floppy**

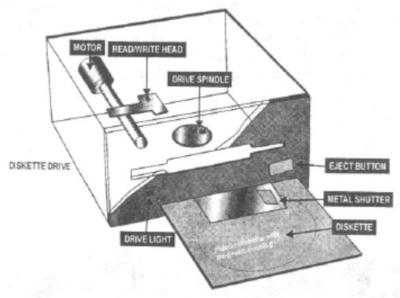


Fig. 1.7.1.3 Floppy Drive

The 5.25-inch type diskette is encased in a flexible vinyl envelope with an oval cutout that allows the read/write head to access the disk. The 3.5-inch type diskette is encased in a hard plastic shell with a sliding metal cover. When the disk is inserted into the drive, the cover slides back to expose the diskette to the read/write head.

The surfaces of diskettes (or disks/tapes discussed later) are coated with millions of tiny iron particles so that the data can be stored on them. Each of these particles can act as a magnet, taking on a magnetic field when subjected to an electromagnet. The read/write heads of a diskette drive (or a hard disk/ tape drive) contain electromagnets, which generate magnetic field in the iron on the storage medium as the head passes over the diskette (or disk or tape)

The diskette drive (Fig. 1.7.1.3) includes a motor that rotates the disk on a spindle and read/write heads that can move to any spot on the disk's surface as the disk spins. This capability is important, because it allows the heads to access data randomly, rather than sequentially. In other words, the heads can skip from one spot to another, without having to scan through everything in between.

Floppy diskettes spin at around 300 revolutions per minute. Therefore, the longest it can take to position a point on the diskette under the read/write heads is the amount of time required for one revolution -about 0.2 second. The farthest the head would ever have to move is from the centre of the diskette to the outside edge. The heads can move from the center to the outside edge in even less time - about 0.17 second. Since both operations (rotating the disk and moving the heads) take place simultaneously, the maximum time to position the heads over a given location on the diskette - known as the maximum access time remains the greater of the two times or 0.2 second.

1.7.1.1 How Data is organised on a disk : When the new diskettes (or a new hard drive) are purchased, the disks inside are nothing more than simple, coated disks encased in plastic. Before the computer can use them to store data, they must be magnetically mapped so that the computer can go directly to a specific point on the diskette without searching through data. The process of mapping a diskette is called **formatting** or **initializing**. Today, many diskettes come preformatted for either PCs or Macs. If unformatted diskettes are purchased, one must format them before they can be used. The computer will warn the user if this is the case, and will format the diskette for him if he wishes so.

The first thing a disk drive does when formatting a disk is to create a set of magnetic concentric circles called *tracks.* The number of tracks on a disk varies with the type (most high-density diskettes have 80) The tracks on a disk do not form a continuous spiral like those on a phonograph record - each one is a separate circle. Most tracks are numbered from the outermost circle to the innermost, starting from zero.

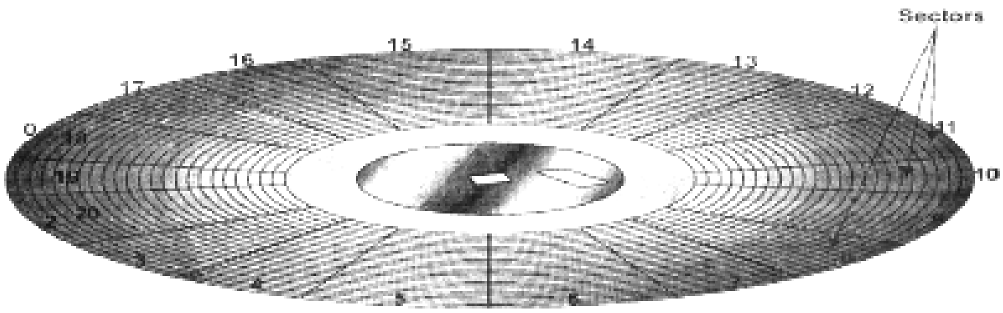


Fig. 1.7.1.1.1 Tracks & Sector

Each track on a disk is also split into smaller parts. Imagine slicing up a disk the way a pie is cut. As shown in Figure-1.7.1.1.1, each slice would cut across all the disk's tracks, resulting in short segments, or *sectors*. All the sectors on the disk are numbered in one long sequence, so the computer can access each small area on the disk with a unique number. This scheme effectively simplifies what would be a set of two-dimensional coordinates into a single numeric address.

When people refer to the number of sectors a disk has, the unit they use is sectors per track - not just sectors. If a diskette has 80 tracks and 18 sectors per track, it has 1440 sectors (80 × 18) - not 18 sectors.

Like any flat object, a disk has two sides. Some early drives could read data on only one side, but today, all disk drives can read and write data on both sides of a disk. To the computer, the second side is just a continuation of the sequence of sectors. For example, the 3.5 inch, 1.44-MB diskette has a total of 2880 sectors (80 tracks per side × 2 sides × 18 sectors per track)

On most diskettes, a sector contains 512 bytes, or 0.5 KB

A sector is the smallest unit with which any disk drive (diskette drive or hard drive) can work. Each bit and byte within a sector can have different values, but the drive can read or write only whole sector at a time. If the computer needs to change just one byte out of 512, it must rewrite the entire sector.

The number of characters that can be stored on a diskette by a disk drive is dependent on following three basic factors:

1 *The number of sides of the diskette used* : The earlier diskettes and drives were designed so that data could be recorded on only one side of the diskette. These drives

were called single-sided drives. Now-a-days diskette drives are manufactured that can read and write data on both sides of the diskette. Such drives are called *double-sided drives.* The use of double-sided drives and diskettes approximately doubles the number of characters that can be stored on the diskette.

2 *The recording density of the bits on a track* : The recording density refers to the number of bits that can be recorded on a diskette in one inch circumference of the innermost track on the diskette. This measurement is referred to as bits per inch (bpi) For the user, the diskettes are identified as being either *single density* (SD) or *double density (DD)* A single density drive can store 2,768 bits per inch on the innermost track. Double density can store 5,876 bits per inch. With improved technology, it is anticipated that recording densities in excess of 10,000 bits per inch will be possible.

3 *The number of tracks on the diskette* : The number of tracks is dependent upon the drive being used. Many drives record 40 tracks on the surface of the diskette. Other drives, however, can record 80 tracks on the diskette. These drives are sometimes called double track drives.

Table given below shows how the capacities of diskettes relate to the dimensions.

Table : Formatting specifications for various Disks

Diameter (inches)	**Sides**	**Tracks**	**Sectors/ Tracks**	**Sectors**	**Bytes/ Sector**	**Bytes**	**KB**	**MB**
5.25	2	40	9	720	512	368,640	360	.36
5.25	2	40	18	1440	512	737,280	720	1.2
3.5	2	80	15	2400	512	1,228,800	1,200	.7
3.5	2	80	18	2880	512	1,474,560	1,440	1.44
3.5	2	80	36	5760	512	2,949,150	2,880	2.88

Because files are not usually a size that is an even multiple of 512 bytes, some sectors contain unused space after the end of the file. In addition, the DOS and Windows operating systems allocate groups of sectors, called clusters, to each of the files they store on a disk. Cluster sizes vary, depending on the size and type of the disk, but they can range from 4 sectors for diskettes, to 64 sectors for some hard disks. A small file that contains only 50 bytes will use only a portion of the first sector of a cluster assigned to it, leaving the remainder of the first sector, and the remainder of the cluster, allocated but unused.

1.7.1.2 How the Operating System Finds Data on a Disk : A computer's operating system is able to locate data on a disk (diskette or hard drive) because each track and sector is labeled, and the location of all data is kept in a special log on the disk. The labeling of tracks and sectors is called performing a logical or soft format. A commonly used logical format performed by DOS or Windows creates these four disk areas:

The boot record

The file-allocation table (FAT)

The root folder or directory

The data area

The boot record: It is a small program that runs when the computer is started. This program determines whether the disk has the basic components of DOS or Windows that are necessary to run the operating system successfully. If it determines that the required files are present and the disk has a valid format, it transfers control to one of the operating system programs that continues the process of starting up. This process is called booting because the boot program makes the computer “pull itself up by its bootstraps.”

The boot record also describes other disk characteristics, such as the number of bytes per sector and the number of sectors per track. The information is required by the operating system to access the data area of the disk

The file-allocation table (FAT): It is a log that records the location of each file and the status of each sector. When a file is written to a disk, the operating system checks the FAT for an open area, stores the file, and then identifies the file and its location in the FAT.

The FAT solves a common filing problem: What happens when a user loads a file, increases it’s size by adding text to it, and then save it again? For example, say, one needs to add 5000 bytes to a 10,000-byte file that has no open space around it. The disk drive could move the surrounding files to make room for the 5000 bytes, but that would be time consuming. Instead, the operating system checks the FAT for free areas, and then places pointers in it that link together the nonadjacent parts of the file. In other words, it splits the file up by allocating new space for the overflow.

When the operating system saves a file in this way, the file becomes fragmented. Its parts are located in nonadjacent sectors. Fragmented files do cause undesirable side effects, the most significant being that it takes longer to save and load them.

Users do not normally need to see the information in the FAT, but they often use the folder information. A **folder**, also called a directory, is a tool for organizing files on a disk. Folders can contain files or other folders, so it is possible to set up a hierarchical system of folders on the computer, just as there are folders within other folders in a file cabinet. The top folder on any disk is known as the root. When the user uses the operating system to view the contents of a folder, the operating system lists specific information about each file in the folder, such as the file's name, its size, the time and date that it was created or last modified, and so on.

The part of the disk that remains free after the boot sector, FAT, and root folder have been created is called the data area because that is where the data files (or program files) are actually stored.

1.7.1.3 Care required in using and storing a diskette : On receiving a new diskette, it should be inspected for sign of obvious damage. The surface of the diskette should not be touched with hand or some sharp object. Write-protect precaution should be observed by peeling off or sticking on (as applicable) the aluminum square on the notch.

Correct insertion of disk in the disk drive is essential, otherwise some data stored on the disk is likely to be destroyed or the disk itself may get damaged. The diskette should be inserted slowly in the disk drive only when power to the entire computer system is on. It should be removed prior to turning the system off.

As a defensive measure, it is advisable that a back-up copy of the information stored on each diskette be prepared and stored separately at a safe location. The diskette should be properly labeled for right identification. While storing a diskette, both physical and environmental factors should be considered. Diskette should not be stored in such a way that may sag, slump or compress it. The main enemies of a diskette are temperature and direct sunlight, dust, liquids and vapors and electromagnetic interference. Diskette should be protected from them. Care should be taken to clean the disk drive head to remove dust regularly.

Floppy diskettes are very cheap and offer both sequential and direct access to data at a substantially high speed. Typically, data may be transferred at the rate of 30,000 to 1,50,000 bytes per second. Records and files on a flexible disk are organised and processed in the same way as with rigid disk systems.

Floppy disk drives are generally smaller and more economical to manufacture than rigid disk systems. That is why these are used as auxiliary storage and I/O media with mini and microcomputer installations. In Mainframes also, these are being used as input medium.

1.7.2 MAGNETIC DISC

Magnetic discs are the most popular *direct access medium.* By direct access we mean that a record can be accessed without having to plod through the preceding records. The other direct access medium is floppy disc (discussed earlier)

Although a shift toward optical technology is occurring, the hard disk is still the most common storage device for all computers. Much of what was discussed about floppy diskettes and disk drives apply to hard disks as well. Like diskettes, hard disks store data in tracks that are divided into sectors. Physically, however, hard disks look quite different from diskettes.

A hard disk is a stack of one or more metal platters that spin on one spindle like a stack of rigid diskettes. Each platter is coated with iron oxides, and the entire unit is encased in a sealed chamber. Unlike diskettes, where the disk and drive are separate, the hard disk and drive is a single unit. It includes the hard disk, the motor that spins the platters, and a set of read/write heads.

Since the disk can not be removed from its drive (unless it is a removable hard disk, which will be discussed later), the terms hard disk and hard drive are used interchangeably.

Hard disks have become the primary storage device for PCs because they are convenient and cost-efficient. In both speed and capacity, they far outperform diskettes. A high-density 3.5-inch diskette can store 1.44 MB of data. Hard disks, in contrast, range in capacity from about 20 GB onward. Most PCs now come with hard disks of at least 80 GB and more.

Two important physical differences between hard disks and diskettes account for the differences in performance. First, hard disks are sealed in a vacuum chamber, and second, the hard disk consists of a rigid metal platter (usually aluminum), rather than flexible mylar.

The rigidity of the hard disk allows it to spin much faster - typically more than ten times faster than diskettes. Thus, a hard disk spins between 3,600 rpm and 7,200 rpm, instead of a diskette's 300 rpm. The speed at which the disk spins is a major factor in the overall performance of the drive.

The rigidity of the hard disk and the high speed at which it rotates allow a lot of data to be recorded on the disk's surface. It may be recalled, waving a magnet past an electric coil causes a current to flow through the coil. The faster the magnet is waved, and the closer the magnet is to the coil, the larger the current it generates in the coil. Similarly, a disk that spins faster can use smaller magnetic charges to make current flow in the read/write head. The drive's heads can also use a lower intensity current to record data on the disk.

1.7.2.1 Data Storage : Not only do hard disks pack data more closely together, they also hold more data, because they often include several platters, stacked one on top of another. To the computer system, this configuration just means that the disk has more than two sides; in addition to a side 0 and side1, there are sides 2,3,4 and so on. Some hard disk drives hold as many as 12 sides, but both sides of the disks are not always used

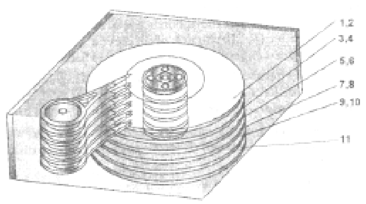


Fig. 1.7.2.1.1 Hard Disk

With hard disks, the number of read/write heads specifies the number of sides that the disk uses. For example, a particular hard disk drive might have six disk platters (that is, 12 sides), but only eleven heads, indicating that one side is not used to store data. Often, this is the bottom side of the bottom disk.

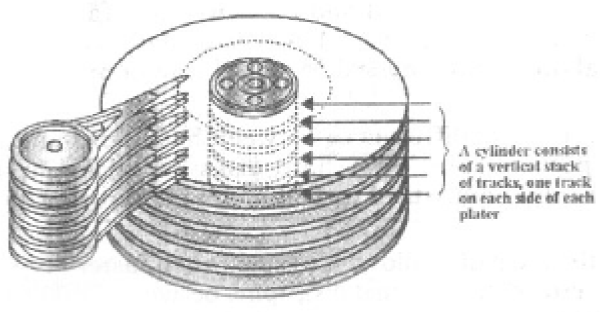


Fig. 1.7.2.1.2 Hard Disk Cylinder

The other point of importance is the fact that read/write heads move in and out simultaneously. Referring to figure1.7.2.1.2, there are 11 magnetisable faces and there are therefore, 11 read/write heads. Even though, a record on the first disc face were to be accessed, not only the first read/write head would move but the other ten read/write heads would also move in unison. However, only the first read head would be activated, others remaining inactive. As a consequence of this, if the read/write heads have once been moved, all the eleven tracks vertically above and below each other should be read or written before any further movement of the heads take place. This eliminates first component of the seek time *i.e.,* horizontal movement of the read/write heads. This has led to the concept of cylinders (synonymous: seek areas) Any eleven tracks vertically above and below each other constitute more or less a hollow cylinder (*See* Figure 1.7.2.1.2) Therefore, there are 200 cylinders. Because of the simultaneous movement of the read/write heads, it is to be desired that the records are arranged sequentially in cylinders so that when the first cylinder (*i.e.,* first track of all eleven faces) has been read, the heads move to the next cylinder *i.e.,* reading or writing is performed cylinder wise.

Like diskettes, hard disks generally store 512 bytes of data in a sector, but because of their higher tolerances, hard disks can have more sectors per track-54, 63, or even more sectors per track are not uncommon.

The computation of a hard disk's capacity is identical to that for diskettes-but the numbers are larger. The breakdown of the storage capacity for a disk that is sold as a 541-MB disk is given below:

1,632 cylinders × 12 heads (sides) = 19,584 tracks

19,584 tracks × 54 sectors / track = 1,057,536 sectors

1,057,536 sectors × 512 bytes/sector = 541,458,432 bytes

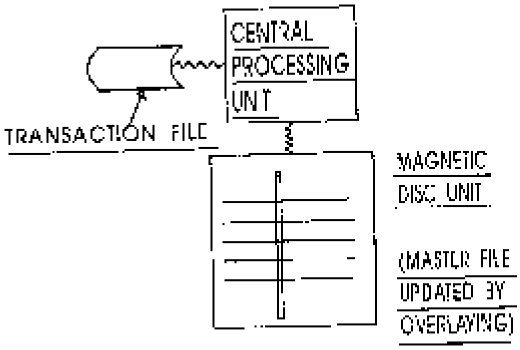


Fig. 1. 7.2.1.3

As depicted in the Figure 1. 7.2.1.3, only one magnetic pack is connected to the CPU and serves both as the input and output unit. The implication of this being that a record picked up from a sector and updated in the CPU is deposited back in the same place in that sector. *This mode of storing updated data is known as overlaying i.e.,* original data is automatically erased when the new updated record is being deposited in its place.

This leads to economies in the sense that fewer discs are needed but as a disadvantage it becomes difficult to trace any errors as it is not possible to reconstruct the latest file from the previous version.

In spite of all the capacity and speed advantages, hard disks have one major drawback. To achieve optimum performance, the read/write head must be extremely close to the surface of the disk. In fact, the heads of hard disks fly so close to the surface of the disk that if a dust particle, a human hair, or even a fingerprint were placed on the disk it would bridge the gap between the head and the disk, causing the heads to crash. A head crash, in which the head touches the disk, destroys the data stored in the area of the crash and can destroy a read/write head, as well.

The time required in accessing a record has generally three components.

(i) *Seek Time* : This is the time required to position a movable read-write head over the recording track to be used. If the read-write head is fixed, this time will be zero.

(ii) *Rotational time* : This is the rotational delay also termed latency, to move the storage medium underneath the read-write head.

(iii) *Data transfer time* : This is the time taken to activate the read/write head, read the requested data, and transmit them to primary memory for processing.

The total of these three components is known as the access time and typically ranges from, 8 to 12 milliseconds.

1.7.2.2 Advantages and disadvantages of magnetic disk

The advantages of magnetic disk include :

1. Magnetic rigid disk is a direct access storage medium; therefore, individual records can be retrieved without searching through the entire file.
2. The costs of disks are steadily declining.
3. For real-time systems where direct access is required, disks are currently the only practical means of file storage. Other new types of storage, such as bubble storage, are not widely used yet.
4. Records can be readily updated by writing the new information over the area where the old information was stored.
5. With removable disk packs, a single disk drive can store large quantities of data although all but one of the disks is offline at any given point in time. However, being offline is not a disadvantage for many applications, especially batch applications.
6. Interrelated files stored on magnetic disk can allow a single transaction to be processed against all of these files simultaneously.

The disadvantages of magnetic disk include :

Updating a master file stored on disk destroys the old information. Therefore, disk does not provide an automatic audit trail. When disk is used, back-up and audit trail require that each old master file records be copied to another medium prior to update.

1.7.2.3 Removable hard disks: Removable hard disks and drives attempt to combine the speed and capacity of a hard disk with the portability of a diskette. There are many different types of devices in this category. Choosing the best type is usually a matter of balancing the needs for speed, storage capacity, compatibility (will it work in different computers?), and price.

1.7.2.4 Hot-Swappable Hard Disks: At the high end, in terms of both price and performance, are hot-swappable hard disks. These are sometimes used on high-end workstations that require large amounts of storage. They allow the user to remove (swap out) a hard disk and insert (swap in) another while the computer is still on (hot)

Hot-swappable hard disks are like removable versions of normal hard disks: the removable box includes the disk, drive, and read/write heads in a sealed container.

1.7.3 OPTICAL LASER DISKS

Optical laser disk storage is capable of storing vast amount of data. Some industry analysts have predicted that optical laser disk technology may eventually make magnetic disk and tape storage obsolete. With this technology, the read/write head used in magnetic storage is replaced by two lasers. One laser beam writes to the recording surface by scoring macroscopic pits in the disk, and another laser reads the data from the light sensitive recording surface. A light beam is easily deflected to the desired place on the optical disk, so a mechanical access arm is not needed.

There are three main categories of optical laser disks.

1.7.3.1 CD-ROM disks : CD-ROM, a spinoff of audio CD technology stands for compact-disk-read-only memory. The name implies its applications, CD-ROM disks are created as a mastering facility. Most of the commercially produced read-only CD-ROM disks contain reference material. The master copy is duplicated or “pressed” at the factory and copies are distributed with their pre-recorded contents. Once inserted into the CD-ROM disk drive, the text, video images, and so on can be read into primary storage for processing or display. However, the data on the disk are fixed, they can not be altered.

The capacity of a single CD-ROM is over 650 MB which is equivalent to 250,000 pages of text, or 1500 floppy disks. The tremendous storage capacity has opened the door to a variety of multimedia applications. Multimedia can provide needed flexibility during a presentation. Unlike a video tape, CD-ROM gives the presenter instant random access to any sequence of images on the disk.

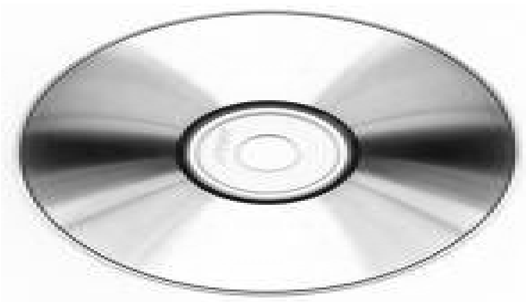


Fig. 1.7.3.1.1 CD-ROM

CDs may soon take a new direction with the advent of DVD, digital video disk, a high density medium that is capable of storing a full-length movie on a single disk side of a CD (actually, it uses both sides of the disk) DVDs look like CDs and DVD - ROM drives are able to play current CD-ROMs. A slightly different player, the DVD movie player connects to the TV and plays movies like a VCR. The DVD movie player will also play audio CDs.

Each side of a DVD can hold up to 4.7 GB. Therefore, these two-sided disks can contain as much as 9.4 GB of data.

CD Rewritables : Hewlett Packard has introduced the next generation of CD Rewritable (CD-RW) drive. This is the third generation in CD technology which began with CD-ROM and was then followed by the CD-Recordable (CD-R) and CD-RW.

CD-R : It stands for compact disc, recordable. A person can only write once on this CD, though it can be read as many times as wished. It can be played in CD players and CD-ROM drives. In a normal CD, polycarbonate plastic substrate, a thin reflective metal coating, and protective outer coating layers are present. However, in a CD-R, an extra layer is present and is an organic polymer dye lying between the polycarbonate and metal layers and serves as a recording medium. A pregrooved spiral track guides the laser for recording data, which is encoded from the inside to the outside of a CD in a continuous spiral, much like the way it is read. The laser makes that are not dissimilar from the pits and lands of a normal CD. After the encoding process is completed, the data can be read as a normal CD. The CD recorders are sometimes referred to as CD burners. Modern recording devices can also read CDs as well. CD-Rs can be created in any CD-R or CD-RW drive.

CD-RW :The rewriteable compact disc is called a CD-RW. This disc allows for repeated recordings on a disc. It is relatively more expensive than the CD-R. However, in certain circumstances the benefits outweigh the cost.

While the CD-R may use a layer of organic dye, which can only be altered once, the CD-RW uses an allow that can change to and fro from a crystalline form when exposed to a particular light. The technology of this process has a special name called phase changing. The patterns, however, are less distinct than that of other ordinary CD formats due to the greater difficulty of manipulating a metal instead of a dye. The alloy is usually made up of silver, indium, antimony and tellurium. After heating to a particular temperature, the alloy will crystallize when cooled. Heating that particular spot to a greater temperature results in the substance becoming amorphous when cooled. By controlling the temperature, some areas have crystals and others do not. The crystals will reflect the laser effectively while the non-crystalline areas would absorb most of it.

To rewrite on a CD-RW, the alloy is first made amorphous, then reshaped using the cooler laser. The CD-RW can be rewritten as many as 1000 times. With the rewritable drive, the CD has now got all the functionalities of the floppy drive. The drive is claimed to be simple to use and universally accepted as a conventional floppy disk drive, but with the qualities of a compact disc.

1.7.3.2 WORM disks : It stands for Write once, read many optical laser disks, or WORM disks. These are used by end user companies to store their own proprietary information. Once the data have been written to the medium, they only can be read, not updated or changed. The PC version of a WORM disks cartridge, which looks like a 5¼ inch version of the 3½ inch diskette, has a capacity of 200 MB.

Access times for CD-ROM and WORM drives tend to be quite slow by hard disk drive standards, ranging from 100 to 300 milliseconds.

The WORM disks cartridge is a feasible alternative to magnetic tape for archival storage, for example, a company might wish to keep a permanent record of all financial transactions during the last year. Another popular application of WORM disks is in information systems that require the merging of text and images that do not change for a period of time. A good example is an "electronic catalogue". A customer can peruse retailer's electronic catalogue on a VDT, or perhaps a PC, and see the item while he or she reads about it. And, with a few keystrokes, the customer can order the item as well. The Library of Congress is using WORM technology to alleviate a serious shelf-space problem.

1.7.3.3 Magneto-Optical Disks : Magneto-optical integrate optical and magnetic disk technology to enable read-write storage. The 5¼ inch disks store up to 1000 MB. However, the technology must be improved before the disks can experience widespread acceptance. At present, magneto-optical disks are too expensive and do not offer anywhere near the kind of reliability that users have come to expect of magnetic media. In addition, the access times are relatively slow, about the same as a low-end Winchester disk.

As optical laser disk technology matures to offer reliable, cost - effective, read/write operation; it eventually may dominate secondary storage in the future as magnetic disks and tape do today.

640 MB Magneto Optical Drive : A **magneto-optical drive** is a kind of optical disc drive capable of writing and rewriting data upon a **magneto-optical disc**. Both 5.25" and 3.5" form factors exist. The technology was introduced at the end of the 1980s. Although optical, they appear as hard drives to the operating system and do not require a special filesystem (they can be formatted as FAT, HPFS, NTFS, etc.)

Initially the drives were 5.25" and had the size of full-height 5.25" hard-drives (like in IBM PC XT) Today a 3.5" drive(See fig. 1.7.3.3.1) has the size of 1.44 megabyte diskette drive. 5.25" media looks a lot like a CD-ROM enclosed in an old-style cartridge while 3.5" media is about the size of a regular 1.44MB floppy disc, but twice the thickness. The cases provide dust resistance, and the drives themselves have slots constructed in such a way that they always appear to be closed.

Fig 1.7.3.3.1 Magneto Optical Disk

The disc consists of a ferromagnetic material sealed beneath a plastic coating. There is never any physical contact during reading or recording. During reading, a laser projects a beam on the disk and according to the magnetic state of the surface, the reflected light varies due to the magneto-optical Kerr effect. During recording, the light becomes stronger so it can heat the material up to the Curie point in a single spot. This allows an electromagnet positioned on the opposite side of the disc to change the local magnetic polarization, and the polarization is retained when temperature drops.

Each write cycle requires both a pass for the laser to erase the surface, and another pass for the magnet to write the information, and as a result it takes twice as long to write data as it does to read it. In 1996, a *Direct Overwrite* technology was introduced for 3.5" discs, to avoid the initial erase pass when writing. This requires special media.

Magneto-optical drives by default check information after writing it to the disc, and are able to immediately report any problems to the operating system. This means that writing can actually take three times longer than reading, but it makes the media extremely reliable, unlike the CD-R or DVD-R technologies upon which data is written to media without any concurrent data integrity checking.

1.7.3.4 Digital Video Disk: DVD (also known as "**Digital Versatile Disc**" or "**Digital Video Disc**") is an optical disc storage media format that can be used for data storage, including movies with high video and sound quality. DVDs resemble compact discs as their physical dimensions are the same- 120 mm (4.72 inches) or occasionally 80 mm (3.15 inches) in diameter, but they are encoded in a different format and at a much higher density. A video disk can store text, video, and audio data. Video disks can be accessed a frame at a time (to provide still information) or played like a phonograph record (to supply up to an hour of moving action) Any of the 54,000 tracks on the surface of typical video disk can be accessed in about three seconds.

A digital video disk (DVD) is a 5 inch plastic disk that uses a laser to encode microscopic pits in its substrate surface. But the pits on a DVD are much smaller and are encoded much closer together than those on a CD-ROM. Also, a DVD can have as many as two layers on each of its two sides (compared to the single-layered, single-sided CD-ROM) The end result is a medium that can hold as much as 17 gigabytes of data – over 25 times the capacity of a standard CD-ROM disk. The advantages of DVDs are therefore self-evident – a huge storage capacity that enables users to archive large amounts of data on a single, lightweight, removable, reliable, easily-transportable medium. Although VDDs are now used mostly for entertainment – for example, storing video movies or large amounts of prerecorded music-experts predict that DVDs will become the medium of choice for distributing software or archiving large amounts of accounting data.

Video disks were first introduced in 1983, as a video game product. Today, however, they can provide companies with a competitive advantage.

Video disk systems were developed to help real estate agents conduct better searches for homes and properties for their clients. For example, the client describes the type of home desired – perhaps three bedrooms, a garage, and priced below Rs.200,000. When these data are entered into the video disk system, photographs and even " video tours" of existing homes meeting the description can be summoned to the display screen.

Video disks are widely used for training applications. At a growing number of companies – Ford, Chrysler, Xerox, Pfizer, and Massachusetts Mutual Life Insurance, to name just a few-video disk systems take on such training tasks as showing how to boost factory performance, helping service technicians do a safer and better job, and training clerks to analyze insurance applications. The U.S. Army has also made extensive use of video disks for training purposes.

Video disks are also used by automobile manufacturers to show their lines and by travel agents to interest clients in resorts. In the future, some industry observers predict that many businesses will develop automatic customer service centres equipped with video disk components so that consumers do not have to depend only on clerks and showrooms. When a desired item flashes on the display screen, the customer can insert a credit card in a device that resembles a bank's automatic teller machine and order that item immediately. Sears-chain of departmental store introduced systems like this in many of its department stores. Even the U.S. Postal Service is spending close to Rs.5 million to develop an automated video disk system that will allow its patrons to do many of the activities that human postal clerks now perform.

1.7.4 TAPE DEVICES

Magnetic tape is probably the oldest secondary storage technology still in wide use. Its biggest drawback is that it can only access data sequentially. However, many data processing operations are sequential or batch oriented in nature, and tape is still economical. Here we will look at the two most popular forms of magnetic tape for large system MIS applications: detachable reel magnetic tapes and tape cartridges.

1.7.4.1 Detachable Reel Magnetic Tapes : Many of the tapes used with mainframes and minicomputers are stored on detachable reels. These plastic tapes are, like disks, coated with a magnetizable surface (often iron oxide) that can be encoded with 0 and 1 bits . Tapes come in various widths, lengths, and data densities. A common specification is a 2400 feet reel of ½ inch diameter tape that packs data at 6250 bytes per inch. Recording densities of tapes are often cited as bytes per inch (bpi) because in most instances, a character (byte) is represented as a vertical slice of bits across the tracks of tape surfaces.

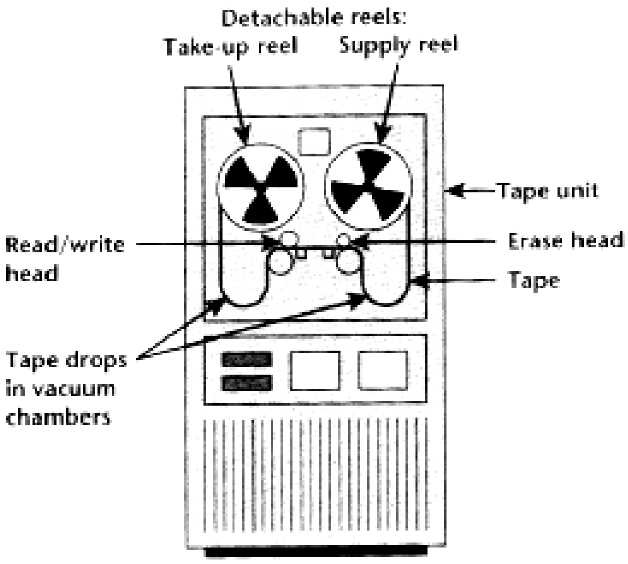


Fig 1.7.4.1.1

Tapes are read on a hardware device called a tape unit (Figure 1.7.4.1.1) Basically, this unit works the same way as the reel-to-reel tape units that were once popular on home stereo systems. An empty take-up reel, running at the same speed as the supply reel on which the tape is initially wound, accepts the tape as it is being processed. The tape is processed by passing it under read/write heads located between the two reels. Depending on the instructions given to the computer system, data can then either be read from the tape or written to it.

1.7.4.2 Tape Cartridge Systems : Catridge tapes represent the leading edge of tape technology. Tape catridges are available for both large and small computer systems.

Tape catridges for microcomputer systems, which resemble cassette tapes in appearance, are frequently used to back up hard disks. These tapes, which are not designed for processing purposes, are sometimes called streaming tapes. The capacities of these tapes vary, but several megabytes of storage are typical. Streaming tapes can usually back up the contents of a hard disk in a few minutes. Among the leading tape cartridge system vendors are Colorado Memory Systems, Everex Systems, Micro Solutions Summit Memory Systems, and Tallgrass Technologies Corporation.

In 1986, IBM introduced a tape cartridge system, the IBM 3480, for its 3090 line of mainframes. Each of these cartridges has a capacity of 200 MB and a data-transfer rate of 3 MB/Sec. Unlike conventional detachable-reel tapes, which uses 9 parallel tracks, these ½ inch tapes store data in 18 tracks. In 1992, IBM released 36 track tape cartridges for use in its mainframes and AS/400 family of midrange computers.

Self-examination questions

1. Describe in detail various generations of computers.
2. Write short notes on the following types of computers :-

   (i) Super computer (ii) Mainframe computer.

   (iii) Mini computer. (iv) Micro computer.

   (v) Workstations (vi) Server
3. Draw the schematic diagram of a computer. Briefly discuss each of the components covered in it.
4. What are the features of the Central Processing Unit?
5. Discuss, in brief, various types of microprocessors.
6. Discuss various components of a motherboard.
7. What do you understand by the term 'Bus'? Discuss two types of bus available on a computer.
8. Write short notes on the following :

   (i) RAM

   (ii) ROM

   (iii) Bubble memory

   (iv) Flash memory

9. Write short note on floppy diskette as an input medium.
10. What are the factors that determine the number of characters that can be stored in a floppy diskette?
11. Explain the following terms :
    (i) The boot record
    (ii) File allocation table
12. What care is required for using and storage of a diskette?
13. Differentiate between floppy diskettes and hard disks.
14. Briefly explain the various characteristics of a hard disk.
15. What are the advantages and disadvantages of direct access storage?
16. Explain the following terms :
    (i) CD-ROM
    (ii) WORM disk
    (iii) Magneto Optical Disks
    (iv) Video Disk
    (v) Detachable Reel Magnetic Tape
    (vi) Tape Cartridge Systems

Multiples choice:

1. Fist Generation of computer have used the following Circuitry option

   a) Vacuum Tubes b) ransistor c) IC d) VLSI

2. Second generation computer home used the following options Circuitry

   a) Vacuum Tubes b) Transistor c) IC d) VLSI

3. Third Generation Computer have used the following circuitry options

   a) Vacuum Tubes b) ransistor c) C d) VLSI

4. Forth Generation computer have used the following Circuitry options

   a) Vacuum Tubes b) ransistor c) IC d) VLSI

5. First Generation have used the following language

   a) Object oriented programmer b) Artificial Interllig

   c) Assembly Language d) Assembly & M/C Langage

5) Which is not the attribute of file :

   a) Hidden b) System c) Big d) Archive

6) Which is the fastest storage device :

   a) Floppy Disk b) Zip Disk c) CD - Rom d) Hard Disk

7. Storage Device which uses light to store data :

   a) Floppy Disk b) Hard Disk c) CD - ROM d)Tape Drive

8. In CD 'X' Denotes:

   a) Speed b) Storage Capacity c) Time d) None

9. In CD - R user can write data.

   a) Once b) More Than Once c) Both A & B d) None of the above

10. Size of Floppy Disk is:

   a) 3.5" b) 5.1/4" c) Both A & B d) None

Answer:

1. a **2.** b **3.** c **4.** d **5.** c **6.** c **7.** d **8.** a **9.** a

10. c

Unit 2 : Input and Output Devices

I/O devices (short for input/output devices) is a general term for devices that send computers information from the outside world and that return the results of computations. These results can either be viewed directly by a user, or they can be sent to another machine, whose control has been assigned to the computer: The first generation of computers were equipped with a fairly limited range of input devices. A punch card reader, or something similar, was used to enter instructions and data into the computer's memory, and some kind of printer, usually a modified teletype, was used to record the results. Over the years, other devices have been added. For the personal computer, for instance, keyboards and mice are the primary ways people directly enter information into the computer; and monitors are the primary way in which information from the computer is presented back to the user, though printers, speakers, and headphones are common, too. There is a huge variety of other devices for obtaining other types of input. One example is the digital camera, which can be used to input visual information.

We will now discuss some of these I/O devices in detail.

1.1 ON-LINE ENTRY

1.1.1. Keyboard : A microcomputer's keyboard is normally its primary input and control device. One can enter data and issue commands via the keyboard. The keyboard is used to type information into the computer or input information. There are many different keyboard layouts and sizes with the most common for Latin based languages being the QWERTY layout (named for the first 6 keys) The standard keyboard has 101 keys. Notebooks have embedded keys accessible by special keys or by pressing key combinations (CTRL or Command and P for example) Ergonomically designed keyboards are designed to make typing easier. Some of the keys have a special use. These are referred to as command keys. Three most common are the Control or CTRL, Alternate or Alt and the Shift keys though there can be more (the Windows key for example or the Command key) Each key on a standard keyboard has one or two characters. Press the key to get the lower character and hold Shift to get the upper. Besides the standard typewriter keyboard, most micro keyboards have function keys, also called soft keys. When tapped, these function keys trigger the execution of software, thus the name “soft key.” For example, tapping one function key might call up a displayed list of user options commonly referred to as a **menu**. Another function key might cause a word processing document to be printed. Function keys are numbered and assigned different functions in different software packages. For example., HELP (context-sensitive user assistance) is often assigned to F1, or Function key 1. Most keyboards are equipped with key pad and cursor-control keys . The keypad permits rapid numeric data entry. It is normally positioned to the right of the standard alphanumeric keyboard.

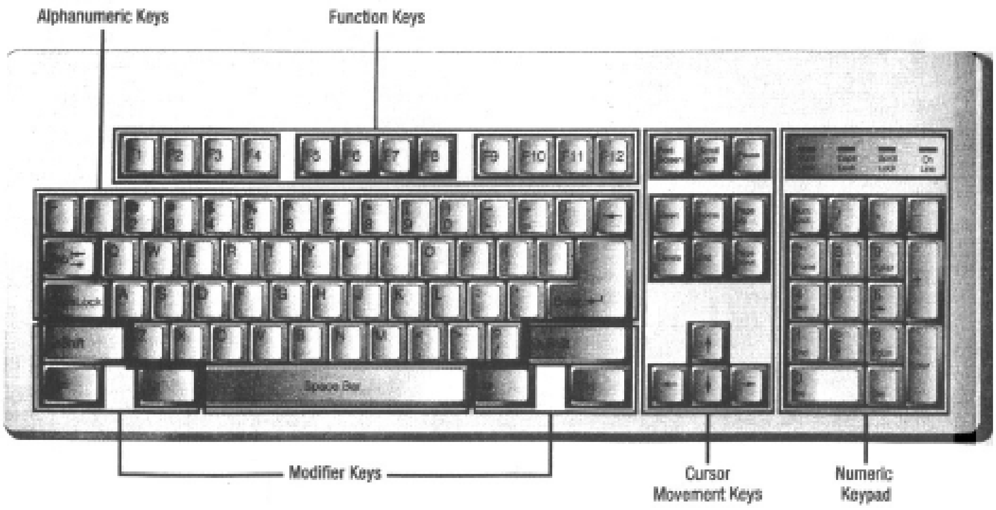


Fig. 1.1.1.1 Keyboard

The cursor-control keys, or “arrow” keys, allow the user to move the text cursor up (↑) and down (↓), usually a line at a time, and left (←) and right (→), usually a character at a time. The text cursor always indicates the location of the next keyed-in-character on the screen. The text cursor can appear as several shapes depending on the application, but frequently, one will encounter an underscore (_), a vertical line (|), or a rectangle ▯▯▯) To move the text cursor rapidly about the screen, simply hold down the appropriate arrow key.

For many software packages, one can use the arrow keys to view parts of a document or worksheet that extend past the bottom, top, or sides of the screen. This is known as **scrolling**. The user can use the up and down arrow keys (↑↓) to scroll vertically and the left and right keys (←→) to scroll horizontally.

In summary, the keyboard provides three basic ways to enter commands:

➢ Key in the command using the alphanumeric portion of the keyboard.

➢ Tap a function key.

➢ Use the arrow keys to select a menu option from the displayed menu.

Other important keys common to most keyboards are the ENTER, HOME, END, PAGE UP AND PAGE DOWN (abbreviated as PGUP and PGDN), DELETE (DEL), BACKSPACE (BKSP), Insert - typeover toggle (INS), ESCAPE (ESC), SPACEBAR, Shift Control (CTRL), Alternate (ALT), TAB, SCROLLLOCK, CAPSLOCK, NUMLOCK, and PRINT SCREEN keys (see Figure 1.1.1.1)

1.1.2 Mouse : The Mouse is a small box, from the bottom of which protrudes a small ball bearing. The ball bearing rotates when the user moves the Mouse across his desk and, as it is linked by cable to the microcomputer, this moves the cursor on the display screen. Another type of mouse uses an optical system to track the movement of the mouse. Most modern computers today are run using a mouse controlled pointer. Generally if the mouse has two buttons the left one is used to select objects and text and the right one is used to access menus. If the mouse has one button (Mac for instance) it controls all the activity and a mouse with a third buttons can be used by specific software programs.

Systems using Mouse have displays which include easily identified functions or programs, such as ‘store’, ‘print’, ‘graphics’, ‘utilities’ and so on. When the cursor alights on the facility required, the user presses a button on the top of the Mouse and it is activated. This is an ideal input medium for those who cannot use keyboards-or are reluctant to learn.

A mouse may have one, two or three buttons. The function of each button is determined by the program that uses the mouse. In its simplest form, a mouse has one button. Moving the mouse moves the cursor on the screen, and clicking the button results in selecting an option. A mouse normally has two or three buttons, but the software package used by the user may use one, two or all three of them.

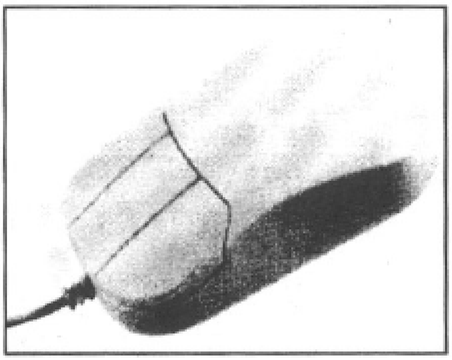


Fig. 1.1.2.1 Mouse

A mouse may be classified as a mechanical mouse or an optical mouse, depending on the technology it uses. In a *mechanical mouse*, that projects through the bottom surface rotates as the mouse is moved along a flat surface. The direction of rotation is detected and relayed to the computer by the switches inside the mouse. Microsoft, IBM, and Logitech are some well-known makers of mechanical mouse. An *optical mouse* uses a light beam instead of a rotating ball to detect movement across a specially patterned mouse pad.

A *serial mouse* is connected to the PC through a serial port. A *bus mouse* is similar to a serial mouse except that it comes with a dedicated port and does not need a free serial port on the computer.

1.1.3 Touch Screen : The 'Touch Screen' is a Hewlett Packard innovation and was introduced on their 100 series microcomputers in 1984. An invisible microwave beam 'matrix' criss crosses the screen, emanating from holes along the bottom and sides of the display unit. By pressing the finger against a function or program displayed on the screen, the infrared beam is broken at that intersection and the system activated. In many ways, this is more effective than the 'Mouse' and very popular with users.

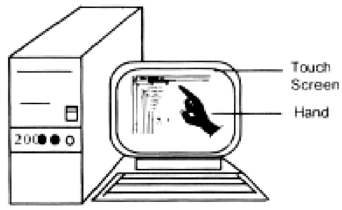


Fig. 1.1.3.1Touch Screen

Two popular technologies exist for touch screens. In one, the screen is made sensitive to touch and the exact position is detected. In the other, the screen is lined with light emitting devices on its vertical sides, photo-detectors are placed on the horizontal sides. When the user's finger approaches the screen, the light beam is broken and is detected by the photo-detectors.

Touch screens are used in information-providing systems. For example, while performing an operation, if the doctor wants to see some test reports of the patient that have been stored in a computer, he can get the information just by touch of his finger. It is also used in airline and railway reservation counters. The user has to indicate the current place of stay and the destination by touching the screen (may be on a map), and all the possible routes with timings, rates, etc. are displayed. These interfaces are also used in travel agents offices to display the names and addresses of all hotels, restaurants, and other places of interest, at a desired destination. Touch screens are also used in stock exchanges where buying and selling of stock is done.

1.1.4 Light Pen : A light pen is a pointing device which can be used to select an option by simply pointing at it, or draw figures directly on the screen and move the figures around.

A light pen has a photo-detector at its tip. This detector can detect changes in brightness of the screen. When the pen is pointed at a particular point on the screen, it records the instant change in brightness that occurs and informs the computer about this. The computer can find out the exact spot

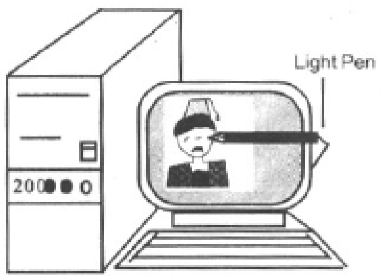


Fig.1.1.4.1 Light Pen

with this information. Thus, the computer can identify where the user is pointing on the screen.

Light-pens are useful for menu-based applications. Instead of moving the mouse around or using a keyboard, the user can select an option by pointing at it. A light pen is also useful for drawing graphics in CAD. An engineer, architect or a fashion designer can draw directly on the screen with the pen. Using a keyboard and a light pen, the designer can select colors and line thickness, reduce or enlarge drawings, and edit drawings.

These are also used to read the bar charts that are now appearing so frequently on the goods which are available in big departmental stores. By using a laser beam, computers are able to 'read' the information stored on the bar chart or on a thin strip of magnetic material and this is used to keep stock records and cheque costs, etc.

1.1.5 The Track Ball : A track ball is a pointing device that works like an upside-down mouse. The user rests his thumb on the exposed ball and his fingers on the buttons. To move the cursor around the screen, the ball is rolled with the thumb. Since the whole device is not moved, a track ball requires less space than a mouse. So when space is limited, a track ball can be a boom. Track balls are particularly popular among users of notebook computers, and are built into Apple Computer's Power Book and IBM ThinkPad notebooks.

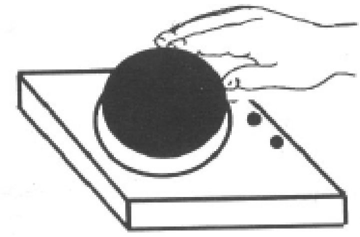


Fig. 1.1.5.1 Track Ball

1.1.6 Joystick : It is a screen pointing input device. It is a vertical lever usually placed in a ball socket, which can be fitted in any direction to control cursor movements for computer games and for some professional applications.

Fig 1.1.6.1 Joystick

1.1.7 Display Devices : Virtually everyone who interacts with a computer system today uses some type of display device. These peripheral hardware units consist of a television like viewing screen, to which computer output is sent. The two most common types of display devices found today are monitors and terminals.

Monitors are the devices found most commonly with microcomputer systems. As mentioned previously, a monitor is just a "box with a viewing screen". On the screen, the user is able to see not only what is entered into the computer, but the computer output as well.

A **computer terminal** or video display terminal (VDT), generally combines input and output functions. It consists of a QWERTY keyboard for inputting information direct to the computer, and either a printer or a TV screen for displaying information from the computer. Terminals are most commonly found in settings that are remote from the main computer and they interact with the computer through communications lines or networks. Airline agents are familiar examples of people who use communications terminals. Tellers in banks and cashiers in many retail settings also use terminals to perform their work duties.

There can be several types of terminals as discussed below :

A dumb terminal is an input/output (I/O) device that provides for data entry and information exit when connected to a computer but has no additional capability.

An intelligent terminal has an in-built processing capability. It is also user-programmable. It contains not only a storage area but also a microprocessor. The terminal can be programmed to communicate with and instruct the user who is entering data. It can also do some processing of the data internally such as sorting, summarizing, checking both input and computed values for reasonableness and so on, rather than relying on the mini-computer or the main-frame CPU. This feature can reduce the load on the central CPU. Thus, intelligent terminals can be used on a stand-alone basis or can be part of a distributed network of terminals.

Intelligent terminals cost several times more than non-intelligent terminals but the savings they provide for many companies is much more than their cost. Savings come about because the amount of data to be transmitted to the central CPU and the number of times it is interrupted are both reduced. Intelligent terminals also provide a type of back up to the main computer because the terminal can handle some of the processing.

Smart terminals additionally, contain a microprocessor and some internal storage. They have data editing capability and can consolidate input data before sending it to CPU. These terminals are non-programmable by users.

Remote job terminal (also referred to as Remote Job entry or RJE), groups data into blocks for transmission to a computer from a remote site. Some RJE terminals have the capability of receiving back and printing the results of the application program. Such a unit is in itself a small computer, which can be used either as job entry terminal or as a stand-alone computer.

A terminal may be situated at the computer site or situated at a remote place where the data to be input is more readily available. Terminals linked to the computer system by a direct cable are known as *hard-wired terminals.* However, for remote terminals, communication to the main system can be established via *telecommunication* lines such as ordinary telephone lines.

Keyboard printer terminal: The keyboard printer terminal or *teletypewriter* consists of a keyboard for sending information to the computer and a printer, for providing a copy of the input and for receiving information from the computer. The output is normally typed on a continuous role of paper at speeds typically between 20 to 50 characters per second. A paper tape reader/punch is sometimes incorporated in the design of a terminal to enable information to be keyed in and punched on to paper tape for retention of data or for subsequent input to the computer. In place of the paper tape reader/punch, some more recently designed machines may have magnetic tape cassettes incorporated for the same purpose.

Hundreds of different display devices are now available. Although a number of important features distinguish one display device from another, the three that follow are among the most significant.

(a) Screen Resolution : One of the most important features used to differentiate display devices is the clarity, or resolution, of the images that are formed on –the screen. Most display devices form images from tiny dots - called pixels (a contraction of the two words "picture elements") - that are arranged in a rectangular pattern. The more dots that are available to display any image on -screen, the sharper the image (the greater the resolution) is.

Images are formed on monitor's screen by a card called the display adaptor card. If a user wishes to change the kind of display, e.g, from black and white to colour, the display adaptor card must be changed. The key elements of display adaptor cards the video controller and the memory. A variety of display adaptor cards exist in the market, each with its own special features. Some of the popular display adaptors reported by personal computers are discussed below:

1. MGA- MGA or Monochrome Graphics Adapter is one of first adapters. It is a text -only adapter which generates very clear, easy-to-read characters. It works only with monochrome monitor.

2. CGA - CGA or Colour Graphics Adapter works in both text and graphics mode. It supports both colour and monochrome modes with various resolutions. However, it has relatively poor display quality in text mode. A CGA adapter provides following two combinations of resolutions

   (i) 640 x 200 pixels with 16 colours.

   (ii) 320 x 200 pixels with 4 palettes.

   Each of these palettes has 4 different colours. Only one palette can be used at a given time.

3. EGA- An EGA or Enhanced Graphics Adapter combines all features of a MGA & CGA with higher resolutions. It supports up to 16 colours at a time. An EGA usually has a high resolution of either 640 x 200 pixels or 640 x 350 pixels.

4. VGA - VGA or Video Graphics Adapter is a high quality graphics adapter which provides upto 256 colours and also a high resolution. Following are the two typical combinations of resolutions and colours that a VGA provides.

   (i) 640 x 480 pixels with 16 colours.

(ii) 320 x 200 pixels with 256 colours.

5. SVGA- SVGA or Super Video Graphics adapter is an improvement on the VGA. The two combinations of resolutions and colours provided by SVGA are

   (i) 640 x 480 pixels with 256 colours.

   (ii) 1024 x 480 pixels with 16 colours

(b) Text and Graphics : Many display devices made today (principal exceptions are inexpensive terminals such as those used in dedicated transaction processing applications) can produce both text and graphics output. Text output is composed entirely of alphabetic characters, digits, and special characters. Graphics output includes such images as drawings, charts, photographs, and maps.

Display devices that are capable of producing graphics output commonly employ a method called **bit mapping**. Bit-mapped devices allow each individual pixel on the screen to be controlled by the computer. Thus, any type of image that can be formed from the rectangular grid of dots on the screen (for example, a 640-by-480 grid) is possible. Character-addressable devices are not bit-mapped and partition the screen into standard character widths- for example, a series of 5-by-7 dot widths - to display text.

Perhaps the most important business-related use for graphics is presentation graphics. Presentation graphics enable managers to easily construct such information-intensive images as bar charts, pie charts, and line charts on their display devices and have these images sent to a printer, plotter, or slide-making machine so that they can be used later for presentations in meetings. Because these types of graphical images are relatively simple, a super-high-resolution workstation that can display photographs and sophisticated artwork is not needed.

Graphics display devices have been widely used for many years in the engineering and scientific disciplines. The display devices used for applications in these areas are extremely sophisticated and expensive.

(c) CRT Versus Flat-Panel : Most of the display devices used today are of the cathode ray tube (CRT) type. These devices use a large tube-type element that looks like the picture tube in a standard TV set. Inside the tube is a gun that lights up the phosphorescent pixels on the screen surface. Although CRT technology is relatively inexpensive and reliable, CRT-type display devices are rather bulky and limited in the resolution that they provide.

Currently challenging the CRT in the display device marketplace is the flat-panel display. The most common of these devices use either a liquid crystal display (LCD) or gas-plasma technology. To form images, LCD devices use crystalline materials sandwiched between two panes of glass. When heat or voltage is applied, the crystals line up. This prevents light from passing through certain areas and produces the display. Gas-plasma displays, which provide better resolution but are more expensive than liquid crystal displays, use gas trapped between glass to form images.

The biggest advantage of flat-panel displays is that they are lightweight and compact. This makes them especially useful for laptop, notebook, and pocket personal computers.

The Video Controller : As mentioned earlier, the quality of the images that a monitor can display is defined as much by the video controller as by the monitor itself. The video controller is an intermediary device between the CPU and the monitor. It contains the video-dedicated memory and other circuitry necessary to send information to the monitor for display on the screen. It consists of a circuit board, usually referred to simply as a card ("video card" and "video controller" mean the same thing), which is attached to the computer's motherboard. The processing power of the video controller determines, within the constraints of the monitor, the refresh rate, the resolution, and the number of colors that can be displayed.

During the 1980s, when most PCs were running DOS and not Windows, the screen displayed ASCII characters. Doing so took very little processing power, because there were only 256 possible characters and 2,000 text positions on the screen. Rendering each screen required only 4,000 bytes of data.

Windows, however, is a graphical interface, so the CPU must send information to the video controller about every pixel on the screen. At the minimum resolution of 640 × 480, there are 307,200 pixels to control. Most users run their monitors at 256 colors, so each pixel requires one byte of information. Thus, the computer must send 307,200 bytes to the monitor for each screen.

If the user wants more colors or a higher resolution, the amount of data can be much higher. For example, for the maximum amount of color (24 bits per pixel will render millions of colours) at 1024 × 768, the computer must send 2,359,296 bytes to the monitor for each screen.

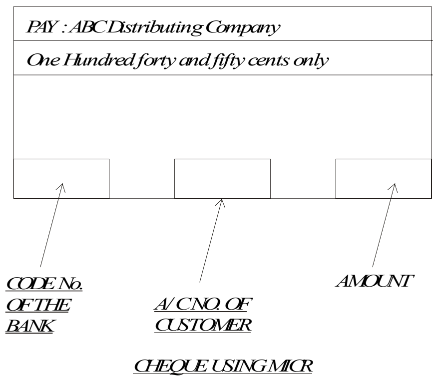
The result of these processing demands is that video controllers have increased dramatically in power and importance. There is a microprocessor on the video controller, and the speed of the chip limits the speed at which the monitor can be refreshed. Most video controllers today also include at least 2 MB of video RAM, or VRAM. (This is in addition to the RAM that is connected to the CPU.)VRAM is "dual-ported," meaning that it can send a screenful of data to the monitor while at the same time receiving next screenful of data from the CPU. It's faster and more expensive than DRAM (Dynamic RAM) Users with larger monitors or with heavy graphics needs usually will want even more than 2 MB of VRAM.

1.2 DIRECT DATA ENTRY

Direct Data Entry (DDE) refers to entry of data directly into the computers through machine readable source documents. DDE does not require manual transcription of data from original paper documents. DDE devices can scan source documents magnetically or optically to capture data for direct entry into the computer. Magnetic ink character readers and optical character readers are examples of such devices..

We will now describe each of the above devices.

1.2.1 Magnetic ink character recognition (MICR) : MICR employs a system of printed characters which are easily decipherable by human beings as well as a machine reader. There is used special printing font to represent characters. In this font, each character is basically composed of vertical bars (See "2" of Figure 1.2.1.1) The characters are printed in special ink, which contains a magnetizable material. In "2" of Figure 1.2.1.1 there are four small gaps and two big gaps.



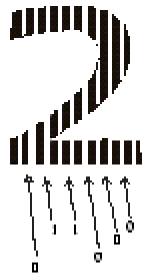


Fig. 1.2.1.1 Check using MICR

When a character is subsequently read it is passed beneath a reading head and big and small gaps send in different types of impulses represented by 1 bit and 0 bit respectively.

This method is primarily used in banking industry, and most cheques are now processed under the MICR approach. The data printed across the bottom of a blank cheque are recorded in MICR form ; the characters represent the bank on which the cheque is drawn, the customer's account number and the amount of the cheque. The cheques themselves are prepared off-line. When they are originally printed by a printing press, the MICR about the bank identification number, as well as the data about the customer's bank account number are printed simultaneously. The cheques then are turned over to the proper bank customer for use. Once the cheques have been cashed or deposited in a bank, an operator uses an off-line encoding machine to encode the amount on the cheque's bottom-right side.

MICR data are used for input purposes. Unlike other media (floppy disk and magnetic disk), MICR can not be used for output purposes.

Advantages of MICR :

(*i*) MICR possesses a very high reading accuracy. Cheques may be smeared, stamped, roughly handled yet they are accurately read.

(*ii*) Cheques can be handled directly without transcribing them on floppy disk, magnetic tape etc.

(*iii*) Cheques can be read both by human beings and machines.

Disadvantages of MICR :

(*i*) MICR has not found much favour from business.

(*ii*) Damaged documents, cheques not encoded with amount etc. have still to be clerically processed.

1.2.2 Optical character reading (OCR) : OCR also employs a set of printing characters with standard font that can be read by both human and machine readers. The machine reading is done by light scanning techniques in which each character is illuminated by a light source and the reflected image of the character is analysed in terms of the light-dark pattern produced. Key-board devices are used to give the required print quality. OCR has the potential of reading even handwritten documents straightway.

Optical character readers can read upper and lower case letters, numerics and certain special characters from handwritten, typed and printed paper documents. The specific characters that can be read and whether the characters must be handwritten, typed or printed depends upon the type of OCR being used. Obviously OCR annihilates the time consuming step of transcription.

Fig. 1.2.2.1 OCR

The optical character readers have slightly irregular type face as shown in the figure1.2.2.1. They can read the characters printed by computer printers, cash registers, adding machines and typewriters. Some readers can also read hand-written documents. Figure 1.2.2.2 shows some handwritten characters that can be read by the recognition devices, most optical character readers can be used to sort out forms as well as to read data into computer storage.

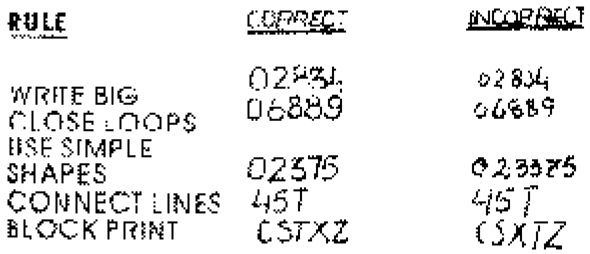


Fig. 1.2.2.2 Hand written characters

Large volume billing applications (*e.g.* the bills of utility companies, credit-card organisations, and magazine subscription outfits) increasingly are being adapted to OCR methods. The customer paying the bill returns the bill, which has OCR data (*e.g.* customer number and amount of the bill) recorded on it, along-with payment. Thus, the billing organisation's bill (or the part returned by the customer) becomes input for recording cash payments received from the customer. This procedure sometimes referred to as the use of "**turn-around documents**" has the advantage of minimizing or eliminating the keying process when cash receipts are received from customers.

Advantages of OCR

(i) OCR eliminates the human effort of transcription.

(ii) Paper work explosion can be handled because OCR is economical for a high rate of input.

(iii) Since documents have only to be typed or handwritten, not very skilled staff (like the keypunch operators) is required.

(iv) Furthermore, these input preparation devices (typewriters etc.) are much cheaper than the keypunch or the key-to-tape devices.

Limitations of OCR

(i) Rigid input requirements - There are usually specific (and rather inflexible requirements for type font and size of characters to be used. In typing there is always the scope for strike-overs, uneven spacing, smudges and erasures; and the form design, ink specifications, paper quality, etc. become critical and have to be standardized.

(ii) Most optical readers are not economically feasible unless the daily volume of transactions is relatively high. However, further developments in OCR are likely to make optical readers much cheaper.

OCR characters can be sent as input to the CPU. Also, printers can be used to generate OCR output. Optical character readers can read from both cut form and continuous sheets.

1.2.3. Optical mark recognition (OMR) : Optical marks are commonly used for scoring tests. The (Fig. 1.2.3.1) shows part (just the social security number in the U.S) of a typical test scoring sheet. It is marked by the person taking the test, and can be read by the optical mark page reader. The optical mark reader when on-line to the computer systems, can read up to 2,000 documents per hour. Seemingly this rate is slow but the fact that transcription has been eliminated, the overall time is less than those of the conventional file media.

OMR can also be used for such applications as order writing, payroll, inventory control, insurance, questionnaires, etc. However, it is to be noted that designing the documents for OMR is rather a tough task. They should be simple to understand otherwise errors may result more perhaps than would occur in using traditional source documents and keypunching from them.

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Fig. 1.2.3.1 Optical Mark Reorganization

Technical details of optical scanning: In all optical readers, the printed marks and/or characters must be scanned by some type of photo-electric device, which recognises characters by the absorption or reflectance of light on the document (characters to be read are non-reflective) Reflected light patterns are converted into electric impulses, which are transmitted to the recognition logic circuit — there they are compared with the characters the machine has been programmed to recognise, and, if valid, are then recorded for input to the CPU. If no suitable comparison is possible, the document may be rejected.

1.2.4 Smart Card Systems- Smart cards resemble credit cards in size and shape; however, they contain a microprocessor chip and memory, and some include a keypad as well. These were pioneered in France and many organizations are still just experimenting with them. In many instances, smart cards make it possible for organizations to provide new or enhanced services for customers.

So far, smart cards are used most frequently to make electronic purchases and to electronically transfer funds between accounts. However, the potential applications for these are abound. For example, in the health care industry, smart cards could be used to store the holder's identity, address, insurance data, relatives' details, allergies, and even a brief medical history. If the cardholder was disabled by an accident or illness, the card could be used immediately to assist with treatment. Smart cards could also be used for security applications. For example, a card could contain the digitized fingerprint of the cardholder, which could be compared at a security checkpoint to fingerprints of people who are authorized to enter a secured area.

1.2.5 Bar Code Reader : The most widely used input device after the keyboard and mouse is the flatbed or hand-held bar code reader commonly found in supermarkets and departmental stores. These devices convert the bar code, which is a pattern of printed bars on products, into a product number by emitting a beam of light – frequently a laser beam – which reflects off the bar code image. A light-sensitive detector identifies the bar code image by recognizing special bars at both ends of the image. Once the detector has identified the bar code, it converts the individual bar patterns into numeric digits. The special bars at each end of the image are different, so the reader can tell whether the bar code has been read right side up or upside down.

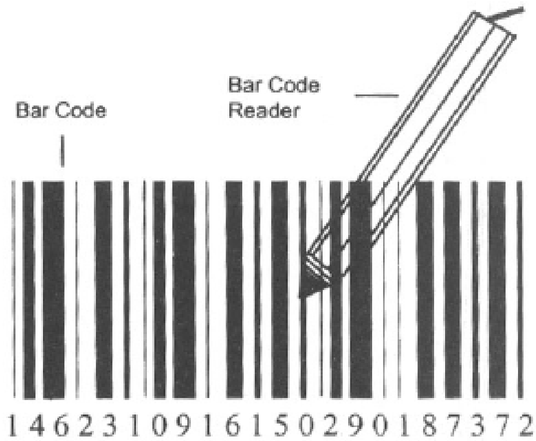


Fig. 1.2.5.1 Bar Code Reader

After the bar code reader has converted a bar code image into a number, it feeds that number to the computer, just as though the number had been typed on a keyboard.

Bar codes provide the advantages of improved accuracy of data entry, better customer service through faster checkout at the point of sale, and greater control and reliability of inventory records. They are used in industries and organizations that must count and track inventory, such as retail, medical, libraries, military and other government operations, transportation facilities, and the automobile industry.

Two-dimensional (2D) bar codes have been developed that store the equivalent of two text pages in the same amount of space as a traditional UPC. One of the first uses of 2D bar coding was handing barrels of hazardous toxic waste. Now it is commonly used in a variety of industries. For example, every shipping carton sent to one of Wal-Mart's distribution centers must have a 2D bar code. The bar code contains the purchase order, stock numbers, the contents of each box, a product's origin, its destination, and how it should be handled during shipping. These bar codes automate many of the mundane and time-consuming shipping tasks.

1.2.6 Image Processing : Image Processing captures an electronic image of data so that it can be stored and shared. Imaging systems can capture almost anything, including keystroked or handwritten documents (such as invoices or tax returns), flowcharts, drawings, and photographs. Many companies that use document imaging are making significant progress toward paperless offices. There are five distinct steps to document imaging:

- *Step1:* **Data capture.** The most common means of converting paper documents into electronic images is to scan them. The scanning device converts the text and pictures into digitized electronic code. This scanner can range from a simple hand held device to a high-end, high-speed scanner capable of scanning more than 2,500 pages an hour. *Hand held scanners* could transform text or graphical images into machine-readable data. Organisations such as publishers and law firms, that frequently receive documents, may use such scanners to convert the typed pages into word processing files. These can also be used for entering logos and other graphics for desk top publishing application. Fax modems are also used to receive electronic images of documents. Some of today's low speed printers and fax machines have removable print heads that can be replaced with a scanning head, enabling the printer to work as an image scanner.

- *Step2:* **Indexing**. Document images must be stored in a manner that facilitates their retrieval. Therefore, important document information, such as purchase order numbers or vendor numbers, is stored in an index. Great care is needed in designing the indexing scheme, as it affects the ease of subsequent retrieval of information.

- *Step 3:* **Storage.** Because images require a large amount of storage space, they are usually stored on an optical disk. One 5.25-inch optical platter can store 1.4 gigabytes, or about 25,000 documents (equivalent to 3 four-drawer filing cabinets) A 12-inch removable optical disk stores up to 60,000 documents, and up to 100 optical disks can be stored in devices called jukeboxes.

- *Step 4:* **Retrieval**. Keying in any information stored in an index can retrieve documents. The index tells the system which optical disk to search and the requested information can be quickly retrieved.
- *Step5:* **Output**. An exact replica of the original document is easily produced on the computer's monitor or on paper, or is transmitted electronically to another computer.

Advantages of Image Processing : It has been estimated that 90% of the work accountants and others do today is done using paper. It is also estimated that the volume of information required by companies doubles every three or four years. As a result we are faced with being buried by paper. One solution is to make better use of document imaging. More companies are moving to this technology and it is estimated that by 2004 only 30% of our work will be paper-based; 70% will be electronic. The move to document imaging provides the following advantages:

(i) Accessibility : Documents can be accessed and reviewed simultaneously by many people, even from remote locations.

(ii) *Accuracy :* Accuracy is much higher because costly and error-prone manual data-entry processes are eliminated.

(iii) *Availability :* There are no more lost or misfiled documents.

(iv) *Capacity:* Vast amounts of data can be stored in very little space, which significantly reduces storage and office space.

(v) *Cost :* When large volumes of data are stored and processed, the cost per document is quite inexpensive. As a result, the costs to input, file, retrieve, and refile documents are reduced significantly.

(vi) *Customer satisfaction :* When waiting time is significantly reduced (due to lost or misfiled documents, queue time, etc.), customers can get the information almost immediately.

(vii) *Security :* Various levels of passwords (network, data base, files, etc.) and clearances can be assigned to restrict document access.

(viii) *Speed :* Data can be retrieved at fantastic speeds. Stored documents can be indexed using any number of identifying labels, attributes, or keywords.

(ix) *Versatility :* Handwritten or types text can be added to an image, as can voice messages. Documents can be added to word processing files; the data can be included in a spreadsheet or data base.

1.3 TYPES OF COMPUTER OUTPUT

The various types of output from a computer system may be chosen from the following list according to specific requirements :

- Printed
- Visual display
- COM(Computer Output on Microfilm)
- Audio
- Magnetically encoded
- Graphical

1.3.1 PRINTED OUTPUT : PRINTERS

Printer is one of the most common output devices. It provides the user with a permanent visual record of the data output from the computer. Printers can print on ordinary paper or on specially prepared forms such as dispatch notes, invoices or packing slips. Printers have been developed that are capable of printing from 150 to 2,500 lines per minute, each line consisting of as many as 150 characters. Printers can broadly be subdivided into two categories: impact and non-impact printers. The former are the most common.

1.3.1.1 Impact printers : Impact printers can be described as printers which utilize some form of striking device to transfer ink from an inked ribbon onto the paper being printed to form images or characters. The characters printed are formed by one of two methods : (*i*) they are either distinct, whole alphanumeric images produced by a process known as full character or formed character printer or, (*ii*) they are formed by a dot matrix method which arranges a series of dots to assume the shape of each character being printed.

Impact printers fall into two basic categories-Serial or line printing.

(a) Serial Printers : Regard less of which character generation method is used, serial printers print one character at a time, usually from left to right. Some printers, however, can also print in a bidirectional format at an increased speed. In most business organisations two types of serial printers are used :

(i) Dot-matrix Printers : In the early 1970's a new print system called dot matrix printing was developed for use with data processing systems. These small, compact printers offered high speed, relatively low price and greater programmability for graphics and illustrations due to their method of character generation. They became the standard printers for many minicomputers and nearly all microcomputers and, consequently, were also used for word processing requirements. Dot matrix printers utilise wire needles or pins which strike the ribbon against the paper in the pattern necessary to produce each character image. The printing head is a matrix block which consists of rows and columns of holes through which pins appear. The characters being printed are formed by activating the printing head so that certain pins appear through the holes to from a pattern which resembles each character. The pins are formed into the shape of the character to be printed, then pressed against an inked ribbon and the pattern printed on the paper. The character, whether they are letters, numbers or grammatical symbols are printed as a series of dots which merge together to form the character.

The matrices of these printers can vary in size from printer to printer depending on the print quality required. Some may have 11 rows of pins with 9 columns in each row; while others may have as many as 23 rows with 18 columns per row. The characters can, therefore, be formed from matrices using any combination from 99 to 414 dots printed by the pins. The greater the number of dots printed on the paper, the better the quality of the copy. An example of how a lower case letter ‘d’ is formed is shown in Figure 1.3.1.1.1.

```
0 0 0 0 0 0   0 0
0 0 0 0 0 0   0 0
0 0 0 0 0 0   0 0
0 0 0         0 0
0 0   0 0 0   0 0
0 0   0 0 0   0 0
0 0   0 0 0   0 0
0 0   0 0 0   0 0
0 0 0       0 0 0
```

Figure 1.3.1.1.1 : Dot Matrix Character Formation.

Dot matrix printers are fast and cheap but their print quality is relatively poor. They are only really suitable for printing draft copies and documents, which are usually retained within an organisation. The printing also varies according to the type of matrix printer used. Most employ an ink ribbon, similar to conventional typewriter ribbons, to print documents. Although not of a high quality, when compared to letter quality printers, dot matrix printers do have the advantage of being able to print a much wider range and size of typeface and, in addition, can print graphs, illustrations and drawings. This type of printer can also be used to print colour.

Manufacturers of dot matrix printers include: Brother, Canon, Centronics, Commodore, Epson, Facit, General Electric, Hewlett Packard, Mannesheim Tally, NEC, OKI, Seikosha, Shinwa, Star, and TEC.

(ii) Daisywheel Printers : 'Daisywheel' printers work in a similar manner to an electronic typewriter. The major difference is that they use a new type of printing element called a 'daisywheel'. This is a molded metal or plastic disc-shaped printing element which looks very much like a daisy - hence the name. (See Figure 1.3.1.2) It is about 65 m.m. in diameter and has a number of stalks or petals which radiate from a central core. On the end of each stalk is a type character set in a similar manner to the keys as on a typewriter. This type of printer works by rotating the print element until the required character is positioned in front of the sheet of paper at the point where it will be printed. A small hammer hits the back of the stalk forcing that character against an inked ribbon and through onto the paper. All this 'happens at anything from 10 to 80 characters per second, which is far faster than a typist can type. A similar device, shaped like and called a 'Thimble' printer is used by the Japanese company NEC on the 'Spinwriter " printer. There printers enable users to change the typeface elements very quickly giving far more scope to the typing of important documents.

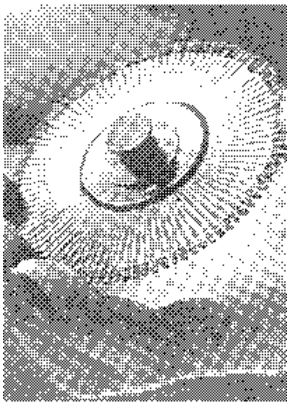


Figure 1.3.1.2 : The daisy wheel Printer

Quite recently cheaper daisywheel printers have appeared on the market. Major manufacturers of the daisywheel printers include: Brother, Data point, Diablo, Fujitsu, NEC, Olivetti, Olympia, TEC and Wang etc.

(b) Line Printers : A line printer operates at much higher speeds and prints what appears to be a full line at a time. Line printers are only used where high speed and volume is necessary and where quality is the lesser requirement. Two types of line printers are discussed belows :

(i) **Chain Printers :** (Fig. 1.3.1.3) It has a chain that revolves at a constant speed in a horizontal plane. The complete chain has a complement of 48 numbers, alphabets and special symbols cast on 5 times over. It is confronted by a set of as many hammers as the number of print position say, 160. These hammers are magnetically controlled. The continuous stationery and ribbon are inter posed between a segment of the chain and the set of hammers. When a required character on the chain faces its print position, the corresponding hammer is actuated.

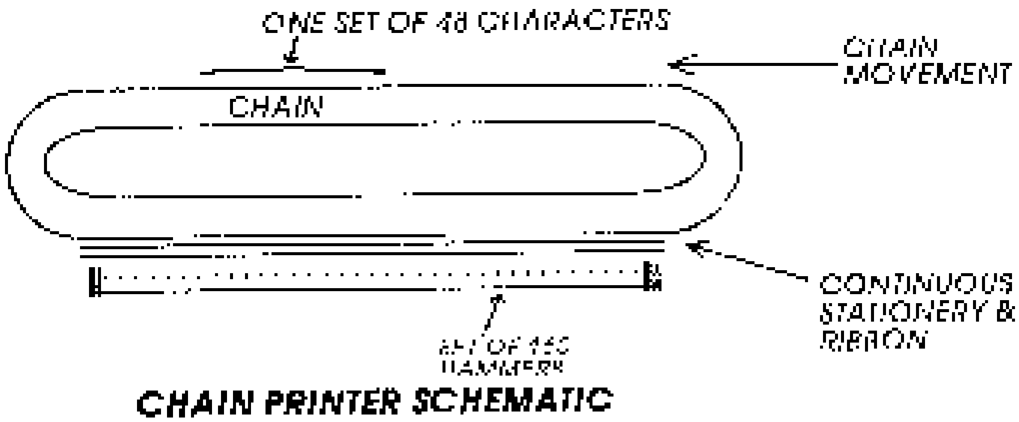


Fig. 1.3.1.3 : Chain Printer Schematic

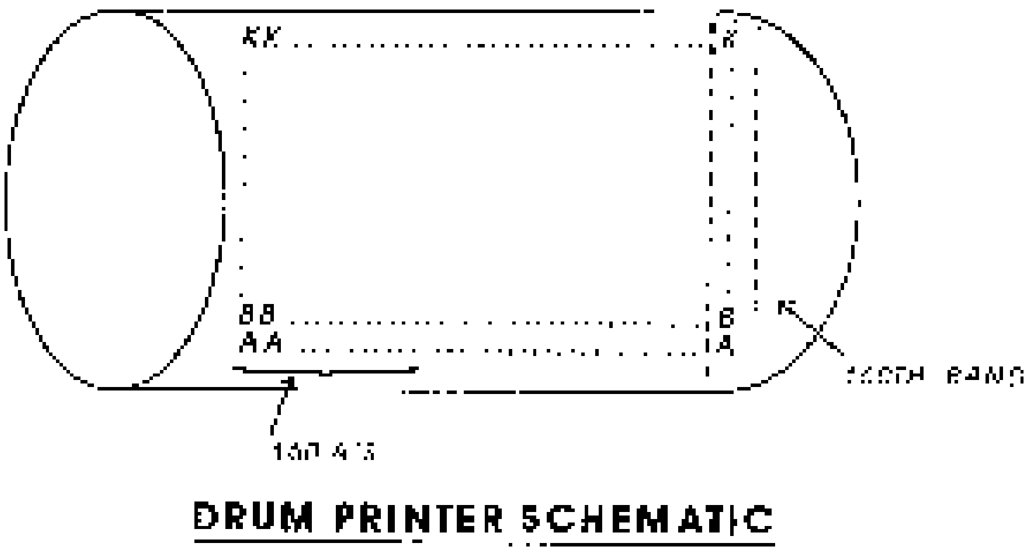


Fig. 1.3.1.4 : Drum printer schematic

(ii) Drum Printers : These printers use a solid cylinder. There are as many bands on it as the number of print positions. Each band has cast on it the complement of 48 numerals, alphabets and special characters. The drum rotates at a constant speed confronted by a set of as many hammers as the number of bands with the inked ribbon and continuous stationery interposed. In one rotation of the drum there would be appropriate strikes by the set of the hammers. In the first strike A's are printed in the appropriate print positions, followed by B,C,.......Z,0,1.........9 and special symbols one by one.

Various Characteristics of Printers

(i) *Speed* : The speed of a printer is measured in terms of cps (characters per second), lps (lines per second) or PPM (pages per minute) The speed of a dot-matrix printer is measured in CPS. While the speed can vary widely, it is generally 200 CPS. A line printer prints a line at a time. Its speed can be any where from 5 to 50 lps.

(ii) *Quality of output* : Depending on the type of characters formed, printers can be classified as draft, near letter quality (NLQ) or letter quality printers.

In a *draft quality printer,* a character is formed by arranging dots to resemble it. Although the characters can be distinguished, the output is not as good as that of near letter quality printouts. A dot-matrix printer is an example of a draft printer.

Near letter quality printers use a special character which resembles that of a typewriter. A daisy wheel printer is an example of a NLQ printer. Most dot-matrix printers can also be set to produce near - letter quality printouts.

Letter quality printers use a character set in which each letter or character is fully formed. The quality of output is the best in such printers. A *laser* printer discussed below is an example of a letter quality printer.

(iii) *Direction* : Printers can be unidirectional or bi-directional. In a unidirectional printer, printing takes place in one direction only. After printing a line from left to right, the print head returns to the left without printing. A bi-directional printer prints both ways.

1.3.1.2 Non-impact printers : A non-impact printer forms characters by chemical or electronic means. The non-impact printers are, however, not commonly used for the following reasons:-

(i) Special and more expensive paper is required.

(ii) Only one copy can be printed at a time.

(iii) The print is not as sharp or clear as with the impact printer.

(iv) Output is difficult to copy on office machines.

However, three types of non-impact printers are worth mentioning because they are expected to become more important in the future, as the technology becomes cheaper. These are

- *Thermal printers*
- *Ink-jet printers*
- *Laser printers.*

They are fast in operation, printing a page, or even more in a second but currently they are too expensive to be widely used. The laser printer produces very high quality prints from a wide selection of character fonts. Not many business organisations can justify the present high cost of laser printing but costs are falling sharply and laser printing is likely to become more common place. We have discussed below each of these briefly :

i) **Thermal printers :** These printers use thermal printing facility i.e. the printer forms each character on the matrix printing head in the normal way but, instead of the printing head being impacted physically against an inked ribbon to print the character, the pins are heated by the electric element and then pressed against the paper. When the pins touch the paper, the area heated by the pins changes colour, usually to black or brown to form the character.

Fig.1.3.1.2.1 Thermal Printers

(ii) **Ink-Jet Printers :** This type of printers utilize the dot matrix principle but in stead of pins, set mechanically to form a character, it uses an array of nozzles which spray jets of ink onto the paper. When they first appeared; ink jet printers were very expensive but now a number of ink jet printers are beginning to find their way on to the market at fairly reasonable prices. An excellent example of such a printer is the Hewlett Packard" Thinkjet" originally

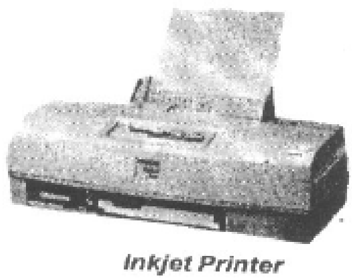


Fig. 1.3.1.2.2 Inkjet Printer

developed for the Hewlett Packard HP 150 "Touch-Screen" microcomputer. HP 670C and HP 810C have now been made available for use with the IBM PC and other micro-computers.

Fig. 1.3.1.2.2 : Inkjet Printer

Other examples include Canon's PJ 1080 A, the Diablo C-150 and the Olivetti Spark Ink Jet Printer, which can operate at 50 lines per minute.

There are two types of inkjet printers:

Inkjet printers are very quiet and provide laser-like quality at a much lower cost although supplies are relatively expensive. Although one can print on regular paper, better results are obtained by using special paper that doesn't allow the ink to soak in.

Liquid inkjet : Color inkjet printers use three separate inkjets, one for each of the primary colors (red, green, and blue)

Liquid inkjet printers use ink cartridges from which they spray ink onto the paper. A cartridge of ink attached to a print head with 50 or so nozzles, each thinner than a human hair, moves across the paper. The number of nozzles determines the printer's resolution. A digital signal from the computer tells each nozzle when to propel a drop of ink onto the paper. On some printers, this is done with mechanical vibrations.

Solid inkjet : Solid inkjet printers use solid ink sticks that are melted into a reservoir and sprayed in precisely controlled drops onto the page where the ink immediately hardens. High- pressure rollers flatten and fuse the ink to the paper to prevent smearing. This produces an exceptionally high-quality image with sharp edges and good colour reproduction. Solid inkjet printers are also the best for producing low-cost but high-quality transparencies. These printers are sometimes referred to as phase-change printers because the ink moves from a solid to a liquid phase to be printed then back to a solid phase on the page. As a final step, the paper moves between two rollers to cold-fuse the image and improves the surface texture.

(iii) **Laser Printers :** Laser printer uses a combined system which utilizes laser and Xerographic photocopying technology. In a laser printer, a beam from a small laser scans horizontally across a charged xerographic selenium drum to build up an invisible electrostatic image of a whole page of text. Using standard photocopier techniques, the formed image is then transferred to the paper being printed. Toner is attracted to the electrostatic image and it is then permanently fixed using heat. A wide

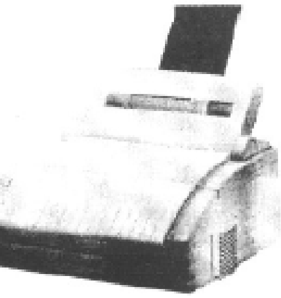


Fig. 1.3.2.3 : Laser Printer

variety of typefaces are available. Very competitively priced laser printers have been introduced by various companies such as Hewlett Packard. These printers, which can be used by most personal computers and the microcomputers, have an excellent print quality. Laser printer produces not only alphanumeric characters but also drawings, graphics and other requirements. Its output can be very close to professional printing quality. The dots making up the image are so closely spaced that they look like characters typed on a typewriter. The laser printer prints a page at a time. Its speed can be anywhere between 4 to 17 pages per minute (ppm) The resolution of laser printers is measured in dots per inch (DPI) The most common laser printers have resolutions of 600 DPI, both horizontally and vertically. Some laser printers have a resolution of 1200 DPI also.

Laser printer features : Even with the best printers, there are differences that affect their use. These include the number of sides the printer prints on, its memory, and its fonts.

Duplex printers print on both sides of a sheet of paper at the same time. This duplex printing is ideal for documents that will be stapled or bound.

Laser printers make up an entire page before printing it. The page is temporarily stored in the printer's memory while it is being processed and printed. If a page contains a graphics image, the memory required for it can be substantial. For example, it takes 1 megabyte to store a full-page black-and-white graphics image that is to be printed with a 300-dpi resolution. To fill the page, the printer has to address over 8 million dots (1 megabyte x 8 bits = 8 million bits) This is obviously a big chore.

All laser printers come with some built-in fonts; however thousands of others can be added. At one time, these were added using plug-in cartridges. Currently they are built-in or distributed on disks and installed onto the system's hard disk drive. From there they are fed to the printer when needed.

1.3.2 COMPUTER OUTPUT MICROFILM (MICROFICHE)

Computer output microfilm (COM) is an output technique that records output from a computer as microscopic images on roll or sheet film. The images stored on COM are the same as the images, which would be printed on paper. The COM recording process reduces characters 24, 42 or 48 times smaller than would be produced from a printer. The information is then recorded on sheet film called 16 mm, 35 mm microfilm or 105 mm microfiche.

The data to be recorded on the microfilm can come directly from the computer (online) or from magnetic tape, which is produced by the computer (off-line) The data is read into a recorder where, in most systems, it is displayed internally on a CRT. As the data is displayed on the CRT, a camera takes a picture of it and places it on the film. The film is then processed, either in the recorder unit or separately. After it is processed, it can be retrieved and viewed by the user.

COM has several advantages over printed reports or other storage media for certain applications. Some of these advantages are:

(1) Data can be recorded on the film at up to 30,000 lines per minute-faster than all except very high-speed printers.

(2) Costs for recording the data are less.

(3) Less space is required to store microfilm than printed materials. A microfilm that weighs an ounce can store the equivalent of 10 pounds of paper.

(4) Microfilm provides a less expensive way to store data than other media provide.

To access data stored on microfilm, a variety of readers are available which utilize indexing techniques to provide a ready reference to data. Some microfilm readers can perform automatic data lookup, called computer-assisted retrieval, under the control of an attached minicomputer. With powerful indexing software and hardware now available, a user can usually locate any piece of data within a 200,000,000 characters data base in less than 10 seconds at a far lower cost per inquiry than using an on-line inquiry system consisting of a CRT, hard disk, and computer.

Though both microfilm and microfiche are created on a continuous negative film and one can make as many copies of the film as one desires, there are certain basic differences between the two. The Physical difference between a microfilm and microfiche is that a microfilm stays in a continuous form while a microfiche is cut into pieces. A microfilm is 16 millimeters (mm) or 35 mm roll of film contained in cartridges. Each roll can hold 2,000 to 5,000 pages of information. A microfiche, on the other hand, is 105-mm film cut in 4 × 6 inch sheet, each sheet capable of reproducing upto 270 page sized images. The operational difference between the two is that a microfilm has to be read sequentially until the desired record is retrieved whereas a microfiche allows direct access to data through hunt and storage procedure.

For certain applications, COM is a viable way to store and retrieves data.

1.3.3 MICROPHONES AND VOICE RECOGNITION

Now that sound capabilities are a standard part of computers, microphones are becoming increasingly important as input devices. Sound is used most often in multimedia, where the presentation can benefit from narration, music, or sound effects. In software, sounds are used to alert the user to a problem or to prompt the user for input.

For this type of sound input, basically a digitized recording is required. All that one needs to make such a recording are a microphone (or some other audio input device, such as a CD player) and a sound card that translates the electrical signal from the microphone into a digitized form that the computer can store and process. Sound cards can also translate digitized sounds back into analog signals that can then be sent to the speakers.

There is also a demand for translating spoken words into text, much as there is a demand for translating handwriting into text. Translating voice to text is a capability known as **voice recognition** (or speech recognition) With it, one can speak to the computer rather than having to type . The user can also control the computer with oral commands, such as "shut down" or "print status report".

Voice recognition software takes the smallest individual sounds in a language, called phonemes, and translates them into text or commands. Even though English uses only about 40 phonemes, a sound can have several different meanings ("two" versus "too," for example) making reliable translation difficult. The challenge for voice distinguish meaningful sounds from background noise.

Sound Systems : Just as microphones are now important input devices, speakers and their associated technology are key output systems. Today, when one buys a multimedia PC, one gets a machine that includes a CD-ROM drive, a high –quality video controller (with plenty of VRAM), speakers, and a sound card.

The speakers attached to these systems are similar to ones that are connected to a stereo. The only difference is that they are usually smaller and they contain their own small amplifiers. Otherwise, they do the same thing that any speaker does: they transfer a constantly changing electric current to a magnet, which pushes the speaker cone back and forth. The moving speaker cone creates pressure vibrations - in other words, sound.

The more complicated part of the sound output system is in the **sound card**. The sound card translates digital sounds into the electric current that is sent to the speakers. Sound is defined as air pressure varying over time. To digitize sound, the waves are converted to an electric current measured thousands of times per second and recorded as a number. When the sound is played back, the sound card reverses this process, translating the series of numbers into electric current that is sent to the speakers. The magnet moves back and fourth with the changing current, creating vibrations.

With the right software, one can do much more than simply record and play back digitized sound. Utilities that are built into Windows 95 provide a miniature sound studio, allowing the user to view the sound wave and edit it. In the editing one can cut bits of sound, copy them, amplify the parts one wants to hear louder, cut out static, and crate many exotic audio effects.

1.3.4 GRAPH PLOTTER

A graph plotter is a device capable of tracing out graphs, designs and maps into paper and even into plastic or metal plates. A high degree of accuracy can be achieved, even upto one thousandth of an inch. Plotters may be driven *on-line or off-line*. Computer systems dedicated to design work often operate plotter on-line but systems used for other applications as well as graphic applications operate them off-line.

There are two types of plotters:

Drum : A drum plotter plots on paper affixed to a drum. The drum revolves back and forth, and a pen suspended from a bar above moves from side-to-side taking up new plot positions or plotting as it moves. This device is suitable for routine graph plotting and also for fashion designs.

Flat-bed: On a flat-bed plotter, the paper lies flat. The bar on which the pen is suspended itself moves on a gantry to provide the necessary two-way movement. Colour plotting is usually possible.

Plotters are now increasingly being used in application like CAD, which requires high quality graphics on paper. A plotter can be connected to a PC through the parallel port. A plotter is more software dependent than any other peripheral, and needs much more instructions than the printer for producing output.

Many of the plotters now available in the market are desktop models that can be used with PCs. Business generally use plotters to present an analysis in visual terms (bar charts, graphs, diagrams) etc. as well as for engineering drawings.

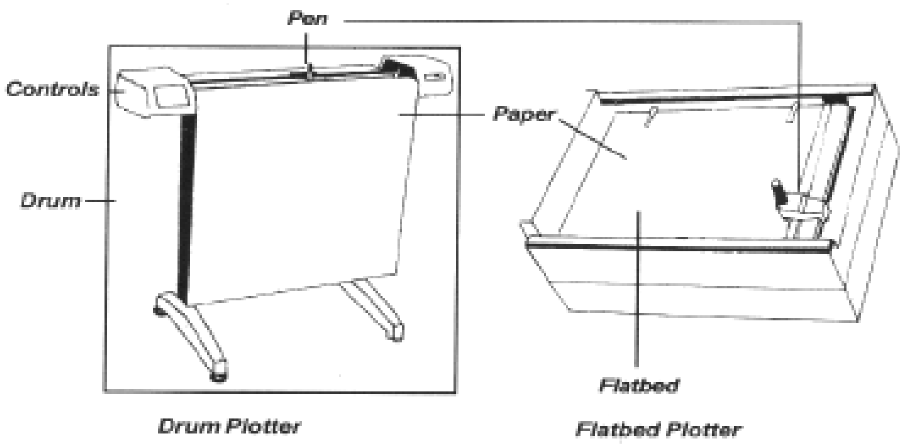


Fig. 1.3.4.1 : Graph Plotter

Self-examination questions

1. Write short notes relating to computer input and data capture.
2. Write brief notes on the following techniques and describe the situation in which each technique would be used :—

(i) Optical Character recognition (OCR)

(ii) Magnetic Ink Character Recognition (MICR)

(iii) Optical Mark Reader (OMR)

(iv) Image Scanners.

(v) Bar Codes

3. List the types of terminals which may be used for computer input.

4. What purpose do terminals serve ?

5. VDU (Visual display unit) and key-board-printer units are widely used as terminals to multiaccess systems. Give one example for each device where it is preferable to use it. Give reasons for your choice.

6 . Explain the differences between a dumb terminal and an intelligent terminal.

7. Summarise the different methods of producing computer output.

8. Distinguish between impact printers and non-Impact printers.

9. List the main features of a dot matrix and a daisy wheel printer.

10. Write short notes on laser printer and an ink-jet printer.

12. Write short notes on chain printer and a drum printer.

13. Explain the following terms:-

(*i*) Computer Output Microfilm.

(*ii*) Graph Plotter.

(*iii*) Voice recognition.

Multiple Choice Questions:

1. Mouse are of following types:

a) Mechanical b) Optomechanical c) Optical d) All above

2. Dot - Pitch is :

a) Vertical distance between pixel on a display screen

b) Distance between characters on printer

c) Horizontal distance between character in scanner

d) Rate at which screen is drawn

3. If the monitor has more resolution then:

   a) Colour will not be good b) Picture quality is good c) Both A & B d) None of the above

4. For graphics printing we use

   a) Dot Matrix Printer b) Scanner c) Plotter d) None of the above

5. Which is impact printer :

   a) Laser Printer b) Thermal Printer c) Ink Jet printer d) Dot Matrix Printer

Answer:

1. d **2.** a **3.** b **4.** c **5.** d

Unit 3 : Software

WHAT IS SOFTWARE ?

Software is a term used for the various kinds of programs, used to operate computers and related devices. It is different from The term hardware which describes the physical aspects of computers and related devices.

Software can be thought of as the variable part of a computer and **hardware** the invariable part. Software is often divided into **application software** (programs that do work users are directly interested in) and **System Software** (which includes operating systems and any program that supports application software). The term middleware is sometimes used to describe programming that mediates between application and system software or between two different kinds of application software (for example, sending a remote work request from an application in a computer that has one kind of operating system to an application in a computer with a different operating system).

There are basically three types of software : Systems software, applications software and general-purpose software. We will now discuss each of these in detail.

1.1 SYSTEMS SOFTWARE

It comprises of those programs that control and support the computer system and its data processing applications. It includes the following:

- Programming languages.
- Operating systems.
- Subroutines.
- Utility programs.
- Diagnostic routines.
- Language translators.

A broad spectrum of the above software is usually available from the manufacturer, but some software is also available from software concerns. There is generally an extra charge for software but some manufacturers furnish software without extra cost for those who purchase or lease their equipment. We will now describe each of the aforesaid software in detail.

1.1.1 PROGRAMMING LANGUAGES

The programming languages are part of the software or programming aids provided by the manufacturer. A programming language is a language used in writing programs to direct processing steps to be carried out by a computer.

A wide variety of computer programming languages are available. The programmer must be familiar with one or more of them in order to write a computer program. Each programming language has very specific standards and rules of use, which the programmer must know and adhere to when developing a program. The programming languages can be hierarchically divided as follows.

1.2 OPERATING OR (EXECUTIVE) SYSTEMS

Operating system is system software, act as an interface between hardware and user. It has two goals:

- Resource allocator
- Control Program

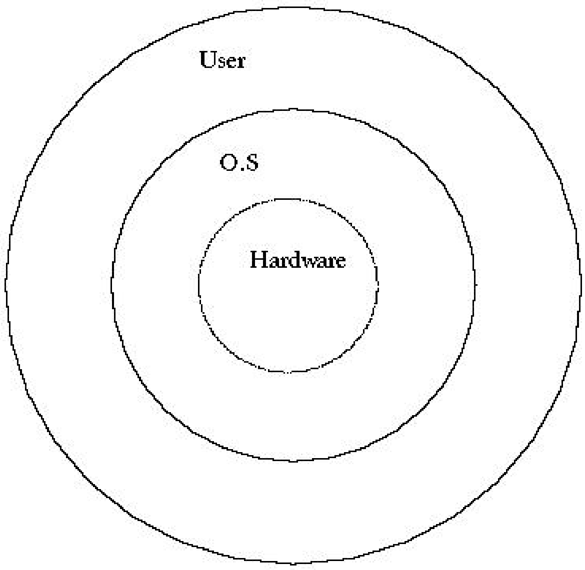


Fig. 1.2.1 Operating System as an Interface

The resources like Processor,Hard Disk,Memory etc are allocated by the Operating system.

As control program it provides the environment for the execution of the program and prevents improper use of computer.

There are six basic functions that an operating system can perform

(*i*) *Schedule Jobs:* They can determine the sequence in which jobs are executed, using priorities established.

(*ii*) *Manage Hardware and Software Resources:* They can first cause the user's application program to be executed by loading it into primary storage and then cause the various hardware units to perform as specified by the application.

(*iii*) *Maintain System Security:* They may require users to enter a password - a group of characters that identifies users as being authorised to have access to the system.

(*iv*) *Enable Multiple User Resource Sharing:* They can handle the scheduling and execution of the application programs for many users at the same time, a feature called multiprogramming.

(*v*) *Handle Interrupts* : An interrupt is a technique used by the operating system to temporarily suspend the processing of one program in order to allow another program to be executed. Interrupts are issued when a program requests an operation that does not require the CPU, such as input or output, or when the program exceeds some predetermined time limit.

(*vi*) *Maintain Usage Records* : They can keep track of the amount of time used by each user for each system unit - the CPU, secondary storage, and input and output devices. Such information is usually maintained for the purpose of charging users' departments for their use of the organisation's computing resources.

1.2.1 Files and Directories : OSs function at two different levels, the hardware level and the user level. The interaction of the OS with the computer's hardware level is, for the most part, hidden from the user. For example, signals relayed from the keyboard to the computer's microprocessor are done automatically, under the control of the OS, and without further recourse to instructions from the user.

Even so, the user will, at some stage or another, wish to install programs/ applications, copy files, perform search routines or execute any one of a wide and ever-increasing range of tasks. In order to carry out these procedures, the user has to access and operate an appropriate user interface. However, before doing so, the user should have an appreciation of the significance of files and directories at the operating system level.

File names : A file is a collection of related data, saved on a specific area of the surface of whatever storage medium the system is using. To be accessed, the file must have a name which is recognised by the system. The name is also significant in that it is usually an indication of purpose of the file and the type of data stored in the file.(It should be pointed out that OSs such as Windows 95 and Windows NT place greater emphasis on small icons as a means of identifying the nature and type of a particular file.) For most OSs the file usually has two names. These are known as the prefix and the suffix/ extensions. The prefix is supplied by the user. The suffix is supplied by either the user or the computer application currently being used.

The prefix is frequently separated from the suffix by a full stop or a slash. For example, in a DOS or Windows environment, the file LETTER.TXT would suggest that it is a letter file containing text data. Below is a listing of some typical DOS/ Window file names with appropriate suffixes indicating their contents:

File Name	**Data Type**
PAY.BAS	Basic program (.BAS - Basic)
COMP.WKS	Spreadsheet data file (.WKS -Worksheet)
ACC.CBL	Cobol program(.CBL - Cobol)
FRED.DAT	Simple data file (.DAT-Data)
SAVE.BAT	Batch file (.BAT -Batch file)
NOTE.TXT	Text file (.TXT - Text)
LETTER.DOC	Document file (.DOC - Document)
MENU.EXE	Executable file (.EXE - Executable)
PROG.COM	Command file (.COM - Command)
REG.DBS	Database file (.DBS - Database)
PIC.IMG	Image file (.IMG - IMAGE)

Directories : A directory is like a drawer in a filing cabinet. It contains files. In addition, just as a filing cabinet usually consists of multiple drawers, similarly a computer disk usually contains multiple directories. A directory can, if necessary, also contain other directories. When the directory contains another directory, it is known as sub directory. The purpose of directories is to enable the user to partition the computer's disk/storage devices in an organised and meaningful manner.

1.2.2 Graphical User Interfaces - Through the 1980s, micro computer's operating system was strictly text-based, and syntax sensitive command *i.e.* the users were required to issue commands to the operating system by entering them on the key board, one character at a time. For example, to copy a word processing document from one disk to another, he might enter "copy c:myfile a:" via the key board.

The trend now-a-days is away from command-driven interfaces to an user-friendly graphics oriented environment called Graphical User Interfaces or GUI.

GUIs provide an alternative to cryptic text commands. With the GUI, the user can interact with operating system and other software packages by selecting options from menus that are temporarily super-imposed over whatever is currently on the screen by using mouse to position the graphics cursors over the appropriate icons. Graphical user interfaces have effectively eliminated the need for users to memorise and enter cumbersome commands.

When 386 and 486 — based computers were launched, these systems supported complex graphic displays, hence graphical user interface became necessary for almost all applications. Responding in a timely manner, Microsoft produced MS-Windows. This was actually not an operating system but an operating environment which internally exploited MS-DOS capabilities to execute various system calls. Officially introduced in November 1983, Windows provided an effective GUI cover for MS-DOS. In November 1985, Microsoft released Windows 2.0, but it met with a lukewarm response. Windows 3.0, which became widely popular, was launched in May 1990.

1.2.3 Various Operating Systems

MS/ PC-DOS : The origins of Microsoft's Disk Operating System (MS-DOS) lie in the prelaunch era of the IBM PC. As IBM was about to finalise the PC, it started to negotiate with other computer companies to secure a suitable OS for the product. Initial contracts between IBM and Digital Research, the company which happened to own the rights to CP/M (Control Program for a Micro computer) which was, at that time, the market leader in microcomputer OSs, proved unsuccessful.

Microsoft Windows:

Microsoft windows is one of the most popular operating system, its success is often attributed because of Graphical user interface(GUI) feature. In this system we click on icons with mouse button rather than writing the command as in MS-DOS. Microsoft windows have the following features:

- Simple and user friendly.
- No need to write the command.
- Screen quite animated and attractive.
- It has the multitasking feature because of that more than one program can be executed concurrently.

Flavors of windows Operating System:

Windows 95 : Windows 95, a 32 bit OS was released in August 1995. It took Microsoft three and a half years to develop. It was a gigantic task as far as computer projects go and was estimated to have taken 75 million hours of testing prior to its release. It was greeted enthusiastically by the computer industry, which saw it as a significant launch platform which would enable it to sell even more sophisticated computers.

The significance of a 32-bit OS as opposed to a 16-bit OS can be measured by the amount of internal main memory that can be directly access by the user/program. For example, with a 16-bit version of MS-DOS, the maximum amount of directly accessible memory is 1 MB. However, with a 32 bit OS, the user has direct access to 4 GB of main memory. To run Windows 95 users need a computer equipped with a 386DX or higher processor with a minimum of 4 Mb of memory (8Mb is recommended) along with a hard disk of 50 Mb as well as 3.5 inch disk drive or a CD-ROM.

Windows 95 was designed to have certain critical features over and above what was already supplied by Windows 3.1 or Windows for Workgroups. These included:

(a) A 32-bit architecture which provides for a multitasking environment allowing the user to run multiple programs or execute multiple tasks concurrently. This architecture also enables faster data / file access as well as an improvement in printing delivery.

(b) A friendlier interface fitted with what is described as ‘one click’ access. One click access refers to the fact that users didn’t have to double click on the mouse every time that they wanted to activate an application. Other congenial attributes include the ability to employ long file names, easy navigation routes and ‘plug and play technology’ enabling users to connect various peripheral devices or add-ons with the minimum of fuss.

(c) Windows 95 is also network ready. In other words the OS is designed for easy access to network resources. The OS also facilitates gateways to e-mail and fax facilities and access to the Internet via the Microsoft Network. In addition Windows 95 is backwardly compatible with most 3.1 Windows / DOS applications so enabling users to migrate from previous systems / applications.

Windows NT: Unlike Windows 3 and Windows 95, Windows New Technology (NT) is what is known as an industry standard mission critical OS. As a 32 bit OS Windows NT represents the preferred platform for Intel’s more powerful Pentium range of processors. Although not exactly the same, Windows NT 4.0 is, as might be expected, very similar in appearance to Windows 95. Critical features that allow the program to context the commercial OS market include:

- A stable multitasking environment
- Enhanced security features
- Increased memory
- Network utilities
- Portability: NT can operate on microprocessors other than those designed for the PC.

Windows NT is, as might be expected, more expensive than the other Windows OS and makes greater processing demands. However, it should be pointed out that Windows NT is making massive inroads into the corporate computing market and is fully recognised as being a competent useful OS.

OS/2: In 1987 IBM and Microsoft announced a new PC OS called OS/2 (Operating System Two) Unfortunately, the original OS/2 was not very successful. Hindsight suggests that, as with the early versions of Windows, one of the reasons for the slow uptake of OS/2 was the then considerable hardware demand of this particular application.

Another more serious problem with the original OS/2 that it was unable to support many existing PC applications. So users faced problems due to lack of compatibility between their original applications and OS/2. Predictably, the initial lack of interest in the original OS/2 resulted in a considerable strain on the IBM - Microsoft alliance. Not long after the launch of OS/2, IBM and Microsoft began to go their separate ways. Microsoft effectively abandoned OS/2 to IBM and chose instead to concentrate on MS-DOS and Windows.

1.3 OPERATING SYSTEMS FOR LARGER SYSTEMS

- Operating systems for mid-range and mainframe systems are often more complex than those for microcomputers.
- MVS is the most common operating system used on IBM mainframe. OS/400, an operating system for the IBM AS/400 line of midrange computers, is used at most of the sites where AS/400 is installed.
- VMS is the operating system used most frequently on DEC midrange and mainframe systems.

Interleaving Techniques : Large centralized systems often support multiple simultaneous users. The users' terminals may have limited processing capabilities and actual processing may be done entirely on the large computer that is connected to the terminals. Hence, this computing configuration requires an operating system that enables many users to concurrently share the central processor. To do this, the operating systems on large computer systems often combine (interleave) the processing work of multiple simultaneous users or applications in a manner that achieves the highest possible resource efficiency. Among the interleaving techniques commonly used are multiprogramming, foreground/background processing ,multi-tasking, virtual memory, and multi-processing.

Feature of Operating System:

1.3.1 Multiprogramming - The purpose of multiprogramming is to increase the utilization of the computer system as a whole. You might have noted when a program issues an input/output command, the program and hence the CPU is placed in a wait state until the execution of the command has been completed. When the transfer of data between main memory and the input/output devices has been completed, the device generates an *interrupt*, which is a signal that the data has been transferred. Till then the CPU remains idle and only after it receives the interrupt signal, it continues processing. Hence, in a way, the speed of the CPU is restricted by the speed of I/O devices and most of the time the CPU keeps waiting for the I/O operations to be completed. In order to utilize the computer more effectively, a technique known as *multiprogramming* has been developed. It is a module that is available in an operating system.

Multiprogramming is defined as execution of two or more programs that all reside in primary storage. Since the CPU can execute only one instruction at a time, it cannot simultaneously execute instructions from two or more programs. However, it can execute instructions from one program then from second program then from first again, and so on. This type of processing is referred to as "concurrent execution". Using the concept of concurrent execution, multiprogramming operates in the following way:

When processing is interrupted on one program, perhaps to attend an input or output transfer, the processor switches to another program. This enables all parts of the system, the processor, input and output peripherals to be operated concurrently thereby utilizing the whole system more fully. When operating on one program at a time, the processor or peripherals would be idle for a large proportion of the total processing time even though this would be reduced to some extent by buffering. **Buffering** enables the processor to execute another instruction while input or output is taking place rather than being idle while transfer was completed. Even then, when one program is being executed at a time, basic input and output peripherals such as floppy disk drive and line printers are slow compared with the electronic speed of the processor and this causes an imbalance in the system as a whole. However, in a multi-programming environment, the CPU can execute one program's instructions while a second program is waiting for I/O operations to take place.

In a system of multiprogramming, storage is allocated for each program. The areas of primary storage allocated for individual programs are called "partitions". Each partition must have some form of storage protection and priority protection to ensure that a program in one portion will not accidentally write over and destroy the instructions of another partition and priority (when two or more programs are residing in primary storage) because both programs will need access to the CPU's facilities (*e.g.*, the arithmetic and logic section) A system of priority-a method that will determine which program will have first call on the computer's facilities-is normally determined by locating the programs in specific partitions.

1.3.2 Foreground/background processing: Usually, it is possible to partition main memory into logically separate areas. This enables, for instance, two different operating systems to work on the same machine because each will have its own memory to manage in its own way. Partitioning also allows separate "job streams" to be set up. A common procedure is to set up a partition for high-priority tasks (called a foreground partition) and one for low-priority tasks (called a background partition) With foreground/background processing, foreground jobs are usually handled first. When no foreground task awaits processing, the computer goes to the background partition and starts processing tasks there. As other foreground tasks come into the job queue, the computer leaves the background partition and resumes working in the foreground

1.3.3 Multi-tasking : Multi-tasking refers to the operating system's ability to execute two or more of a single user's tasks concurrently. Multitasking operating systems are often contrasted with single-user operating systems. *Single-user operating systems* have traditionally been the most common type of operating system for microcomputers. These only allow the user to work on one task at a time. For example, with many single-user operating systems for microcomputer systems, a word-processing user cannot effectively type in a document while another document is being printed out on an attached printer. For microcomputers, multi-tasking operating systems provide single users with multiprogramming capabilities. This is often accomplished through foreground/background processing. Multitasking operating systems for microcomputers-Such as Windows, OS/2, UNIX, Xenix, and Macintosh System 7 – only run on the more powerful microprocessors that were developed; older machines with less powerful microprocessors typically have single-user operating systems.

1.3.4 Virtual Memory - A programmer has to take into account the size of the memory to fit all his instructions and the data to be operated in the primary storage. If the program is large, then the programmer has to use the concept of virtual memory. Virtual memory systems, sometimes called virtual storage systems, extend primary memory by treating disk storage as a logical extension of RAM. The technique works by dividing a program on disk into fixed-length pages or into logical, variable-length segments.

Virtual memory is typically implemented as follows. Programs stored on disk are broken up into fixed-length pages. When a program need to be processed, the first few pages of it are brought into primary memory. Then, the computer system starts processing the program. If the computer needs a page it does not have, it brings that page in from secondary storage and overwrites it onto the memory locations occupied by a page it no longer needs. Processing continues in this manner until the program finishes. This is known as *overlaying*

By allowing programs to be broken up into smaller parts, and by allowing only certain parts to be in main memory at any one time, virtual memory enables computers to get by with less main memory than usual. Of course, during page swapping in multiprogramming environments, the system may switch to other programs and tasks.

Thus, virtual memory is primary storage-that does not actually exist. It gives the programmers the illusion of a primary storage that is for all practical purposes never ending. It uses the hardware and software features, which provide for automatic segmentation of the program and for moving the segments from secondary storage to primary storage when needed. The segments of the program are thus spread through the primary and secondary (on-line) storage, and track of these segments is kept by using tables and indices. So far as the programmer is concerned, the virtual memory feature allows him to consider unlimited memory size, though not in physical term.

Virtual memory is tricky because writing software that determines which pages or segments are to be swapped in and out of real storage is a system programming art. A disadvantage of virtual memory systems is that time is lost when page swapping occurs. In some cases, the same pages will be brought in and out of primary memory and unusually large number of times, which is an undesirable condition known as thrashing. Machines that do not offer a virtual memory feature usually compensate for this by having larger primary memories.

1.3.5 Multiprocessing - The term multiprogramming is sometimes loosely interchanged with the term multiprocessing, but they are not the same. Multiprogramming involves concurrent execution of instructions from two or more programs sharing the CPU and controlled by one supervisor. Multiprocessing (or parallel processing) refers to the use of two or more central processing units, linked together, to perform coordinated work simultaneously.

Instructions are executed simultaneously because the available CPUs can execute different instructions of the same program or of different programs at any given time.

Multiprocessing offers data-processing capabilities that are not present when only one CPU is used. Many complex operations can be performed at the same time. CPU can function on complementary units to provide data and control for one another. Multiprocessing is used for nation's major control applications such as rail road control, traffic control, or airways etc.

Although parallel processing is not widespread yet, multiprocessing should be the wave of the future. Because of the availability of cheaper but more powerful processors, many computer manufacturers are now designing hardware and software systems to do multiprocessing. Since several machines can work as a team and operate in parallel, jobs can be processed much more rapidly than on a single machine..

1.4 OTHER SYSTEMS SOFTWARE

1.4.1 Utility Programs or Service Programs: Utility programs are systems programs that perform general system –support tasks. These programs are provided by the computer manufacturers to perform tasks that are common to all data processing installations. Some of them may either be programs in their own right or subordinates to be assembled/compiled in the application programs. The following tasks are performed by the utility programs.

(i) Sorting the data.

(ii) Editing the output data.

(iii) Converting data from one recording medium to another, viz., floppy disk to hard disc, tape to printer, etc.

(iv) Dumping of data to disc or tape.

(v) Tracing the operation of program.

In many instances, it is unclear what differentiates an operating system routine from a utility program. Some programs that one vendor bundles into an operating system might be offered by another vendor as separately priced and packaged utility programs.

A wide variety of utilities are available to carry out special tasks. Three types of utility programs found in most computer systems: sort utilities, spooling software, and text editors are discussed below:

(a) Sort utilities: Sort utility programs are those that sort data. For example, suppose we have a file of student records. We could declare "name" the *primary sort key* and arrange the file alphabetically on the name field. This would be useful for, perhaps, producing a student directory. Alternatively, we could sort the file by name, and then within name, by date-of-birth. Hence, we would declare name as the primary sort key and date-of-birth as the *secondary sort key*. Although the examples described here use only one or two sort keys, many sorting packages enable the user to identify 12 or more sort keys and to arrange outputted records in either ascending or descending order on each declared key.

Sort utilities are often found in mainframe and minicomputer environments. In the micro-computing world, it is typical for sort routines to be bundled into application packages; for example, sort routines are commonly found in spreadsheet and database management software.

(b) Spooling software: The purpose of spooling software is to compensate for the speed differences between the computer and its peripheral devices. Spooling software is usually encountered in large system and network computing environments. For instance, during the time it takes to type in or print out all the words on this page, the computer could begin and finish processing dozens of programs. The computer would be horribly bottlenecked if it had to wait for slow input and output devices before it could resume processing. It just does not make sense for a large computer, which may be worth lacs of rupees, to spend any time sitting idle because main memory is full of processed but unprinted jobs and the printer attached to the system cannot move fast enough.

To preclude the computer from being slowed down by input and output devices, many computer systems employ **spooling** software. These programs take the results of computer programs and move them from primary memory to disk. The area on the disk where the program results are sent is commonly called the output spooling area. Thus, the output device can be left to interact primarily with the disk unit, not the CPU. Spooling utilities can also be used on the input side, so that programs and data to be processed are temporarily stored in an input spooling area on disk.

Assume for example that a floppy disc, a line printer and a disk are used in a spooling operation on a computer system to process the pay-roll and prepare invoices by loading both programs into the main memory. While the line printer is printing an invoice line, the processor switches to the pay roll application and transfers input data from floppy disc to magnetic disk. Afterwards the processor reverts back to the invoice application. As the printer is being used for printing invoices, pay roll application will be executed and output data would be recorded on the Magnetic disk for later conversion when the printer becomes available. As a result, the CPU can give the output at the maximum speed, while several relatively slow input and output units operate simultaneously to process it.

(c) Text editors: Text editors are programs that allow text in a file to be created and modified. These utilities are probably most useful to professional programmers, who constantly face the problems of cutting and pasting programs together, changing data files by eliminating certain data fields, changing the order of certain data fields, adding new data fields, and changing the format of data. Although text editors closely resemble word processors, they are not the same. Word processors are specifically designed to prepare such “document” materials as letters and reports, where text editors are specifically designed to manipulate “non-document” instructions in computer programs a or data in files. Text editors lack the extensive text-formatting and document-printing capabilities found on most word processors.

Some of the other commonly used utilities for a microcomputer operating systems are discussed below :

(i) *Disk copy program* - This program allows an user to copy the entire contents of one diskette to another diskette. It is generally used to make a backup or archive copy of a data diskette or an application program. The diskcopy program can also be used to transfer data stored from one size or capacity diskette to another. For example, it can be used to transfer data from a 360 KB diskette to a 1.2MB diskette or from a 5¼ inch diskette to a 3½ inch diskette.

(ii) *File copy program* - This program allows an user to copy just one file or a group of files, rather than the entire contents of the diskette, to be copied to another diskette. It has the same functions as a diskcopy utility except that it allows an individual file or group of files to be copied.

(iii) *Disk formatting program* - This program allows an user to prepare a new, blank diskette to receive data from the computer system. The data can not be stored on a diskette until it is formatted or initialized. The formatting process writes the sectors on the diskette so that the operating system is able to place data in these locations.

(iv) *File deletion program* - It allows an user to delete a file stored on a diskette.

(v) *File viewing program* - This program is used to view the contents of a file on the display screen of the microcomputer.

(vi) *Directory program* - This program allows an user to view the names of the data and program files which are stored on a disk/diskette. It will not only list the files, but also will show the amount of kilobytes of memory these files occupy, the time and day they were last revised and the amount of unused storage space available on the floppy.

1.4.2 Diagnostic Routines : These programs are usually written and provided by the computer manufacturers. They assist in program debugging. They usually trace the processing of the program being debugged. In personal computer, if an user wants to know anything regarding the processing equipments in his computers, he/she can consult the Microsoft Diagnostic Program, a utility built into the DOS version 6.0 operating system. Using the program, one can get answer to following questions *e.g.* :—

1. What type of processor does the computer use?
2. Is there a math coprocessor in the computer ?
3. Who is the BIOS manufacturer? (BIOS stands for Basic Input/Output System. It is a set of instructions, contained on a ROM chip, that are loaded in the computer memory before the operating system. The BIOS manufacturer is the maker of the ROM chip)
4. What is the total amount of conventional memory in the computer?
5. What type of keyboard is attached to the computer?
6. What is the display type?
7. If there is a mouse attached to the computer, what type is it and who made it?

The diagnostic routines are however also often treated as a category of the utility or service programs

1.4.3 Language translators : A language translator or language processor is a general term used for any assembler, compiler or other routine that accepts statements in one language and produces equivalent statements in another language. The language processor reads the source language statements one at a time and prepares a number of machine instructions to perform the operations specified or implied by each source statement. Most computer installations have several language processors available, one for each programming language the computer can accept.

The three most widely used types of language translators are compilers, interpreters, and assemblers.

Compilers : A compiler translates the entire program into machine language before the program is executed. Compilers are most commonly used to translate high-level languages such as COBOL, FORTRAN, and Pascal. Compilers typically result in programs that can be executed much more swiftly than those handled by interpreters. Since either a compiler or an interpreter can be developed to translate most languages, compilers would be preferred in environments where execution speed is important.

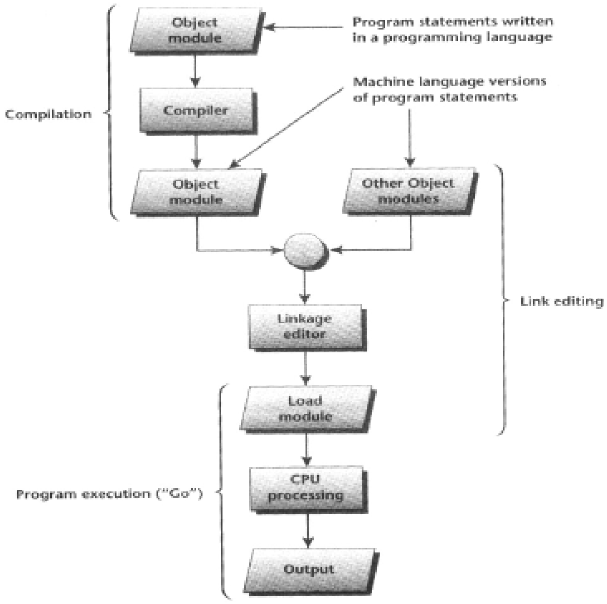


Fig. 1.4.2.1 Compiling Process

Compilers work in the manner illustrated in Figure 1.4.2.1. Program is entered into the computer system and submitted to the appropriate compiler. For instance, A COBOL program is input to a COBOL compiler; a Pascal program, to a Pascal compiler. The program submitted for compilation is called a *source program* (or source module) The compiler then translates the program into machine language, producing *an object program* (or object module) Then, another software program called a **linkage editor** binds the object module of this program to object modules of any subprograms that must be used to complete processing. The resultant program, which is ready for computer execution, is called a *load program* (or load module) It is the load program that the computer actually executes.

The entire process is sometimes referred to as "compile/link-edit/go," corresponding to the compilation, link-editing, and execution stages that the user must go through to get a program processed. Programs can be saved on disk for processing in either source, object, or load-module form. Frequently run applications will often be saved in load module form to avoid repeated compilation and link-editing.

Interpreters: Whereas compilers translates programs into machine language all at once before programs are run, *interpreters* translate programs a line at a time as they are being run. For instance, if a user has a program in which a single statement is executed a thousand times during the course of the program's run, the interpreter would translate that statement a thousand different times into machine language. With an interpreter, each statement is translated into machine language just before it is executed. No object module or storable load module is ever produced.

Although interpreters have the glaring weakness of inefficiency because they translate statements over and over, they do have some advantages over compilers. First, they are usually easier and faster to use, since the user is not bothered with distinct and time-consuming compile, link-edit, and execution stages. Second, they typically provide users with superior error messages. When a program contains an error and "blows up," the interpreter knows exactly which statement triggered the error – the one it last translated. Because interpreters stop when errors are encountered, they help programmers debug their programs. This boosts programmer productivity and reduces program development time. Syntax errors encountered by compilers during the program translation process are counted, but the diagnostic routines and error messages associated with most compilers do not help programmers locate errors as readily as interpreters. Third, an interpreter for a 3GL typically requires less storage space in primary memory than a compiler for that language. So they may be ideal for programming environments in which main memory is limited, such as on low-end microcomputers. Fourth, interpreters are usually less expensive than compilers.

Assemblers : Assemblers are used exclusively with assembly languages. They work similarly to compilers, translating an assembly language program into object code. Because assembly language programs are usually more machine efficient than those written in high-level languages, a two-step translation process may take place. First, the high-level language is translated to assembly language; then, using an assembler, it is converted to machine language.

1.4.5 Firmware : Firmware or micro programs refer to a series of special program instructions. The most basic operations such as addition, multiplication etc. in a computer are carried out by hardwired circuits. These fundamental tasks are then combined in the form of micro programs to produce higher level operations such as move data, make comparisons etc. These micro-programs are called firmware because they deal with very law-level machine operations and thus essentially substitute for additional hardware. Firmware are held in the CPU in a special control storage device.

1.5 GENERAL PURPOSE SOFTWARE/UTILITIES

This software provides the framework for a great number of business, scientific, and personal applications. Spreadsheet, data bases, Computer-Aided Design (CAD) and word processing software etc. fall into this category. Most general-purpose software is sold as a package. The software is accompanied by user-oriented documentation such as reference manuals, keyboard templates, and so on. It is then upto the user of the software to create the application. For example, an accountant can use spreadsheet software to create a template for preparing a balance sheet of a company. An aeronautical engineer can use CAD software to design an airplane or an airport. A personnel manager can use word processing software to create a letter and so on.

The three basic types of software are; commercial, shareware and open source software. Some software is also release into the public domain without a license. **Commercial** software comes prepackaged and is available from software stores and through the Internet. **Shareware** is software developed by individual and small companies that cannot afford to market their software world wide or by a company that wants to release a demonstration version of their commercial product. You will have an evaluation period in which you can decide whether to purchase the product or not. Shareware software often is disabled in some way and has a notice attached to explain the legal requirements for using the product. **Open Source software** is created by generous programmers and released into the public domain for public use. There is usually a copyright notice that must remain with the software product. Open Source software is not public domain in that the company or individual that develops the software retains ownership of the program but the software can be used freely. Many popular Open Source applications are being developed and upgraded regularly by individuals and companies that believe in the Open Source concept.

1.5.1 Word Processor : A **word processor** (more formally a **document preparation system**) is a computer application used for the production (including composition, editing, formatting, and possibly printing) of any sort of printable material.

Word processors are descended from early **text formatting** tools (sometimes called **text justification** tools, from their only real capability) Word processing was one of the earliest applications for the personal computer in office productivity.

Although early word processors used tag-based markup for document formatting, most modern word processors take advantage of a graphical user interface. Most are powerful systems consisting of one or more programs that can produce any arbitrary combination of images, graphics and text, the latter handled with type-setting capability.

Microsoft Word is the most widely used computer word processing system; Microsoft estimates over five million people use the Office suite. There are also many other commercial word processing applications, such as WordPerfect. Open-source applications such as OpenOffice's Writer and KWord are rapidly gaining in popularity.

1.5.2 Spreadsheet Program : A **spreadsheet** is a rectangular table (or grid) of information, often financial information. The word came from "spread" in its sense of a newspaper or magazine item (text and/or graphics) that covers two facing pages, extending across the center fold and treating the two pages as one large one. The compound word "spread-sheet" came to mean the format used to present bookkeeping ledgers -- with columns for categories of expenditures across the top, invoices listed down the left margin, and the amount of each payment in the cell where its row and column intersect -- which were traditionally a "spread" across facing pages of a bound ledger (book for keeping accounting records) or on oversized sheets of paper ruled into rows and columns in that format and approximately twice as wide as ordinary paper.

1.5.3 Database Management System: A **database management system** (**DBMS**) is a system or software designed to manage a database, and run operations on the data requested by numerous clients. Typical examples of DBMS use include accounting, human resources and customer support systems. DBMSs have more recently emerged as a fairly standard part of any company back office.

1.5.4 Internet Browser : An Internet Browser or a **web browser** is a software application that enables a user to display and interact with text, images, and other information typically located on a web page at a website on the World Wide Web or a local area network. Text and images on a web page can contain hyperlinks to other web pages at the same or different websites. Web browsers allow a user to quickly and easily access information provided on many web pages at many websites by traversing these links.

Web browsers available for personal computers include Microsoft Internet Explorer, Mozilla Firefox, Apple Safari, Netscape, and Opera, in order of descending popularity (July 2006) Web browsers are the most commonly used type of HTTP user agent. Although browsers are typically used to access the World Wide Web, they can also be used to access information provided by web servers in private networks or content in file systems.

1.5.5 Electronic mail, abbreviated as **e-mail** or **e-Mail** or **email**, is a method of composing, sending, storing, and receiving messages over electronic communication systems. The term e-mail applies both to the Internet e-mail system based on the Simple Mail Transfer Protocol (SMTP) and to intranet systems allowing users within one company to e-mail each other. Often these workgroup collaboration organizations may use the Internet protocols for internal e-mail service.

1.6 APPLICATION SOFTWARE

Application software is a loosely defined subclass of computer software that employs the capabilities of a computer directly to a task that the user wishes to perform. This should be contrasted with system software which is involved in integrating the computer's various capabilities, but typically does not directly apply them in the performance of tasks that benefit the user. The term application refers to both the application software and its implementation. A simple, if imperfect, analogy in the world of hardware would be the relationship of an electric light—an application—to an electric power generation plant—the system. The power plant merely generates electricity, itself not really of any use until harnessed to an application like the electric light which performs a service that the user desires.

Multiple applications bundled together as a package are sometimes referred to as an application suite.. The separate applications in a suite usually have a user interface that has some commonality making it easier for the user to learn and use each application. And often they may have some capability to interact with each other in ways beneficial to the user.

User-written software tailors systems to meet the user's specific needs. User-written software include spreadsheet templates, word processor macros, scientific simulations, graphics and animation scripts. Even email filters are a kind of user software. Users create this software themselves and often overlook how important it is.

The program usually solves a particular application or problem. Examples of such programs are payroll, General accounting, sales statistics and inventory control etc. Usually different organisations require different programs for similar application and hence it is difficult to write standardized programs. However, tailor-made application software can be written by software houses on *modular* design to cater to the needs of different users.

1.6.1 Enterprise Resource Planning systems (ERPs) integrate (or attempt to integrate) all data and processes of an organization into a single unified system. A typical ERP system will use multiple components of computer software and hardware to achieve the integration. A key ingredient of most ERP systems is the use of a single, unified database to store data for the various system modules.

The term ERP originally implied systems designed to plan the utilization of enterprise-wide resources. Although the acronym ERP originated in the manufacturing environment, today's use of the term ERP systems has much broader scope. ERP systems typically attempt to cover all basic functions of an organization, regardless of the organization's business or charter. Business, non-profit organizations, governments, and other large entities utilize ERP systems.

Additionally, it may be noted that to be considered an ERP system, a software package generally would only need to provide functionality in a single package that would normally be covered by two or more systems. Technically, a software package that provides both Payroll and Accounting functions (such as QuickBooks) would be considered an ERP software package.

However; the term is typically reserved for larger, more broadbased applications. The introduction of an ERP system to replace two or more independent applications eliminates the need for interfaces previously required between systems, and provides additional benefits that range from standardization and lower maintenance (one system instead of two or more) to easier and/or greater reporting capabilities (as all data is typically kept in one database)

Examples of modules in an ERP which formerly would have been stand-alone applications include: Manufacturing, Supply Chain, Financials, CRM, Human Resources, and Warehouse Management.

1.6.2 DECISION SUPPORT SYSTEMS

Decision support systems are information processing systems frequently used by accountants, managers, and auditors to assist them in the decision-making process. The concept of decision support systems evolved in the 1960s from studies of decision making in organisations. These studies noted that managers required flexible systems to respond to less well-defined questions than those addressed by operational employees. Advances in hardware technology, interactive computing design, graphics capabilities, and programming languages contributed to this evolution. Decision support systems have achieved broad use in accounting and auditing today.

Characteristics of Decision Support Systems : Although decision support system applications vary widely in their level of sophistication and specific purpose, they possess several characteristics in common.

(1) Decision support system support management decision making – Although most heavily used for management planning decisions, operational managers can use them (e.g., to solve scheduling problems), as can top managers (e.g., to decide whether to drop a product line) Decision support systems enhance decision quality. While the system might point to a particular decision, it is the user who ultimately makes the final choice.

(2) Decision support systems solve relatively unstructured problems – problems that do not have easy solution procedures and therefore problems in which some managerial judgment is necessary in addition to structured analysis. Thus, in contrast to transaction processing systems, decision support systems typically use non-routine data as input. These data are not easy to gather and might require estimates. For example, imagine that the manager is selecting accounting software for his company's use. This problem is unstructured because there is no available listing of all the features that are desirable in accounting software for his particular company. Furthermore, he will need to use his judgment to determine what features are important.

Because managers must plan for future activities, they rely heavily on assumptions of future interest rates, inventory prices, consumer demand, and similar variables. But what if managers' assumptions are wrong? A key characteristic of many decision support systems is that they allow users to ask what-if questions and to examine the results of these questions. For instance, a manager may build an electronic spreadsheet model that attempts to forecast future departmental expenditures. The manager cannot know in advance how inflation rates might affect his or her projection figures, but can examine the consequences of alternate assumptions by changing the parameters (here, growth rates) influenced by these rates. Decision support systems are useful in supporting this type of analysis.

Although systems designers may develop decision support systems for one-time use, managers use them to solve a particular type of problem on a regular basis. The same is true of expert systems. However, decision support systems are much more flexible and may handle many different types of problems. Accountants might use a spreadsheet model developed to calculate depreciation only for depreciation problems, but many more general decision support system tools such as Expert Choice (discussed later as an example of a decision support system) are sufficiently flexible and adaptive for ongoing use. Another example is decision support systems that perform data mining tasks.

(3) Finally, a "friendly" computer interface is also a characteristic of a decision support system – Because managers and other decision makers who are non programmers frequently use decision support systems, these systems must be easy to use. The availability of nonprocedural modeling languages, eases communication between the user and the decision support system.

Components of Decision Support Systems : A decision support system has four basic components: (1) the user, (2) one or more databases, (3) a planning language, and (4) the model base (see Figure 1.6.2.1)

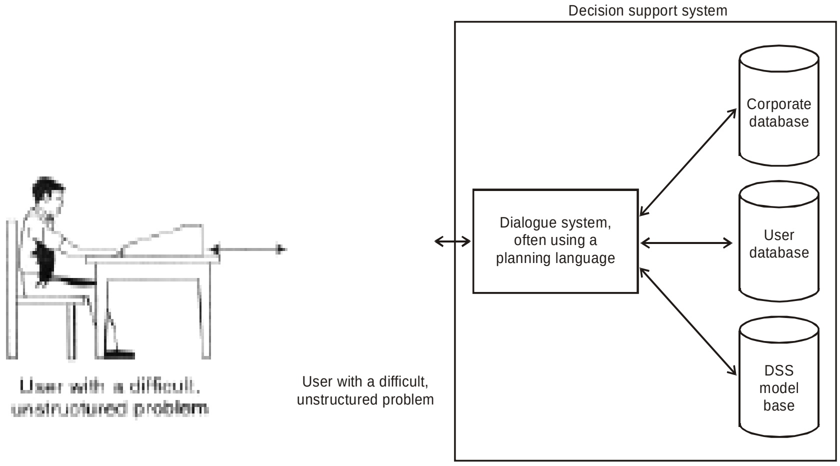


Fig. 1.6.2.1 Components decision support system

(i) The users : The user of a decision support system is usually a manager with an unstructured or semi-structured problem to solve. The manager may be at any level of authority in the organisation (e.g., either top management or operating management) Typically, users do not need a computer background to use a decision support system for problem solving. The most important knowledge is a thorough understanding of the problem and the factors to be considered in finding a solution. A user does not need extensive education in computer programming in part because a special planning language performs the communication function within the decision support system. Often, the planning language is nonprocedural, meaning that the user can concentrate on what should be accomplished rather than on how the computer should perform each step.

(ii) Databases : Decision support systems include one or more databases. These databases contain both routine and non-routine data from both internal and external sources. The data from external sources include data about the operating environment surrounding an organisation – for example, data about economic conditions, market demand for the organisation's goods or services, and industry competition.

Decision support system users may construct additional databases themselves. Some of the data may come from internal sources. An orgnaisation often generates this type of data in the normal course of operations – for example, data from the financial and managerial accounting systems such as account, transaction, and planning data. The database may also capture data from other subsystems such as marketing, production, and personnel. External data include assumptions about such variables as interest rates, vacancy rates, market prices, and levels of competition.

(iii) Planning languages : Two types of planning languages that are commonly used in decision support systems are: (1) general –purpose planning languages and (2) special-purpose planning languages. General-purpose planning languages allow users to perform many routine tasks – for example, retrieving various data from a database or performing statistical analyses. The languages in most electronic spreadsheets are good examples of general-purpose planning languages. These languages enable user to tackle a broad range of budgeting, forecasting, and other worksheet-oriented problems. Special-purpose planning languages are more limited in what they can do, but they usually do certain jobs better than the general-purpose planning languages. Some statistical languages, such as SAS, SPSS, and Minitab, are examples of special purpose planning languages.

(iv) Model base : The planning language in a decision support system allows the user to maintain a dialogue with the model base. **The model base** is the “brain” of the decision support system because it performs data manipulations and computations with the data provided to it by the user and the database. There are many types of model bases, but most of them are custom-developed models that do some types of mathematical functions-for example, cross tabulation, regression analysis, time series analysis, linear programming and financial computations. The analysis provided by the routines in the model base is the key to supporting the user’s decision. The model base may dictate the type of data included in the database and the type of data provided by the user. Even where the quantitative analysis is simple, a system that requires users to concentrate on certain kinds of data can improve the effectiveness of decision making.

Examples of Decision Support Systems in Accounting : Decision support systems are widely used as part of an orgnaisation’s AIS. The complexity and nature of decision support systems vary. Many are developed in-house using either a general type of decision support program or a spreadsheet program to solve specific problems. Below are several illustrations of these systems.

***Cost Accounting system**:* The health care industry is well known for its cost complexity. Managing costs in this industry requires controlling costs of supplies, expensive machinery, technology, and a variety of personnel. Cost accounting applications help health care organisations calculate product costs for individual procedures or services. Decision support systems can accumulate these product costs to calculate total costs per patient. Health care managers many combine cost accounting decision support systems with other applications, such as productivity systems. Combining these applications allows managers to measure the effectiveness of specific operating processes. One health care organisation, for example, combines a variety of decision support system applications in productivity, cost accounting, case mix, and nursing staff scheduling to improve its management decision making.

Capital Budgeting System: Companies require new tools to evaluate high-technology investment decisions. Decision makers need to supplement analytical techniques, such as net present value and internal rate of return, with decision support tools that consider some benefits of new technology not captured in strict financial analysis. One decision support system designed to support decisions about investments in automated manufacturing technology is AutoMan, which allows decision makers to consider financial, nonfinancial, quantitative, and qualitative factors in their decision-making processes. Using this decision support system, accountants, managers, and engineers identify and prioritize these factors. They can then evaluate up to seven investment alternatives at once.

Budget Variance Analysis System: Financial institutions rely heavily on their budgeting systems for controlling costs and evaluating managerial performance. One institution uses a computerized decision support system to generate monthly variance reports for division comptrollers. The system allows these comptrollers to graph, view, analyse, and annotate budget variances, as well as create additional one-and five-year budget projections using the forecasting tools provided in the system. The decision support system thus helps the controllers create and control budgets for the cost-center managers reporting to them.

General Decision Support System: As mentioned earlier, some planning languages used in decision support systems are general purpose and therefore have the ability to analyze many different types of problems. In a sense, these types of decision support systems are a decision maker's tools. The user needs to input data and answer questions about a specific problem domain to make use of this type of decision support system. An example is a program called **Expert Choice.** This program supports a variety of problems requiring decisions. The user works interactively with the computer to develop a hierarchical model of the decision problem. The decision support system then asks the user to compare decision variables with each other. For instance, the system might ask the user how important cash inflows are versus initial investment amount to a capital budgeting decision. The decision maker also makes judgments about which investment is best with respect to these cash flows and which requires the smallest initial investment. Expert Choice analyzes these judgments and presents the decision maker with the best alternative.

1.6.3 ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is software that tries to emulate aspects of human behavior, such as reasoning, communicating, seeing, and hearing. AI software can use its accumulated knowledge to reason and, in some instances, learn from experience and thereby modify its subsequent reasoning. There are several types of AI, including natural language, voice and visual recognition, robotics, neural networks, and expert systems.

Natural language and voice and visual recognition both focus on enabling computers to interact more easily and naturally with users. Robotics focuses on teaching machines to replace human labour. Both neural networks and expert systems aim to improve decision-making.

1.6.4 EXPERT SYSTEMS

An expert system (ES) is a computerized information system that allows non-experts to make decisions comparable to those of an expert. Expert systems are used for complex or ill-structured tasks that require experience and specialised knowledge in narrow, specific subject areas, as shown in Figure 1.6.4.1 , expert systems typically contain the following components:

Major Components of an Expert System

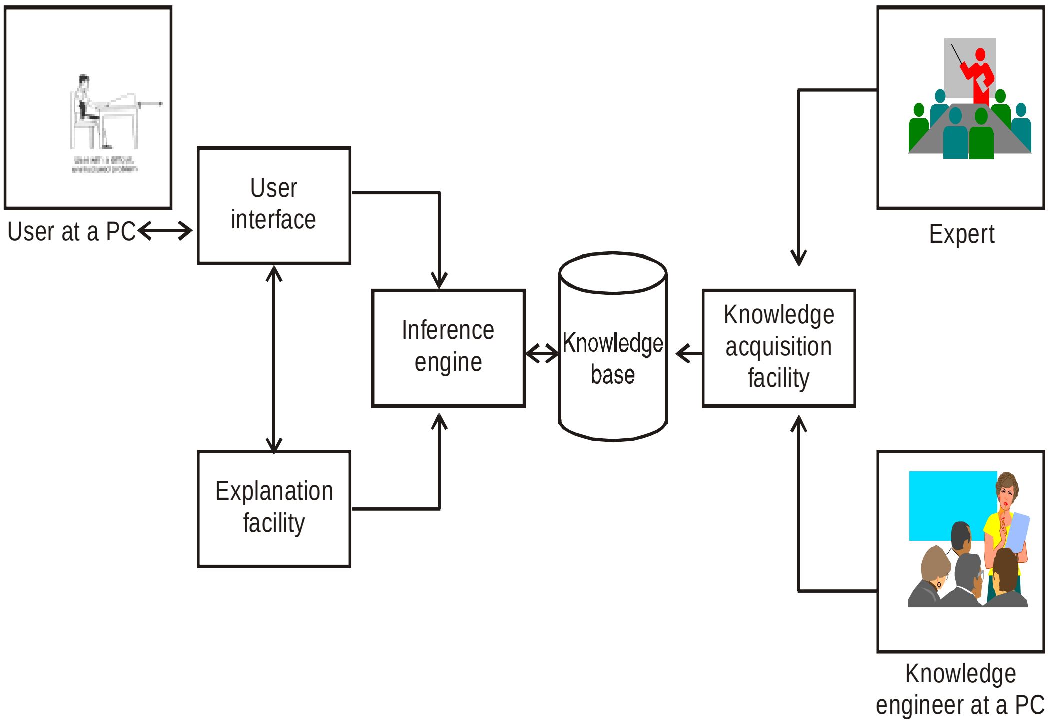


Fig 1.6.4.1

1. **Knowledge base :** This includes the data, knowledge, relationships, rules of thumb (heuristics), and decision rules used by experts to solve a particular type of problem. A knowledge base is the computer equivalent of all the knowledge and insight that an expert or a group of experts develop through years of experience in their field.

2. **Inference engine :** This program contains the logic and reasoning mechanisms that simulate the expert logic process and deliver advice. It uses data obtained from both the knowledge base and the user to make associations and inferences, form its conclusions, and recommend a course of action.

3. **User interface :** This program allows the user to design, create, update, use, and communicate with the expert system.

4. **Explanation facility :** This facility provides the user with an explanation of the logic the ES used to arrive at its conclusion.

5. **Knowledge acquisition facility :** Building a knowledge base, referred to as knowledge engineering, involves both a human expert and a knowledge engineer. The knowledge engineer is responsible for extracting an individual's expertise and using the knowledge acquisition facility to enter it into the knowledge base.

Expert systems can be example-based, rule based, or frame based. Using an example-based system, developers enter the case facts and results. Through induction the ES converts the examples to a decision tree that is used to match the case at hand with those previously entered in the knowledge base. Rule-based systems are created by storing data and decision rules as if- then -else rules. The systems asks the user questions and applied the if-then-else rules to the answers to draw conclusions and make recommendations. Rule -based systems are appropriate when a history of cases is unavailable or when a body of knowledge can be structured within a set of general rules. Frame -based systems organize all the information (data, descriptions, rules etc.) about a topic into logical units called frames, which are similar to linked records in data files. Rules are then established about how to assemble or interrelate the frames to meet the user's needs.

Expert systems provide several levels of expertise. Some function as assistants that perform routine analysis and call the user's attention to tasks that require human expertise. Others function as colleagues, and the user "discusses" a problem with the system until both agree on a solution. When a user can accept the system's solution without question, the expert system can be referred to as a true expert. Developers of expert systems are still striving to create a true expert; most current systems function at the assistant or colleague level.

Expert systems offer the following benefits:

- They provide a cost-effective alternative to human experts.
- They can outperform a single expert because their knowledge is representative of numerous experts. They are faster and more consistent and do not get distracted, overworked, or stressed out.

- They produce better-quality and more consistent decisions. Expert systems assist users in identifying potential decision making problems, which increases the probability that sound decisions will be made.
- They can increase productivity.
- They preserve the expertise of an expert leaving the organization.

Although expert systems have many advantages and great promise, they also have a significant number of limitations

- Development can be costly and time-consuming. Some large systems required upto 15 years and millions of dollars to develop.
- It can be difficult to obtain knowledge from experts who have difficulty specifying exactly how they make decisions.
- Designers have not been able to program what humans consider common sense into current systems. consequently, rule-based systems break down when presented with situations they are not programmed to handle.
- Until recently, developers encountered skepticism from businesses due to the poor quality of the early expert systems and the high expectations of users.

As technology advances, some of these problems will be overcome and expert systems will play an increasingly important role in accounting information systems. Here are specific examples of companies that have successful used expert systems:

- The IRS analyzes tax returns to determine which should be passed on to tax fraud investigators.
- IBM designs and evaluates internal controls in both new and existing applications.
- Americans Express authorizes credit card purchases to minimize fraud and credit losses. Its ES replaced 700 authorization clerks and saved tens of millions of dollars.

Self-examination questions

Multiple Choice Questions

1. First Generation of computer have used the following
   a) Vacuum Tubes
   b) Transistor
   c) IC
   d) VLSI

2. Second generation computer home used the following.
   a) Vacuum Tubes
   b) Transistor
   c) IC
   d) VLSI
3. Third Generation Computer have used the following circuitry options
   a) Vacuum Tubes
   b) Transistor
   c) IC
   d) VLSI
4. Forth Generation computer have used the following Circuitry options
   a) Vacuum Tubes
   b) Transistor
   c) IC
   d) VLSI
5. First Generation have used the following language
   a) Object oriented programmer
   b) Artificial Intelligence
   c) Assembly Language
   d) Assembly & M/C Language
6. Which is not the attribute of file :
   a) Hidden
   b) System
   c) Big
   d) Archive
7. Which is the fastest storage device :
   a) Floppy Disk
   b) Zip Disk
   c) CD - Rom

d) Hard Disk

8. Storage Device which uses light to store data :

   a) Floppy Disk

   b) Hard Disk

   c) CD - ROM

   d) Tape Drive

Answers:

1	a	**2**	b	**3**	c	**4**	d	**5**	d	**6**	d	**7**	c	**8**	c

Short Term Questions

1. Write short notes on the following types of computers :-

   (i) Super computer

   (i) Mainframe computer.

   (iii) Mini computer.

   (iv) Micro computer.

   (v) Workstations

   (vi) Server

2. What are the features of the Central Processing Unit?

3. Discuss various components of a motherboard.

4.. What do you understand by the term 'Bus'? Discuss two types of bus available on a computer.

5. Write short notes on the following :

   (i) RAM

   (ii) ROM

   (iii) Bubble memory

   (iv) Flash memory

6. Write short note on floppy diskette as an input medium.

7. What are the factors that determine the number of characters that can be stored in a floppy diskette?

8. Explain the following terms :
    - (i) The boot record
    - (ii) File allocation table
9. What care is required for using and storage of a diskette?
10. Differentiate between floppy diskettes and hard disks.
11. Briefly explain the various characteristics of a hard disk.
12. What are the advantages and disadvantages of direct access storage?
13. Explain the following terms :
    - (i) CD-ROM
    - (ii) WORM disk
    - (iii) Magneto Optical Disks
    - (iv) Video Disk
    - (v) Detachable Reel Magnetic Tape
    - (vi) Tape Cartridge Systems

Long Term Questions

1. Describe in detail various generations of computers.
2. Draw the schematic diagram of a computer. Discuss each of the components covered in it.
3. Discuss, in detail, various types of microprocessors.
4. Describe in detail various generations of computers.
5. Draw the schematic diagram of a computer. Discuss each of the components covered in it.
6. Discuss, in detail, various types of microprocessors

CHAPTER 2

DATA STORAGE, RETRIEVAL AND DATA BASE MANAGEMENT SYSTEMS

Learning Objectives

- Understand number systems and file organizations.
- Understand the difference between relational database systems and others.
- Understand the need of data warehousing and data mining in business applications.

2.0 INTRODUCTION

We use the decimal numbers or the decimal number system for our day-to-day activities. As we all know, in the decimal number system there are ten digits – 0 through 9. But computers understand only 0s and 1s - the machine language. But using 0s and 1s to program a computer is a thing in the past. Now we can use the decimal numbers, the alphabets and special characters like +,-,*,?,/, etc. for programming the computer. Inside the computer, these decimal numbers, alphabets and the special characters are converted into 0s and 1s, so that the computer can understand what we are instructing it to do. To understand the working of a computer, the knowledge of binary, octal and hexadecimal number systems is essential.

2.1 DECIMAL NUMBER SYSTEM

The base or radix of a number system is defined as the number of digits it uses to represent the numbers in the system. Since decimal number system uses 10 digits - 0 through 9 - its base or radix is 10. The decimal number system is also called *base-10 number system.* The weight of each digit of a decimal number system depends on its relative position within the number. For example, consider the number 3256.

3256 = 3000 + 200 + 50 + 6 , or, in other words,

$3256 = 3 \times 10^3 + 2 \times 10^2 + 5 \times 10^1 + 6 \times 10^0$

From the above example, we can see that the weight of the nth digit of the number from the right hand side is equal to n^{th} *digit* $X\ 10^{n-1}$ which is again equal to *nth digit x* $(\text{base})^{n-1}$. The number system, in which the weight of each digit depends on its relative position within the numbers, is called the *positional number system.*

2.1.1 Binary Number System

The base or radix of the binary number system is 2. It uses only two digits - 0 and 1. Data is represented in a computer system by either the presence or absence of electronic or magnetic signals in its circuitry or the media it uses. This is called a binary or two-state representation of data since the computer is indicating only two possible states or conditions. For example, transistors and other semiconductor circuits are either in a conducting or non-conducting state. Media such as magnetic disks and tapes indicate these two states by having magnetized spots whose magnetic fields can have two different directions or polarities. These binary characteristics of computer circuitry and media are the primary reasons why the binary number system is the basis for data representation in computers. Thus, for electronic circuits, the conduction state (ON) represents a ONE and the non-conducting state (OFF) represents a ZERO.

Therefore, as mentioned earlier, the binary number system has only two symbols, 0 and 1. The binary symbol 0 or 1 is commonly called a bit, which is a contraction of the term binary digit. In the binary system, all numbers are expressed as groups of binary digits (bits), that is, as groups of 0s and 1s. Just as in any other number system, the value of a binary number depends on the position or place of each digit in a grouping of binary digits. The values are based on the right to left position of digits in a binary number, using the power of 2 as position values. For example, consider the binary number 10100.

$10100 = 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0 = 16 + 0 + 4 + 0 + 0 = 20$

Table 1 gives the binary equivalents of the decimal numbers from 0 to 20.

Table 1: Binary equivalents of the decimal numbers

Decimal	Binary	Decimal	Binary
0	0	11	1011
1	01	12	1100
2	10	13	1101
3	11	14	1110
4	100	15	1111
5	101	16	10000
6	110	17	10001
7	111	18	10010
8	1000	19	10011
9	1001	20	10100
10	1010		

Binary-decimal Conversion

To convert a binary number to its decimal equivalent, we use the following expression:

The weight of the n^{th} bit of a number from the right hand side = n^{th} bit x 2^{n-1}

After calculating the weight of each bit, they are added to get the decimal value as shown in the following examples**:**

101 = $1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = 4 + 0 + 1 = 5$

1010 = $1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 8 + 0 + 2 + 0 = 10$

1111 = $1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 = 8 + 4 + 2 + I = 15$

1.001 = $1 \times 2^0 + 0 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} = 1 + 0 + 0 + .125 = 1.125$

2.1.2 Decimal-binary Conversion: Decimal numbers are converted into binary by a method called *Double Dabble Method.* In this method, the mantissa part of the number is repeatedly divided by two and noting the reminders, which will be either 0 or 1. This division is continued till the mantissa becomes zero. The remainders, which are noted down during the division is read in the reverse order to get the binary equivalent. This can be better illustrated using the following example.

2	14	Remainder
2	7	0
2	3	1
2	1	1
2	0	1

The number is written from below, that is 1110. So the binary equivalent of 14 is 1110

If the decimal number has a fractional part, then the fractional part is converted into binary by multiplying it with 2. Only the integer of the result is noted and the fraction is repeatedly multiplied by 2 until the fractional part becomes 0. This can be explained using the following example.

0.125	
X 2	
0.25	0
X 2	
0.5	0
X 2	
0	1

Here the number is written from top - 0.001. So the binary equivalent of 0.125 is 0.00 1

2.1.3 Fixed-Point Representation of Number

In the fixed-point number representation system, all numbers are represented as integers or fractions. Signed integer or BCD numbers are referred to as fixed-point numbers because they contain no information regarding the location of the decimal point or the binary point. The binary or decimal point is assumed to be at the extreme right or left of the number.

If the binary or decimal point is at the extreme right of the computer word, then all numbers are positive or negative integers. If the radix point is assumed to be at the extreme left, then all numbers are positive or negative fractions.

Consider that you have to multiply 23.15 and 33.45. This will be represented a 2315 x 3345. The result will be 7743675. The decimal point has to be placed by the user to get the correct result, which is 774.3675. So in the fixed-point representation system, the user has to keep track of the radix point, which can be a tedious job.

2.1.4 Floating-Point Representation of Number

In most computing applications, fractions are used very frequently. So a system of number representation which automatically keeps track of the position of the binary or decimal point is better than the fixed-point representation. Such a system is the floating-point representation of numbers.

A number, which has both an integer part and a fractional part, is called a real number or a floating-point number. These numbers can be either positive or negative. Examples of real numbers (decimal) are 123.23, -56.899, 0.008, etc. The real number 123.23 can be written as 1.2323×10^2 or 0.12323×10^3. Similarly the numbers 0.008 and 1345.66 can be represented as 0.8×10^{-2} and 1.34566×10^3 respectively. This kind of representation is called the *scientific representation.* Using this scientific form, any number can be expressed as a combination of a mantissa and an exponent, or in other words, the number 'n' can be expressed as 'n = m re' where 'm' is the **mantissa, 'r' is the radix** of the number system and 'e' is the **exponent.**

In a computer also the real or floating-point number is represented by two parts mantissa and exponent. Mantissa is a signed fixed point number and the exponent indicates the position of the binary or decimal point. For example, the number 123.23 is represented in the floating-point system as:

Sign
0 .12323
Mantissa

Sign
0 03
Exponent

The zero in the leftmost position of the mantissa and exponent indicates the plus sign. The mantissa can be either a fraction or an integer, which is dependent on the computer manufacturer. Most computers use the fractional system of representation for mantissa. The decimal point shown above is an assumed decimal point and is not stored in the register.

The exponent of the above example, +3, indicates that the actual decimal point is 3 digits to the right of the assumed one. In the above example, the mantissa is shown as a fraction. As mentioned, we can use an integer as **the mantissa.** The following example shows how it is done.

Sign
0 .12323
Mantissa

Sign
1 02
Exponent

In the above representation, the sign of the exponent is negative and it indicates that the actual decimal point lies 2 decimal positions to the left of the assumed point (in this case, the assumed decimal point is placed at the extreme right of the integer or 12323.)

A negative number say -123.23 can be expressed as follows.

Sign
1 .12323
Mantissa

Sign
0 03
Exponent

A negative fraction, say -0.0012323 can be represented as follows.

Sign
1 .12323
Mantissa

Sign
1 02
Exponent

2.1.5 Binary Coded Decimal (BCD)

The BCD is the simplest binary code that is used to represent a decimal number. In the BCD code, 4 bits represent a decimal number.

2.1.6 ASCII CODE

ASCII stands for American Standard Code for Information Interchange. ASCII code is used extensively in small computers, peripherals, instruments and communications devices. It has replaced many of the special codes that were previously used. It is a seven-bit code.

Microcomputers using 8-bit word length use 7 bits to represent the basic code. The 8th bit is used for parity or it may be permanently 1 or 0.

With 7 bits, up to 128 characters can be coded. A letter, digit or special symbol is called a character. It includes upper and lower case alphabets, numbers, punctuation mark and special and control characters.

ASCII-8 Code: A newer version of ASCII is the ASCII-8 code, which is an 8-bit code. With 8 bits, the code capacity is extended to 256 characters.

2.1.7 EBCDIC Code

EBCDIC stands for Extended BCD Interchange Code. It is the standard character code for large computers. It is an 8-bit code without parity. A 9th bit can be used for parity. With 8 bits up to 256 characters can be coded.

In ASCII-8 and EBCDIC, the first 4 bits are known as zone bits and the remaining 4 bits represent digit values. In ASCII, the first 3 bits are zone bits and the remaining 4 bits represent digit values.

Some examples of ASCII and EBCDIC values are shown in the table 2.

Table 2: ASCII and EBCDIC Codes

Character	ASCII	EBCDIC
0	00110000	11110000
1	00110001	11110001
2	00110010	11110010
3	00110011	11110011
4	00110100	11110100
5	00110101	11110101
6	00110110	11110110
7	00110111	11110111
8	00111000	11111000
9	00111001	11111001
A	01000001	11000001
B	01000010	11000010
C	01000011	11000011
D	01000100	11000100
E	01000101	11000101

F	01000110	11000110
G	01000111	11000111
H	01001000	11001000
1	01001001	11001001
1	01001010	11010001
K	01001011	11010010
L	01001100	11010011
M	01001101	11010100
N	01001110	11010101
0	01001111	11010110
P	01010000	11010111
Q	01010001	11011000
R	01010010	11011001
S	01010011	11100010
T	01010100	11100011
U	01010101	11100100
V	01010110	11100101
W	01010111	11100110
X	01011000	11100111
Y	01011001	11101000
Z	01011010	11101001

2.2 BITS, BYTES AND WORDS

A **byte** is a basic grouping of bits (binary digits) that the computer operates on as a single unit. It consists of 8 bits and is used to represent a character by the ASCII and EBCDIC coding systems. For example, each storage location of computers using EBCDIC or ASCII-8 codes consist of electronic circuit elements or magnetic or optical media positions that can represent at least 8 bits. Thus each storage location can hold one character. The capacity of a computer's primary storage and its secondary storage devices is usually expressed in terms of bytes.

A word is a grouping of bits (usually larger than a byte) that is transferred as a unit between primary storage and the registers of the ALU and control unit. Thus, a computer with a 32-bit word length might have registers with a capacity of 32 bits, and transfer data and instructions within the CPU in groupings of 32 bits. It should process data faster than computers with a 16-bit or 8-bit word length.

However, processing speed also depends on the size of the CPU's data path or data bus, which are circuits that interconnect the various **CPU components.** For example, a microprocessor like the Intel 80386 SX has 32-bit registers but only a 16-bit data bus. Thus, it only moves data and instructions 16 bits at a time. Hence, it is slower than Intel 80386 DX microprocessor, which has 32-bit registers and data **paths.**

Lots of Bites: When you start talking about lots of bytes, you get into **prefixes** like kilo, mega and giga, as in kilobyte, megabyte and gigabyte (also shortened to K, M and G, as in Kbytes, Mbytes and Gbytes or KB, MB and GB) The following table shows the multipliers:

Name	**Abbr.**	**Size**
Kilo	K	2^10 = 1,024
Mega	M	2^20 = 1,048,576
Giga	G	2^30 = 1,073,741,824
Tera	T	2^40 = 1,099,511,627,776
Peta	P	2^50 = 1,125,899,906,842,624
Exa	E	2^60 = 1,152,921,504,606,846,976
Zetta	Z	2^70 = 1,180,591,620,717,411,303,424
Yotta	Y	2^80 = 1,208,925,819,614,629,174,706,176

You can see in this chart that kilo is about a thousand, mega is about a million, giga is about a billion, and so on. So when someone says, "This computer has a 2 giga hard drive," what he or she means is that the hard drive stores 2 gigabytes, or approximately 2 billion bytes, or exactly 2,147,483,648 bytes. How could you possibly need 2 gigabytes of space? When you consider that one CD holds 650 megabytes, you can see that just three CDs worth of data will fill the whole thing! Terabyte databases are fairly common these days, and there are probably a few petabyte databases floating around the world by now.

2.3 CONCEPTS RELATED TO DATA

2.3.1 Double Precision: Real data values are commonly called single precision data because each real constant is stored in a single memory location. This usually gives seven significant digits for each real value. In many calculations, particularly those involving iteration or long sequences of calculations, single precision is not adequate to express the precision required. To overcome this limitation, many programming languages provide the double precision data type. Each double precision is stored in two memory locations, thus providing twice as many significant digits.

2.3.2 Logical Data Type: Use the Logical data type when you want an efficient way to store data that has only two values. Logical data is stored as true (.T.) or false (.F.)

Data Type	Description	Size	Range
Logical	Boolean value of true or false	1 byte	True (.T.) or False (.F.)

2.3.3 Characters: Choose the Character data type when you want to include letters, numbers, spaces, symbols, and punctuation. Character fields or variables store text information such as names, addresses, and numbers that are not used in mathematical calculations. For example, phone numbers or zip codes, though they include mostly numbers, are actually best used as Character values.

Data Type	Description	Size	Range
Character	1 byte per character to 254	1 byte	Any characters

2.3.4 Strings: A data type consisting of a sequence of contiguous characters that represent the characters themselves rather than their numeric values. A **String** can include letters, numbers, spaces, and punctuation. The **String** data type can store fixed-length strings ranging in length from 0 to approximately 63K characters and dynamic strings ranging in length from 0 to approximately 2 billion characters. The dollar sign (**$**) type-declaration character represents a **String.**

The codes for String characters range from 0–255. The first 128 characters (0–127) of the character set correspond to the letters and symbols on a standard U.S. keyboard. These first 128 characters are the same as those defined by the ASCII character set. The second 128 characters (128–255) represent special characters, such as letters in international alphabets, accents, currency symbols, and fractions.

2.3.5 Variables: A variable is something that may change in value. A variable might be the number of words on different pages of this booklet, the air temperature each day, or the exam marks given to a class of school children.

2.3.6 Memo Data Type: Use the Memo data type if you need to store more than 255 characters. A Memo field can store up to 65,536 characters. If you want to store formatted text or long documents, you should create an OLE Object field instead of a Memo field.

2.4. KEY

The word "**key**" is used in the context of relational database design. In pre-relational databases (hierarchical, networked) and file systems (ISAM, VSAM, *etc.*) "key" often referred to the specific structure and components of a linked list, chain of pointers, or other physical locator outside of the data. It is thus natural, that today people often associate "key" with a RDBMS "index". We will explain what a key is and how it differs from an index.

A key is a set of one or more columns whose combined values are *unique* among all occurrences in a given table. **A key is the relational means of specifying uniqueness**.

There are only three types of relational keys.

2.4.1 Candidate Key: A Candidate key is any set of one or more columns whose combined values are unique among all occurrences (i.e., tuples or rows) Since a null value is not guaranteed to be unique, no component of a candidate key is allowed to be null.

There can be any number of candidate keys in a table. Relational pundits are not in agreement whether *zero* candidate keys are acceptable, since that would contradict the (debatable) requirement that there must be a primary key.

2.4.2 Primary Key: The **primary key** of any table is any candidate key of that table which the database designer arbitrarily designates as "primary". The primary key may be selected for convenience, comprehension, performance, or any other reasons. It is entirely proper to change the selection of primary key to another candidate key.

Enrollment	
student	class
PK	

Enrollment		
student	class	row id
		PK

2.4.3 Alternate Key: The **alternate key**s of any table are simply those candidate keys which are not currently selected as the primary key. An alternate key is a *function* of all candidate keys *minus* the primary key.

Let's look at this simple association or join table below which holds student class enrollment:

This is the default form, and often the only form taught or recommended for a join table. The primary key of each contribution table is inherited so that this table has a compound primary key. Since the Data Definition Language (DDL) will create a unique index on the two columns, the designer knows that each student-class pair will be unique; i.e., each student may enroll in each class only once.

Several years later a new Data Base Administrator (DBA) decides that it is inefficient to use two columns for the primary key where one would do. She adds a "row id" column and makes it the primary key by loading it with a system counter. This is fine as far as an identity for each row. But now nothing prevents a student from enrolling in the same class multiple times!

Enrollment		
student	**class**	**row id**
CK		CK

Enrollment		
student	**class**	**row id**
AK		PK

This happened because the data model did not retain a candidate key property on the two original columns when the primary key was changed. Therefore the new DBA had no direct way of knowing (other than text notes somewhere) that these two columns must still remain unique, even though they are no longer part of the primary key.

Notice here how this could have been handled automatically by the model, if it had captured candidate keys in the first place and then generated alternate keys as a function of those candidates not in the primary key. The original two columns remain unique even after they are no longer primary.

2.4.4 Secondary Key: Secondary keys can be defined for each table to optimize the data access. They can refer to any column combination and they help to prevent sequential scans over the table. Like the primary key, the secondary key can consist of multiple columns.

A candidate key which is not selected as a primary key is known as Secondary Key.

2.4.5 Referential Integrity: A feature provided by relational database management systems (RDBMS's) that prevents users or applications from entering inconsistent data. Most RDBMS's have various referential integrity rules that you can apply when you create a relationship between two tables.

For example, suppose Table B has a *foreign key* that points to a field in Table A. Referential integrity would prevent you from adding a record to Table B that cannot be linked to Table A. In addition, the referential integrity rules might also specify that whenever you delete a record from Table A, any records in Table B that are linked to the deleted record will also be deleted. This is called *cascading delete.* Finally, the referential integrity rules could specify that whenever you modify the value of a linked field in Table A, all records in Table B that are linked to it will also be modified accordingly. This is called *cascading update.*

A

Table DEPT		
DEPTNO	**DNAME**	**LOC**
20	RESEARCH	DELHI
30	TRAINING	KANPUR

Foreign Key
(values in dependent table must match a value in unique key or primary key of referenced table)

B

Table EMP					
EMPNO	**ENAME**	**DESIG**	**DTOFJOI**	**SALARY**	**DEPTNO**
6584	SUNIL	MANAGER	10-DEC-99	40000	20
7451	SANTA	PROFESSOR	21-MAR-95	50000	30
6680	JONES	DIRECTOR	02-APR-90	60000	20

This row violates the referential constraint because "40" is not present in the referenced table's primary key; therefore, the row is not allowed in the table.

7550	RAVI	MANAGE	10-DEC-02	80000	40

Fig. 2.4.5.1 illustrates example of Referential Integrity in the database

2.4.6 Index Fields: Index fields are used to store relevant information along with a document. The data input to an Index Field is used to find those documents when needed. The program provides up to twenty-five user-definable Index Fields in an Index Set.

An index field can be one of three types:

Drop-Down Look-Up List,

Standard,

Auto-Complete History List.

2.4.7 Currency Fields–The currency field accepts data in dollar form by default.

2.4.8 Date Fields – The date field accepts data entered in date format.

2.4.9 Integer Fields – The integer field accepts data as a whole number.

2.4.10 Text Fields – The text field accepts data as an alpha-numeric text string.

2.5 WHAT IS DATA PROCESSING

Data are a collection of facts - unorganized but able to be organized into useful information. A collection of sales orders, time sheets, and class registration cards are a few examples. Data are manipulated to produce output, such as bills and pay cheques. When this output can be used to help people make decisions, it is called *information.*

Processing is a series of actions or operations that convert inputs into outputs. When we speak of data processing, the input is data, and the output is useful information. Hence, data processing is defined as series of actions or operations that converts data into useful information. *The data processing* system is used to include the resources such as people, procedures, and devices that are used to accomplish the processing of data for producing desirable output.

2.5.1 Data storage Hierarchy: The basic building block of data is a *character*, which consists of letters (A, B, C ... Z), numeric digits (0, 1, 2 ... 9) or special characters (+, -, /, *, .1 $ ...) these characters are put together to form a field (also called a fact, data item, or data element) A ***field*** is a meaningful collection of related characters. It is the smallest logical data entity that is treated as a single unit in data processing.

For example, if we are processing employees data of a company, we may have an employee code field, an employee name field, an hours worked field, a hourly-pay-rate field, a tax-rate-deduction field, etc. Fields are normally grouped together to form a record. *A **record***, then, is a collection of related fields that are treated as a single unit. An employee record would be a collection of fields of one employee. These fields would include the employee's code, name, hours-worked, pay-rate, tax-rate-deduction, and so forth. Records are then grouped to form a file. A **file** is a number of related records that are treated as a unit. For example, a collection of all employee records for one company would be an employee file.

It is customary to set up a master file of permanent (and, usually, the latest) data, and to use ***transaction files*** containing data of a temporary nature. For example, the master payroll file will contain not only all the permanent details about each employee, his name and code, pay-rate, income tax rate and so forth, but it will also include the current gross-pay-to-date total and the tax paid-to-date total. The transaction payroll file will contain details of hours worked this week, normal and overtime, and, if piecework is involved, the quantity of goods made. When the payroll program is processed, both files will have to be consulted to generate this week's payslips, and the master file updated in readiness for the following week.

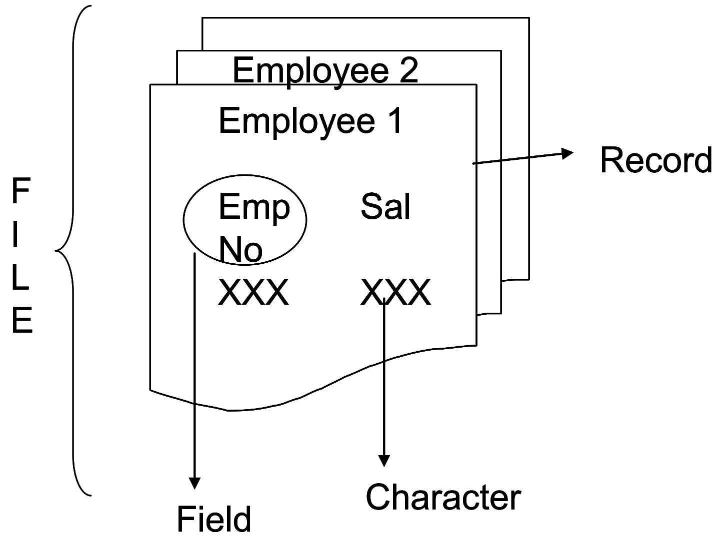


Fig 2.5.1 illustrates relationship between character, field, record, and file.

A *data base* is a collection of integrated and related master files. It is a collection of logically related data elements that may be structured in various ways to meet the multiple processing and retrieval needs of organizations and individuals. Characters, fields, records, files, and data bases form a hierarchy of data storage. Fig. 2.5.1 summarizes the data storage hierarchy used by computer based processing systems. Characters are combined to make a field, fields are combined to make a record, records are combined to make a file, and files are combined to make a data base.

2.6. FILE ORGANIZATIONS

System designers choose to organize, access, and process records and files in different ways depending on the type of application and the needs of users. The three commonly used file organizations used in business data processing applications are - sequential, direct and indexed sequential organizations. The selection of a particular file organization depends upon the type of application. The best organization to use in a given application is the one that happens to meet the user's needs in the most effective and economical manner. In making the choice for an application, designers must evaluate the distinct strengths and weaknesses of each file organization. File organization requires the use of some key field or unique identifying value that is found in every record in the file. The key value must be unique for each record of the file because duplications would cause serious problems. In the payroll example, the employee code field may be used as the key field.

2.6.1 Serial File Organization: With serial file organization, records are arranged one after another, in no particular order- other than, the chronological order in which records are added to the file. Serial organization is commonly found with transaction data, where records are created in a file in the order in which transactions take place.

Records in a serially organized file are sometimes processed in the order in which they occur. For example, when such a file consists of daily purchase and payment transaction data, it is often used to update records in a master account file. Since transactions are in random order by key field, in order to perform this update, records must be accessed randomly from the master file.

Transaction data is not the only type of data found in serially organized files. In many businesses, customer account numbers are issued in a serial manner. In this scheme, a new customer is given the next highest account number that has not been issued and the data about the new customer (such as name, address, and phone number) are placed at the end of the existing customer account file.

2.6.2 Sequential files: In a sequential file, records are stored one after another in an ascending or descending order determined by the key field of the records. In payroll example, the records of the employee file may be organized sequentially by employee code sequence. Sequentially organized files that are processed by computer systems are normally stored on storage media such as magnetic tape, punched paper tape, punched cards, or magnetic disks. To access these records, the computer must read the file in sequence from the beginning. The first record is read and processed first, then the second record in the file sequence, and so on. To locate a particular record, the computer program must read in each record in sequence and compare its key field to the one that is needed. The retrieval search ends only when the desired key matches with the key field of the currently read record. On an average, about half the file has to be searched to retrieve the desired record from a sequential file.

Advantages of Sequential files

- Easy to organize, maintain, and understand.
- There is no overhead in address generation. Locating a particular record requires only the specification of the key field.
- Relatively inexpensive I/0 media and devices can be used for the storage and processing of such files.
- It is the most efficient and economical file organization in case of applications in which there are a large number of file records to be updated at regularly scheduled intervals. That is, when the activity ratio (the ratio of the total number of records in transaction file and the total number of records in master file) is very high. Applications such as payroll processing, billing and statement preparation, and bank cheque processing meet these conditions.

Disadvantages of sequential Files

- It proves to be very inefficient and uneconomical for applications in which the activity ratio is very low.
- Since an entire sequential file may need to be read just to retrieve -and update few records, accumulation of transactions into batches is required before processing them.
- Transactions must be sorted and placed in sequence prior to processing.
- Timeliness of data in the file deteriorates while batches are being accumulated.
- Data redundancy is typically high since the same data may be stored in several files sequenced on different keys.

2.6.3 Direct Access File Organization: Direct file organization allows immediate direct access to individual records on the file. The most widely used direct access techniques are depicted in the chart below:-

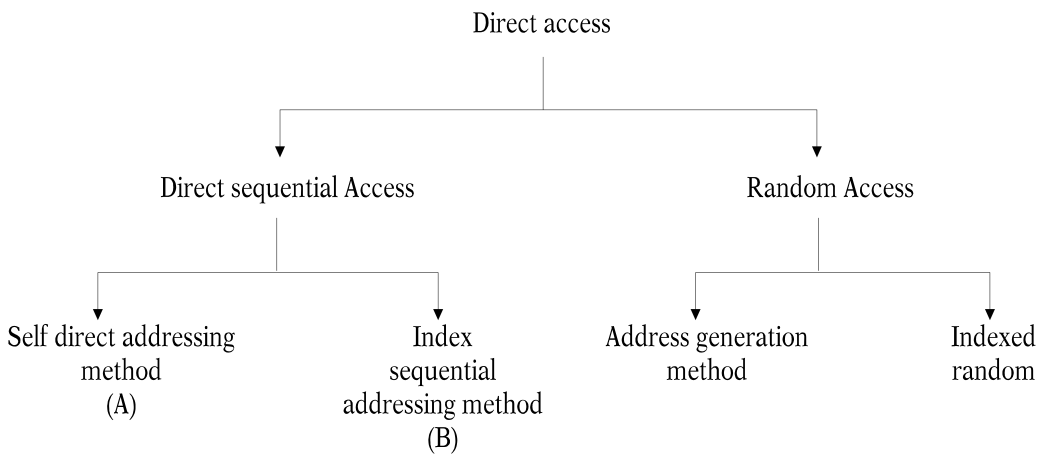


Fig. 2.6.3.1 Direct Access File Organization

The primary storage in a CPU truly provides for direct access. There are some devices outside the CPU which can provide the direct access feature; the direct access storage devices (DASD) have the capability of directly reaching any location. Although there are several types of direct storage devices including discs and other mass storage devices, discs are by far the most widely used direct access storage devices. We will now describe the methods A-B mentioned above to show how data are stored on magnetic disks using these methods.

2.6.4 Direct Sequential Access Methods

(A) Self (Direct) Addressing: Under self direct addressing, a record key is used as its relative address. Therefore, we can compute the record's address directly from the record key and the physical address of the first record in the file.

Thus, this method is suitable for determining the bucket address of fixed length records in a sequential file, and in which the keys are from a complete or almost complete range of consecutive numbers. Suppose we want to store 1,60,000 payroll records cylinder-wise in the magnetic disc pack of 6 discs. The first cylinder carries the first 800 records; the 2nd cylinder carries the next 800 records, and so on. For periodic processing of the file, the read/write heads would move cylinder by cylinder in which the records have been sequentially arranged. For example, the ten faces in the first cylinder would carry the first 800 records as below:

$f_{1,1}$ 1 to 80

$f_{1,2}$ 81 to 160

:

:

:

$f_{1,10}$ 721 to 800

How do we have direct access then in such a file organization? There are a total of 16,000 buckets. Let the bucket address range from 10,001 to 26,000. And the keys of the records range from 1 to 1,60,000. We wish to know where record of the key 1,49,892 is to be found *i.e.,* in which bucket it is stored. The following arithmetic computations would have to be performed towards this purpose.

1. Divide the wanted record's key by the number of records per bucket.
2. Add the first bucket number to the quotient to give the wanted record's bucket:

   14989 + 10001 = 24990.
3. The remainder (2) is the record's position within the bucket. The remainder 0 would indicate that it is the last record of the preceding bucket. Thus, if a manager wishes to know the qualification of a particular employee (say, no 149892) i.e., makes a random inquiry, the above computations would be performed to derive the bucket number, command the read/write heads to move to that bucket and supply the wanted information.

But this method is highly impractical because files too have gaps in the keys and this would leave too many empty buckets *i.e.,* storage would not be compact.

The advantage of Self-addressing is that there is no need to store an index.

The disadvantages of Self-addressing are:

(i) The records must be of fixed length.

(ii) If some records are deleted their storage space remains empty.

(B) Indexed-Sequential File Organization: *The indexed sequential file organization or indexed sequential access method* (ISAM), is a hybrid between sequential and direct access file organizations. The records within the file are stored sequentially but direct access to individual records is possible through an index. This index is analogous to a card catalog in a library.

Cylinder Index

Cylinder	Highest Record key in the Cylinder
1	84
2	250
3	398
4	479
5	590

Cylinder 1 Track index	
Track	Highest record key in the Track
1	15
2	40
3	55
4	75
5	84

Cylinder 2 Track index	
Track	Highest record key in the Track
1	94
2	110
3	175
4	225
5	250

Cylinder 3 Track index	
Track	Highest record key in the Track
1	280
2	301
3	330
4	365
5	398

Fig 2.6.4.1 illustrates a cylinder and track index for an ISAM file.

To locate a record, the cylinder index is searched to find the cylinder address, and then the track index for the cylinder is searched to locate the track address of the desired record. Using

Fig . 2.6.4.1 to illustrate, we assume that the desired record has a key value of 225. The cylinder address is 2, since 225 is greater than 84 but less than 250. Then, we search the track index for cylinder 2 and find that 225 is greater than 175 and equal to 225, therefore, the track address is 4. With the cylinder address, control unit can then search through the records on track 4 within cylinder 2 to retrieve the desired records.

Advantages of indexed sequential files

- Permits the efficient and economical use of sequential processing techniques when the activity ratio is high.
- Permits direct access processing of records in a relatively efficient way when the activity ratio is low.

Disadvantages of indexed sequential files

- These files must be stored on a direct-access storage device. Hence, relatively expensive hardware and software resources are required.
- Access to records may be slower than direct files.
- Less efficient in the use of storage space than some other alternatives.

2.6.5 Random Access Organization: In this method, transactions can be processed in any order and written at any location through the stored file. The desired records can be directly accessed using randomizing procedure without accessing all other records in the file.

Randomizing Procedure is characterized by the fact that records are stored in such a way that there is no relationship between the keys of the adjacent records. The technique provides for converting the record key number to a physical location represented by a disk address through a computational procedure.

Advantages of Direct Files

- The access to, and retrieval of a record is quick and direct. Any record can be located and retrieved directly in a fraction of a second without the need for a sequential search of the file.
- Transactions need not be sorted and placed in sequence prior to processing.
- Accumulation of transactions into batches is not required before processing them. They may be processed as and when generated.
- It can also provide up-to-the minute information in response to inquiries from simultaneously usable online stations.
- If required, it is also possible to process direct file records sequentially in a record key sequence.

- A direct file organization is most suitable for interactive online applications such as airline or railway reservation systems, teller facility in banking applications, etc.

Disadvantages of direct files

- Address generation overhead is involved for accessing each record due to hashing function.
- May be less efficient in the use of storage space than sequentially organized files.
- Special security measures are necessary for online direct files that are accessible from several stations.

2.6.6 THE BEST FILE ORGANIZATION

Several factors must be considered in determining the best file organization for a particular application. These factors are file volatility, file activity, file size, and file interrogation requirements.

File volatility: It refers to the number of additions and deletions to the file in a given period of time. The payroll file for a construction company where the employee roster is constantly changing is a highly volatile file. An ISAM file would not be a good choice in this situation, since additions would have to be placed in the overflow area and constant reorganization of the file would have to occur. Other direct access methods would be better. Perhaps even sequential file organization would be appropriate if there were no interrogation requirements.

File activity: It is the proportion of master file records that are actually used or accessed in a given processing run. At one extreme is the real-time file where each transaction is processed immediately and hence at a time, only one master record is accessed. This situation obviously requires a direct access method. At the other extreme is a file, such as a payroll master file, where almost every record is accessed when the weekly payroll is processed. There, a sequentially ordered master file would be more efficient.

File interrogation: It refers to the retrieval of information from a file. If the retrieval of individual records must be fast to support a real-time operation such as airline reservation then some kind of direct organization is required. If, on the other hand, requirements for data can be delayed, then all the individual requests or information can be batched and run in a single processing run with a sequential file organization.

Large files that require many individual references to records with immediate response must be organized under some type of direct access method. On the other hand, with small files, it may be more efficient to search the entire file sequentially or, with a more efficient binary search, to find an individual record than to maintain complex indexes or complex direct addressing scheme.

2.7 DATA BASE MANAGEMENT SYSTEMS

Traditional sequential and random files are designed to meet specific information and data processing requirements of a particular department such as accounting, sales, or purchasing etc. Different files are created to support these functions, but many of the fields on each of these files are common. For example, each of these functional areas needs to maintain customer data such as customer name, address and the person to be contracted at the customer location etc. In a traditional file environment, when information relating to any of the fields change, each relevant file must be updated separately.

Through the early 1980s, most information systems were implemented in an environment with a single functional objective (such as accounts receivable, purchase accounting, payroll etc.) in mind. The integration of information systems was not a priority. Today companies are using database management systems software (DBMS) as a tool to integrate information flow within an organization.

2.7.1 What is a DBMS? : A DBMS is a set of software programs that controls the organization, storage, management, and retrieval of data in a database. A data base is a repository for related collection of data. For example, an address book can be a data base where the names, address and telephone numbers of friends and business contacts are stored. A company data base might contain information about customers, vendors, employees, sales and inventory. Each piece of information can be added to a data base and extracted later in a meaningful way. DBMS is the program (or collection of programs) that allows users (and other programs) to access and work with a database.

Database programs for personal computers come in many shapes, sizes and variations. Examples of DBMS are tabulated below:

Database	Manufacturer	Computer Type
Access	Microsoft Corporation	Personal computer, server, PDA
Adabas	Software AG	Midrange server, mainframe
D^3	Raining Data	Personal computer, midrange server
DB2	IBM Corporation	Personal computer, midrange server, mainframe
Essbase	Hyperion Solutions Corporation	Personal computer, server
FastObjects	FastObjects Inc.	Personal computer, midrange server
GemFire	GemStone Systems, Inc.	Midrange server
Informix	IBM Corporation	Personal computer, midrange server, mainframe
Ingres	Computer Associates International, Inc.	Personal computer, midrange server, mainframe
InterBase	Borland Software Corporation	Personal computer, server
JDataStore	Borland Software Corporation	Personal computer, server
KE Texpress	KE Software, Inc.	Personal computer, server
MySQL	MySQL AB	Personal computer, midrange server
ObjectStore	Progress Software Corporation	Personal computer, midrange server
Oracle	Oracle Corporation	Personal computer, midrange server, mainframe, PDA
SQL Server	Microsoft Corporation	Server, personal computer, PDA
Sybase	Sybase Inc.	Personal computer, midrange server, PDA
Versant	Versant Corporation	Personal computer, midrange server
Visual FoxPro	Microsoft Corporation	Personal computer, server

Fig. 2.7.1.1 Examples of DBMS Programs

2.7.2 An Example of File Processing Approach: An example to illustrate why organizations started using database processing as an alternative to traditional file processing:

A firm might have a customer credit file containing data such as:

- Customer number
- Customer name and address
- Credit code
- Credit limit

Another file, called a customer master file, contains:

- Customer number
- Customer name and address
- Sales region number
- Salesperson number
- Customer class
- Shipping code
- Year to date sales this year
- Year to date sales last year

A third file, for accounts receivable, contains:

- Customer number
- Customer name and address
- First invoice data

  Invoice number
  Invoice date
  Invoice amount
- Second invoice data

  Invoice number
  Invoice date
  Invoice amount

- n^{th} invoice data

  Invoice number

  Invoice date

  Invoice amount

Each of these files has one or more purposes. The customer credit file is used for approving customer orders, the customer master file is used for invoicing customers, and the accounts receivable file represents the money which is to be recovered from customers on account of sales by the firm. All are master files.

Some redundancies are found in the data elements contained within the files. All three files include customer number, and customer name and address. This redundancy is necessary since each file is designed to provide all of the data needed by a particular program.

Let us assume that the sales manager wants a report showing the amount of receivables by a salesperson. The firm's customers have not been paying their bills promptly, and the sales manager wants to know which sales persons have neglected to follow up on past due receivables. He wants the report to include the data listed in Table 3. It can be seen that this special report will require data from four files. A salesperson master file is needed to provide the sales person name.

Report Data	**Customer Credit File**	**Customer Master File**	**Accounts Receivable File**	**Salesperson Master File**
Salesperson number		X		
Sales person Name				X
Customer Data				
Customer number		X		
Customer name		X		
Credit code	X			
Year to date sales this year		X		
Total accounts receivable			X	

Table 3 illustrates example of integration of report data from several files

The report will list each customer by salesperson, following the process illustrated in Fig. 2.7.2.1. In step 1 a program selects data from the three customer files that are maintained in customer number sequence. An intermediate file is created with the selected data (all the data elements listed in Table 3 except salesperson name) this intermediate file is stored into salesperson sequence in step 2. A sort is necessary since the salesperson master file is maintained in salesperson sequence. A second intermediate file is created and used with the salesperson master file to prepare the report in step 3. The programs for step 1 and step 3 would have to be specially written to satisfy this request.

Similarly a manager may require ad hoc reports for management information. For example, a manager might request a report showing sales for sales person 23. Assume that the firm assigns certain customers in a territory to a salesperson and that a customer file contains a record for each customer. The task is to select records for salesperson 23 only and print data on the report. Since the customer file is in sequence by customer, each record will have to be examined to determine if the sales person field contains a 23. This could be a time consuming process.

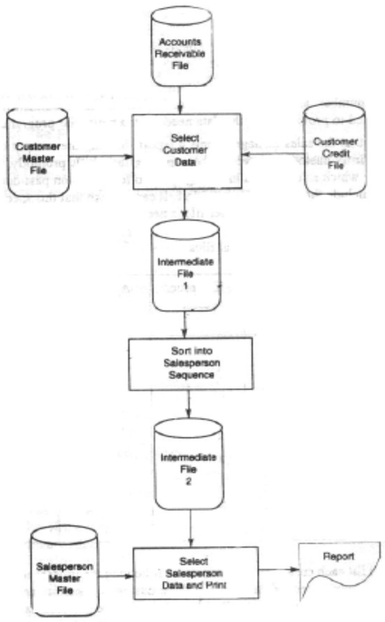


Fig. 2.7.2.1 illustrates example of file processing

2.7.3 Management Problems of File Processing: For many years, information systems had a file processing orientation, as illustrated in the previous example. Data needed for each user application was stored in independent data files. Processing consisted of using separate computer programs that updated these independent data files and used them to produce the documents and reports required by each separate user application. This file processing approach is still being used, but it has several problems that limit its efficiency and effectiveness for end user applications.

1. Data Duplication: Independent data files include a lot of duplicated data; the same data (such as a customer's name and address) is recorded and stored in several files. This data redundancy causes problems when data has to be updated, since separate file maintenance programs have to be developed and coordinated to ensure that each file is properly updated. Of course, this proves difficult in practice, so a lot of inconsistency occurs among data stored in separate files.

2. Lack of Data Integration: Having data in independent files makes it difficult to provide end users with information for ad hoc requests that require accessing data stored in several different files. Special computer programs have to be written to retrieve data from each independent file. This is difficult, time consuming, and expensive for the organizations.

3. Data Dependence: In file processing systems, major components of a system i.e., the organization of files, their physical locations on storage, hardware and the application software used to access those files depend on one another in significant ways. For example, application programs typically contain references to the specific format of the data stored in the various files they use. Thus, if changes are made in the format and structure of data and records in a file, changes have to be made in all the programs that use this file. This program maintenance effort is a major burden of file processing systems. It is difficult to do it properly, and it results in a lot of inconsistency in the data files.

4. Other Problems: In file processing systems, data elements such as stock numbers and customer addresses are generally defined differently by different end users and applications. This causes serious inconsistency in the development of programs which access such data. In addition, the integrity (i.e. the accuracy and completeness) of the data is suspected because there is no control over their use and maintenance by authorized end users.

2.7.4 The Database Management Solution: The concepts of databases and database management were, therefore, developed to solve the problems of file processing systems. A database is an integrated collection of logically related records and files. It consolidates records previously stored in independent files so that it serves as a common pool of data to be accessed by many different application programs.

Benefits of DBMS Solution are:

(a) Reduced data redundancy and inconsistency.

(b) Enhanced data integrity

(c) Logical and physical data independence

(d) Application data independence

(e) Reduced complexity of the organization's Information System environment.

2.8 WHAT IS A DATABASE?

Regardless of its file organization, a data base system includes several components that collectively give it certain distinct, specific characteristics. The following is a precise definition of data base as given by "G"M.Scott"."

A data base is a computer file system that uses a particular *file organization* to facilitate *rapid updating of individual records, simultaneous updating of related records, easy access to all records, by all applications programs, and rapid access to all stored data* which must be brought together for a particular *routine report* or *inquiry* or a *special purpose report* or *inquiry*.

Each of the italicized phrases in the preceding definition has a special meaning that helps define a database. *"File organization"* indicates that the database has one of the three file structures (discussed in the next section) that enable programs to establish associations between the records in the database.

A database facilities *"rapid updating of individual records"* and *"simultaneously updating of related records"* that is a data base permits the entry of an individual transaction to update all records affected by that transaction simultaneously. For example, consider a Rs.100,000 credit sale. In a data base system, the following accounts, along with others could be updated simultaneously with the input of one transaction.

- Sales record
- Salesperson's commissions record
- Division sales record
- Inventory item record
- Accounts receivable customer record
- Cost of sales of individual item record

If transactions are entered as they occur, records that are simultaneously updated are continuously up to date for managerial inquiry purposes. Simultaneous updating also means that the records have consistent contents. For example, the total of the sales record would be consistent with the salesperson's commission's record because the latter is based on the former and both are updated at the same time.

"Easy access to all records by all applications programs" means that the standard data definitions and record formats permit, for example, a payroll applications program to access

the employee number, and data about them from the personnel section of the data base. It also implies that work force planning programs can access pay rates from the payroll section and employees skills from the personnel section of the database. Without a database, each application program would be able to access data only from its own file.

With respect to *"rapid access"* to all stored data needed of a "routine report or inquiry", routine reports can be provided quickly after the end of the accounting period and often whenever requested during the period if the processing of transactions in kept up to date. This is possible because transfer file processing is not required at the end of the period and because data summarization of reports can be fully automated within a database. In other words, little period end processing is required. Similarly, inquiries can be routinely made into the files, for example, to see whether a particular product is available for immediately shipment.

Rapid access with respect to a *"special purpose report or inquiry"* means that records are kept continuously up to date for unanticipated inquiries into the files by managers and that the structure of the data base files facilitates the rapid development of special programs to prepare reports about unanticipated problems.

2.8.1 Architecture of a Database: It follows a three level architecture –

(i) External or user view in different ways to say, the chairman, or the operation manager or the data entry operator,

(ii) Conceptual or global view,

(iii) Physical or internal view.

External or user view encircles the following –

(i) It is at the highest level of the database abstraction,

(ii) It includes only those portion of database or application programs which is of concern to the users,

(iii) It is described by means of a scheme, called the external schema,

(iv) It is defined by the users or written by the programmers.

For example an external view in its Logical Record 1 may indicate employee name, employee address and in its Logical Record 2 may indicate employee name, employee address and employee code and employee salary.

Global or conceptual view, which is viewed by the Data Base Administrator, encompasses the following –

(i) All database entities and relationships among them are included,

(ii) Single view represents the entire database,

(iii) It is defined by the conceptual schema,

(iv) It describes all records, relationships and constraints or boundaries,

(v) Data description to render it independent of the physical representation.

For example a conceptual view may define employee code as a string of characters, employee address also as a string, employee code as a key and employee salary as an integer.

The physical or internal view contains the following –

(i) It is at the lowest level of database abstraction,

(ii) It is closest to the physical storage method,

(iii) It indicates how data will be stored,

(iv) It describes data structure,

(v) It describes access methods,

(vi) It is expressed by internal schema.

The internal view instead, may define employee name is comprised of 30 characters, employee address is also comprised of 30 characters, employee code is comprised of 5 characters and employee salary is comprised of 12 numbers.

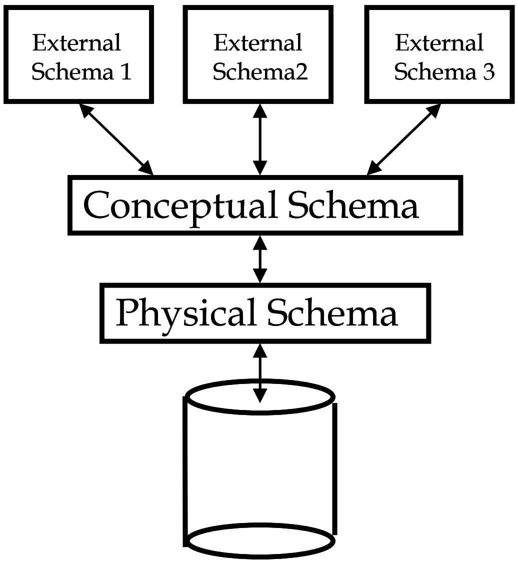


Fig. 2.8.1.1 illustrates three level architecture of a database

The first step in moving from ordinary file management to a data base system is to separate all data definitions from the applications programs and to consolidate them into a separate entity called a **schema**, as illustrated in the fig. 2.8.1.1. In addition to data definition, the schema also includes an indication of the logical relationships between various components of the data base.

The schema then becomes a component of the overall data base itself. From the schema, the installation can generate dictionaries containing a complete description of the data base. These will, in turn, be used by systems analysts in defining new applications.

Database systems have several schemas, partitioned according to the levels of abstraction that we have discussed. At the lowest level is the **physical schema**; at the intermediate level is the **logical schema**; and at the highest level is a **subschema.**

2.8.2 Data independence:

(i) In a database an ability to modify a schema definition at one level is done without affecting a schema in the next higher level,

(ii) It facilitates logical data independence,

(iii) It assures physical data independence.

2.8.3 Classification of DBMS users:

(i) Naive users who are not aware of the presence of the database system supporting the usage,

(ii) Online users who may communicate with database either directly through online terminal or indirectly through user interface or application programs. Usually they acquire at least some skill and experience in communicating with the database,

(iii) Application programmers who are responsible for developing the application programs and user interfaces,

(iv) Data Base Administrator who can execute centralized control and is responsible for maintaining the database.

We will now discuss how data is stored in a database.

2.8.4 File pointers: File pointers establish linkage between records and are a basic part of the file organization of all the database models except the relational model. A pointer is placed in the last field of a record, if more than one pointer is used, then in the last fields. A pointer is the address of another; related record that is “pointed to” and the pointer directs the computer system to that related record. File pointers are used with many database organizations.

Linked List: A linked List is a group of data records arranged in an order, which is based on embedded pointers. An embedded pointer is a special data field that links one record to another by referring to the other record. The field is embedded in the first record, i.e. it is a data element within the record.

Linked lists often have a head, which is a pointer to the first record. It has a tail, which points to the last record. One can start at the head and follow the list to the tail, or one can start in the middle and follow the list to the tail. The user cannot, however, start in the middle and go back to the head. In another words, the linked list is a one way street.

Embedded pointer

Customer	Sales person number	Sales person link
22504		
23694	**23**	**25410**
24782		
25409		
25410	**23**	**30102**
26713		
28914		
30004		
30102	**23**	**30111**
30111	**23**	*
30417		
31715		

Fig. 2.8.4.1 illustrates example of a pointer application.

Fig. 2.8.4.1 shows a linked list of customer records. Each row is a record (only relevant fields are shown) the records are arranged sequentially using customer number as the key. Each record includes a data element, which identifies assigned salesperson. In the right most field of the record there is a pointer (a link) that chains together all customer records for a particular salesperson in the example it is salesperson 23. It can be assumed that customer 23694 is at the head of the list. The pointer links this record to a record for customer 25410 and so on until the tail for customer 30111 is encountered. The asterisk in the link field indicates the tail of the list.

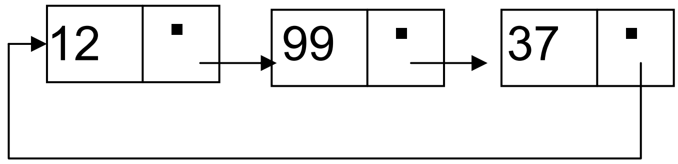


Fig. 2.8.4.2 Example of a linked list

This chaining feature is very powerful. The application program can initiate a search at the beginning of the file looking for the first customer assigned to salesperson 23. When that record is found, the salesperson links enable the program to follow the chain and process records only for salesperson 23. It is a more convenient method than searching through the entire file.

2.8.5 Record relationship in Database: Organizing a large database logically into records and identifying the relationships among those records are complex and time-consuming tasks. There are large number of different records that are likely to be part of a corporate database and the numerous data elements constituting those records. Further, there can be several general types of record relationships that can be represented in a database. These are briefly discussed below:

1. *One –to-one relationship*, as in a single parent record to a single child record or as in a husband record and wife record in a monogamous society [see. fig. 2.8.5.1].
2. *One-to-many relationships,* as in a single parent record to two or more child records – for example, a teacher who teaches three single-section courses [see fig. 2.8.5.1].
3. *Many-to-one relationships*, as in two or more parent records to a single child record-for example, when three administrators in a small town share one minister [see fig. 2.8.5.1].
4. *Many-to-many relationships*, as in two or more parent records to two or more child records – for example, when two or more students are enrolled in two or more courses [See fig. 2.8.5.1].

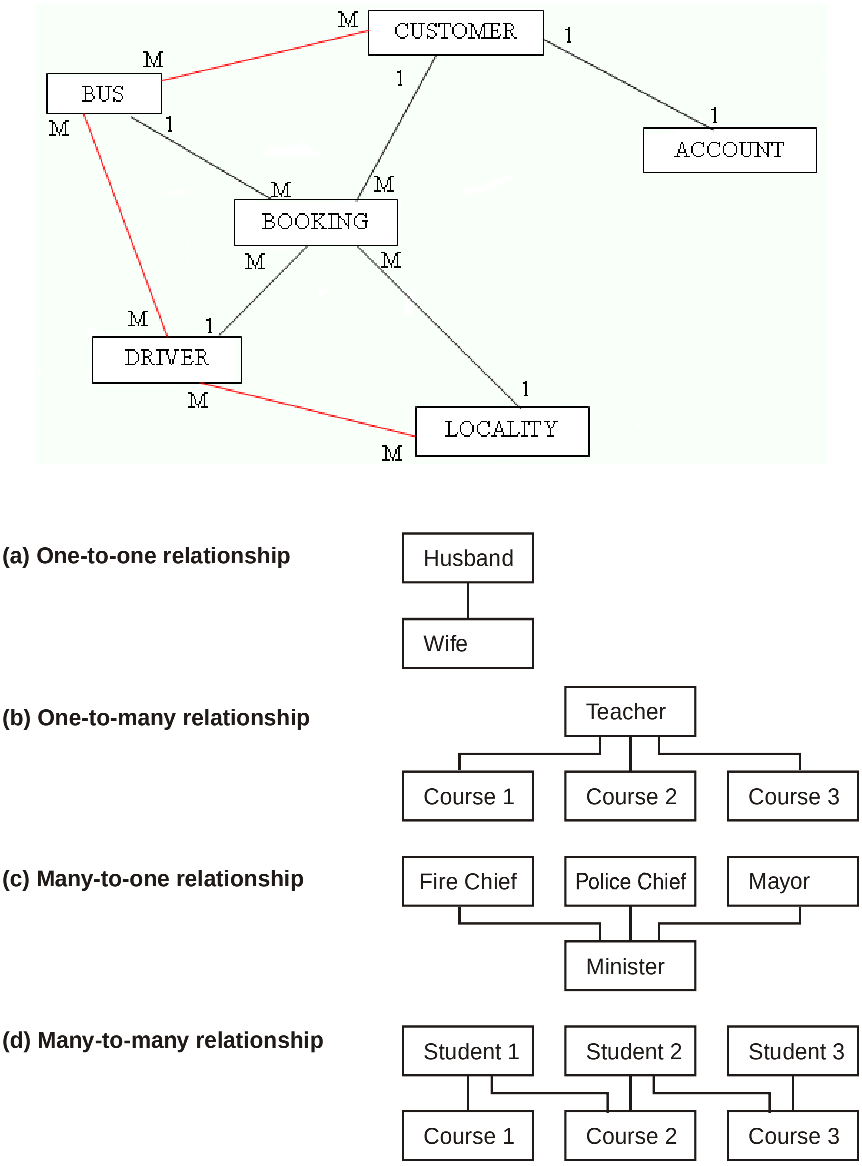


Fig. 2.8.5.1 Illustrates example of relationship in the database

2.9 DATABASE STRUCTURES

Three traditional approaches have been implemented commercially to organize records and their relationships logically. These logical organizational approaches are known as database structures. The three traditional database structures are the

1. Hierarchical database structure
2. Network database structure
3. Relational database structure

These models differ in the manner in which data elements (fields) can be logically related and accessed. Hierarchical models are often considered to be the most restrictive and relational models are the most flexible.

2.9.1 Hierarchical Database Structure: In a hierarchical database structure, records are logically organized into a hierarchy of relationships. A hierarchically structured database is arranged logically in an inverted tree pattern. For example, an equipment database, diagrammed in Fig. 2.9.1.1 may have building records, room records, equipment records, and repair records. The database structure reflects the fact that repairs are made to equipment located in rooms that are part of buildings.

All records in hierarchy are called **nodes**. Each node is related to the others in a parent-child relationship. Each parent record may have one or more child records, but no child record may have more than one parent record. Thus, the hierarchical data structure implements one-to-one and one-to-many relationships.

The top parent record in the hierarchy is called the *root record*. In this example, building records are the root to any sequence of room, equipment, and repair records. Entrance to this hierarchy by the database management system is made through the root record i.e., building. Records that "own" other records are called *parent records*. For example, room records are the parents of equipment records. Room records are also children of the parent record, building. There can be many levels of node records in a database.

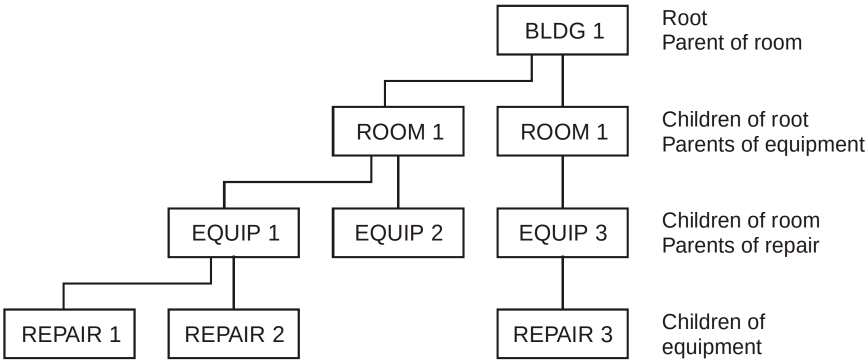


Fig. 2.9.1.1 Hierarchal database structures

Features of Hierarchical Database

- hierarchically structured database are less flexible than other database structures because the hierarchy of records must be determined and implemented before a search can be conducted. In other words, the relationships between records are relatively fixed by the structure.
- Ad hoc queries made by managers that require different relationships other than that are already implemented in the database may be difficult or time consuming to accomplish. For example, a manager may wish to identify vendors of equipment with a high frequency of repair. If the equipment record contains the name of the original vendor, such a query could be performed fairly directly. However, data describing the original vendor may be contained in a record that is a part of another hierarchy. As a result, there may not be any established relationship between vendor records and repair records. Providing reports based on this relationship in a large database is not a minor task and is not likely to be undertaken by the data processing staff for a one-time management query.
- Managerial use of query language to solve the problem may require multiple searches and prove to very time consuming. Thus, analysis and planning activities, which frequently involve ad hoc management queries of the database, may not be supported as effectively by a hierarchical DBMS as they are by other database structures.
- on the plus side, a hierarchical database management system usually processes structured, day-to-day operational data rapidly. In fact, the hierarchy of records is usually specifically organized to maximize the speed with which large batch operations such as payroll or sales invoices are processed.
- Any group of records with a natural, hierarchical relationship to one another fits nicely within the structure. However, many records have relationships that are not hierarchical.

For example, many records relationships require that the logical data structure permit a child record to have more than one parent record. The query to isolate vendors of equipment with extensive repairs might be completed more easily if the equipment records were the children of both the room records and the vendor records

- Though a hierarchical database structure does not permit such a structure conceptually, a commercial hierarchical database management system must have ways to cope with these relationships. Unfortunately, they may not always be easy to implement.

2.9.2 Network Database Structure: A network database structure views all records in sets. Each set is composed of an owner record and one or more member records. This is analogous to the hierarchy's parent-children relationship. Thus, the network model implements the one-to-one and the one-to –many record structures. However, unlike the hierarchical mode, the network model also permits a record to be a member of more than one set at one time. The network model would permit the equipment records to be the children of both the room records and the vendor records. This feature allows the network model to implement the many-to-one and the many-to-many relationship types.

For example, suppose that in our database, it is decided to have the following records: repair vendor records for the companies that repair the equipment, equipment records for the various machines we have, and repair invoice records for the repair bills for the equipment. Suppose four repair vendors have completed repairs on equipment items 1,2,3,4,5, 7 and 8. These records might be logically organized into the sets shown in Fig. 2.9.2.1.

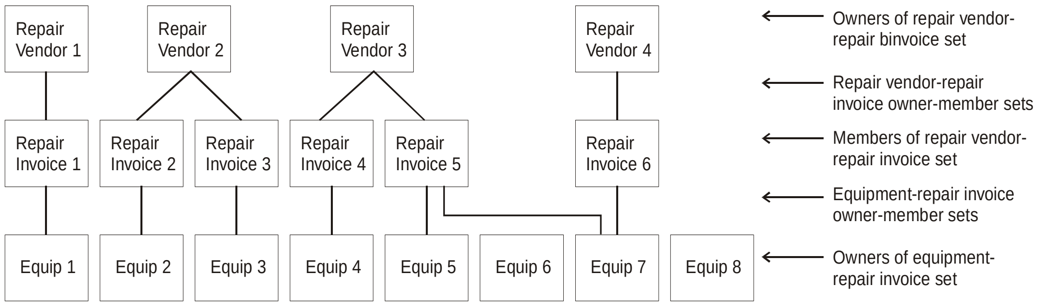


Fig.. 2.9.2.1 Example of Network Database Structure

Notice these relationships in the above:

1. Repair Vendor 1 record is the owner of the Repair Invoice 1 record. This is a one-to-one relationship.

2. Repair Vendor 2 record is the owner of the Repair Invoice 2 and 3 records. This is a one-to-many relationship.

3. Repair Vendor 3 record is the owner of Repair Invoice 4 and 5 records, and the Equipment 7 record owns both the Repair Invoice 5 and 6 records because it was fixed twice by different vendors. Because many equipment records can own many Repair Invoice records, these database records represent a many-to-many relationship.

4. Equipment 6 record does not own any records at this time because it is not required to be fixed yet.

5. Equipment 7 and 8 own Repair Invoice 6 because the repairs to both machines were listed on the same invoice by Repair Vendor 4. This illustrates the many-to-one relationship.

Thus, all the repair records are members of more than one owner-member set: the repair vendor-repair invoice set and the equipment-repair invoice set. The network model allows us to represent one-to-one, one-to-many and many-to-many relationships. The network model also allows us to create owner records without member records. Thus, we can create and store a record about a new piece of equipment even though no repairs have been made on the equipment yet.

Unlike hierarchical data structures that require specific entrance points to find records in a hierarchy, network data structures can be entered and traversed more flexibly. Access to repair records, for example, may be made through either the equipment record or the repair vendor record. However, like the hierarchical data model, the network model requires that record relationships be established in advance because these relationships are physically implemented by the DBMS when allocating storage space on disk. The requirement of established sets means that record processing for regular reports is likely to be swift. Record relationships are usually structured to fit the processing needs of large batch reports. However, ad hoc requests for data, requiring record relationships not established in the data model, may not be very swift at all, and in some cases, they may not be possible.

2.9.3 Relational Database Model: A third database structure is the relational database mode. Both the hierarchical and network data structures require explicit relationships, or links, between records in the database. Both structures also require that data be processed one record at a time. The relational database structure departs from both these requirements.

A relational database is structured into a series of two-dimensional tables. Because many managers often work with tabular financial data, it is easy for most of them to understand the structure used in a relational database. For example, consider the repair vendor relationship. The repair vendor table consists of the repair vendor master records, which contain the repair shown, in fig. 2.9.2.1 as network structure. This can be represented in a tabular form as shown in fig. 2.9.3.1. The repair vendor table consists of the repair vendor master records, which contain the repair vendor number, name and address. The table itself is really a file. Each row in the table is really a record and each column represents one type of data element.

Column 1	Column 2	Column 3
Repair Vendor Number	**Repair Vendor Name**	**Repair Vendor Address**
43623	Telo, Inc.	15 Parliament Street
42890	A-Repair Company	25 G.B.Road
43118	Beeline, Ltd.	498 Old Street
43079	Aspen, Inc.	12 Rouse Avenue
43920	Calso, Inc.	5 Janpath Road

Fig. 2.9.3.1 Repair Vendors Records

A similar table for equipment could look like the one in Fig 2.9.3.2. The table contains the records for each piece of equipment in the firm. Each record also contains the number of the repair vendor who has a contract to repair that piece of equipment.

Column 1	Column 2	Column 3	Column 4
Equipment Number	**Equipment Name**	**Date Purchased**	**Repair Vendor No.**
10893	Typewriter	12/02/1999	43623
49178	Microcomputer	01/31/2000	43920
10719	Telephone	03/12/2000	43079
18572	Copier	11/06/1998	43890
60875	Calculator	08/01/1997	43118

Fig. 2.9.3.2 Equipment Records

If the manager wished to create a report, showing the names of each repair vendor and the pieces of equipment that each vendor repairs, he could combine both tables into a third table. The manager might joint the two tables with a query statement such as this: JOIN REPAIR VENDOR AND EQUIPMENT ON REPAIR VENDOR NUMBER.

This would create a new table with six columns: Repair Vendor Number, Repair Vendor Name, Repair Vendor Address, Equipment Number, Equipment Name and Date Purchases. Now the manager could print out only the columns for vendor name and equipment name. A example of a report is shown in fig 2.9.3.3.

Equipment Repairs 1999	
Repair Vendor	Equipment
Modern Insurance	Telephone
B-line Ltd.	Calculator
Telco India	Type writer

Fig 2.9.3.3 Example of a report

The manager might also produce a report by selecting from both tables only the rows for specific equipment types or for equipment purchased in specific years. The important things to notice are that the relationships, or links, do not need to be specified in advance and that whole tables or files are manipulated.

Relational databases allow the manager flexibility in conducting database queries and creating reports. Queries can be made and new tables created using all or part of the data from one or more tables. The links between data elements in a relational database do not need to be made explicit at the time the database is created since new links can be structured at any time. The relational database structure is more flexible than hierarchical or network database structures and provides the manager with a rich opportunity for ad hoc reports and queries. However, because they do not specify the relationships among data elements in advance, relational databases do not process large batch applications with the speed of hierarchical or network databases.

Many relational database management system products are available. For example, Oracle and IBM offer commercial relational database management systems, Oracle and DB2 respectively.

2.10 DATABASE COMPONENTS

(i) **Data Definition Language (DDL)** that defines the conceptual schema providing a link between the logical (the way the user views the data) and physical (the way in which the data is stored physically) structures of the database. As discussed earlier, the logical structure of a database is a schema. A sub schema is the way a specific application views the data from the database.

Following are the functions of Data Definition Language (DDL) –

(a) They define the physical characteristics of each record, field in the record, field's data type, field's length, field's logical name and also specify relationships among the records,

(b) They describe the schema and subschema,

(c) They indicate the keys of the record,

(d) They provide means for associating related records or fields,

(e) They provide for data security measures,

(f) They provide for logical and physical data independence.

(ii) **Data Manipulation Language (DML): –**

(a) They provide the data manipulation techniques like deletion, modification, insertion, replacement, retrieval, sorting and display of data or records,

(b) They facilitate use of relationships between the records,

(c) They enable the user and application program to be independent of the physical data structures and database structures maintenance by allowing to process data on a logical and symbolic basis rather than on a physical location basis,

(d) They provide for independence of programming languages by supporting several high-level procedural languages like, COBOL, PL/1 and C++.

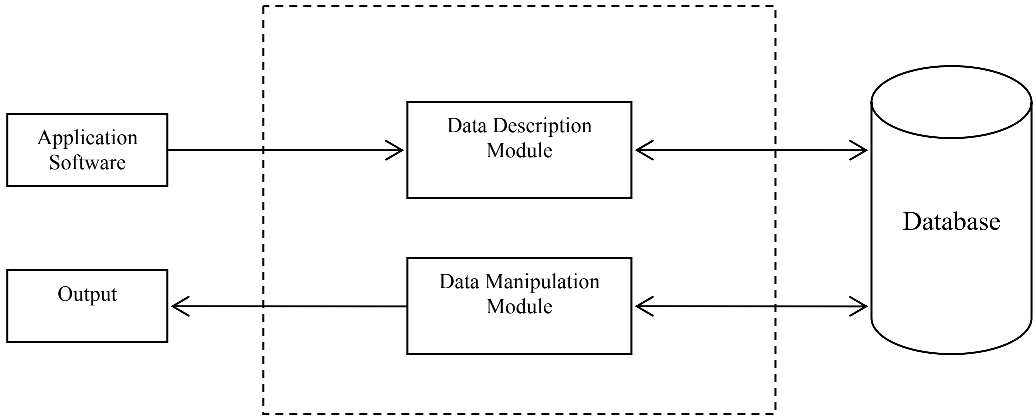


Fig 2.10.1 Data Base Management Systems Components

2.11 STRUCTURE OF DBMS: –

(i) **DDL Compiler –**

a. It converts data definition statements into a set of tables,

b. Tables contain meta data (data about the data) concerning the database,

c. It gives rise to a format that can be used by other components of database.

(ii) **Data Manager –**

a. It is the central software component,

b. It is referred to as the database control system,

c. It converts operations in users' queries to physical file system.

(iii) **File Manager –**

a. It is responsible for file structure,

b. It is responsible for managing the space,

c. It is responsible for locating block containing required record,

d. It is responsible for requesting block from disk manager,

e. It is responsible for transmitting required record to data manager.

(iv) **Disk Manager –**

a. It is a part of the Operating System,

b. It carries out all physical input / output operations,

c. It transfers block / page requested by file manager.

(v) **Query Manager –**

a. It interprets user's online query,

b. It converts to an efficient series of operations,

c. In a form it is capable of being sent to data manager,

d. It uses data dictionary to find structure of relevant portion of database,

e. It uses information to modify query,

f. It prepares an optimal plan to access database for efficient data retrieval.

(vi) **Data Dictionary** –

a. It maintains information pertaining to structure and usage of data and meta data,

b. It is consulted by the database users to learn what each piece of data and various synonyms of data field means.

Data base administrator: As mentioned earlier data base systems are typically installed and coordinated by an individual called the **data base administrator**. He has the overall authority to establish and control data definitions and standards. He is responsible for determining the relationships among data elements, and for designing the data base security system to guard against unauthorised use. He also trains and assists applications programmers in the use of data base. A data dictionary is developed and used in a data base to document and maintain the data definitions.

To design the database, the data base administrator must have a discussion with users to determine their data requirement. He can then decide the schedule and accuracy requirements, the way and frequency of data access, search strategies, physical storage requirements of data, level of security needed and the response time requirements. He may also identify the source of data and the person responsible for originating and updating of data. The database administrator then converts these requirements into a physical design that specifies hardware resources required for the purpose.

Defining the contents of the data base is an important part of data base creation and maintenance. The process of describing formats, relationships among various data elements and their usage is called data definition and the DBA uses data definition language (DDL) for this purpose.

Maintaining standards and controlling access to data base are two other important functions that are handled by the DBA using DDL. The DBA specifies various rules which must be adhered to while describing data for a database. Data description not meeting these rules are rejected and not placed in the data dictionary. Invalid data values entered by users are also rejected. The DBA uses access controls to allow only specified users to access certain paths into the data base and thus prevent unauthorized access. For example, in an airline reservation system, an airline agent should be prevented from offering an expired rate to a passenger.

The DBA also prepares documentation which includes recording the procedures, standards guidelines and data descriptions necessary for the efficient and continued use of the data base environment. Documentation should be helpful to end users, application programmers, operating staff and data administration personnel. The DBA also educates these personnel about their duties.

It is also a duty of the DBA to ensure that the operating staff performs its database processing related responsibilities which include loading the database, following maintenance and security procedures, taking backups, scheduling the database for use and following restart and recovery procedures after some hardware or software failure, in a proper way.

The DBA also monitors the data base environments. He ensures that the standards for database performance are being met and the accuracy, integrity and security of data is being maintained. He also sets up procedures for identifying and correcting violation of standards, documents and corrects errors. This is accomplished by carrying out a periodic audit of the database environment.

The DBA is also responsible for incorporating any enhancements into the database environment which may include new utility programs or new systems releases, and changes into internal procedures for using data base etc.

2.12 TYPES OF DATABASES

The growth of distributed processing, end user computing, decision support and executive information systems has caused the development of several types of databases. Fig 2.12.1 illustrates six of the main databases that may be found in computer using organizations.

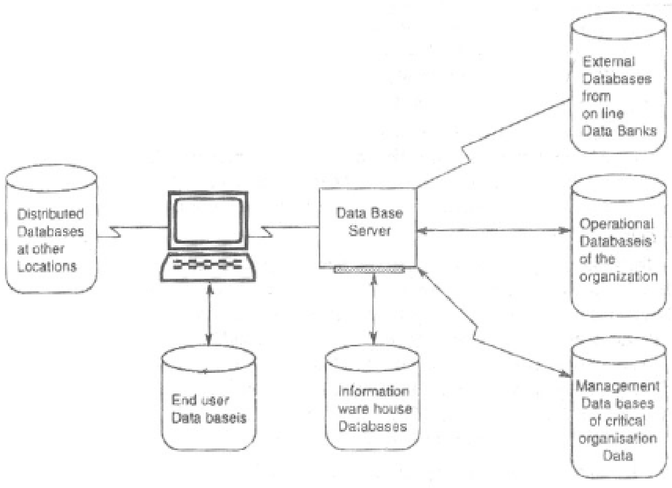


Fig 2.12.1 illustrates six of the main databases

Operational databases: These databases store detailed data needed to support the operations of the entire organization. They are also called subject area databases (SADB), transaction databases, and production databases. Examples are a customer database, personnel database, inventory database, and other databases containing data generated by business operations.

Management Database: These databases store data and information extracted from selected operational and external database. They consist of summarized data and information most needed by the organization's managers and other end users. Management databases are also called information databases. These are the databases accessed by executive end-users as part of decision support systems and executive information systems to support managerial decision making.

Information Warehouse Databases: An information warehouse stores data from current and previous years. This is usually data that has been extracted from the various operational and management databases of an organization. It is a central source of data that has been standardized and integrated so that it can be used by managers and other end-user professionals throughout an organization. For example, an important use of information warehouse databases is pattern processing, where operational data is processed to identify key factors and trends in historical patterns of the business activity.

End User Databases: These databases consist of a variety of data files developed by end users at their workstations. For example, users may have their own electronic copies of documents they generated with word processing packages or received by electronic mail. Or they may have their own data files generated from spreadsheet and DBMS packages.

External Databases: Access to external, privately owned online databases or data banks is available, for a fee, to end users and organizations from commercial information services. Data is available in the form of statistics on economic and demographic activity from statistical data banks. One can receive abstracts from hundreds of newspapers, magazines, and other periodicals from bibliographic data banks.

Text Databases: Text databases are natural outgrowth of the use of computers to create and store documents electronically. Thus, online database services store bibliographic information such as publications in larger text databases. Text databases are also available on CD-ROM optical disks for use with microcomputer systems. Big corporations and government agencies have developed large text databases containing documents of all kinds. They use text database management systems software to help create, store, search, retrieve, modify, and assemble documents and other information stored as text data in such databases.

Microcomputer versions of this software have been developed to help users manage their own text databases on CD-ROM disks.

Image Databases: Up to this point, we have discussed databases, which hold data in traditional alphanumeric records, and files or as documents in text databases. But a wide variety of images can also be stored electronically in image databases. For example, electronic encyclopedia are available on CD-ROM disks which store thousands of photographs and many animated video sequences as digitized images, along with thousands of pages of text. The main appeal of image database for business users are in document image processing. Thousands of pages of business documents, such as customer correspondence, purchase orders and invoices, as well as sales catalogues and service manuals, can be optically scanned and stored as document images on a single optical disk. Image database management software allows employees to hold millions of pages of document images. Workers can view and modify documents at their own workstations and electronically transfer them to the workstations of other end users in the organization.

2.12.1 Other Database models

(i) **Distributed Database:** When an organization follows a centralized system, its database is confined to a single location under the management of a single group. Sometimes an organization may require decentralizing its database by scattering it with computing resources to several locations so that running of applications programs and data processing are performed at more than one site. This is known distributed data processing to facilitate savings in time and costs by concurrent running of application programs and data processing at various sites. When processing is distributed since the data to be processed should be located at the processing site, the database needs to be distributed fully or partly, depending on the organizational requirements. There are two methodologies of distribution of a database. In a *replicated database* duplicates of data are provided to the sites so that the sites can have frequent access to the same data concurrently. But this method of replication is costly in terms of system resources and also maintaining the consistency of the data elements. In a *partitioned database* the database is divided into parts or segments that are required and appropriate for the respective sites so that only those segments are distributed without costly replication of the entire data. A database can be partitioned along *functional lines* or *geographical lines* or *hierarchically*.

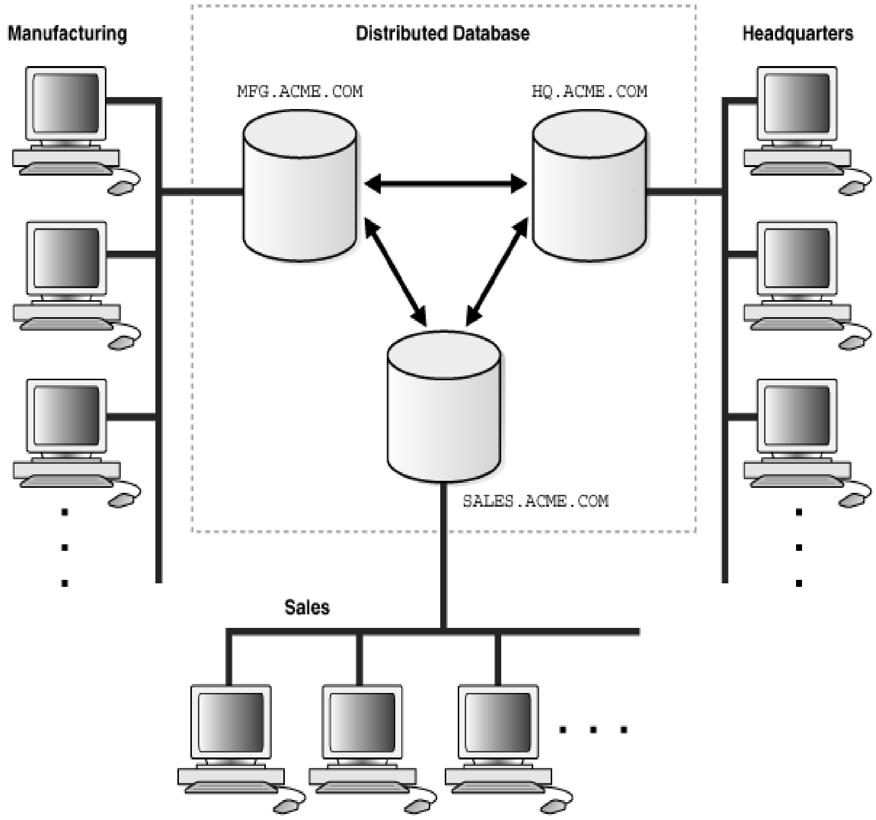


Fig 2.12.1.1 Example of distributed database

(ii) **Object Oriented Database*:*** It is based on the concept that the world can be modeled in terms of objects and their interactions. Objects are entities conveying some meaning for us and possess certain attributes to characterize them and interacting with each other. In the fig 2.12.1.2, the light rectangle indicates that 'engineer' is an object possessing attributes like 'date of birth', 'address', etc. which is interacting with another object known as 'civil jobs'. When a civil job is commenced, it updates the 'current job' attribute of the object known as 'engineer', because 'civil job' sends a message to the latter object.

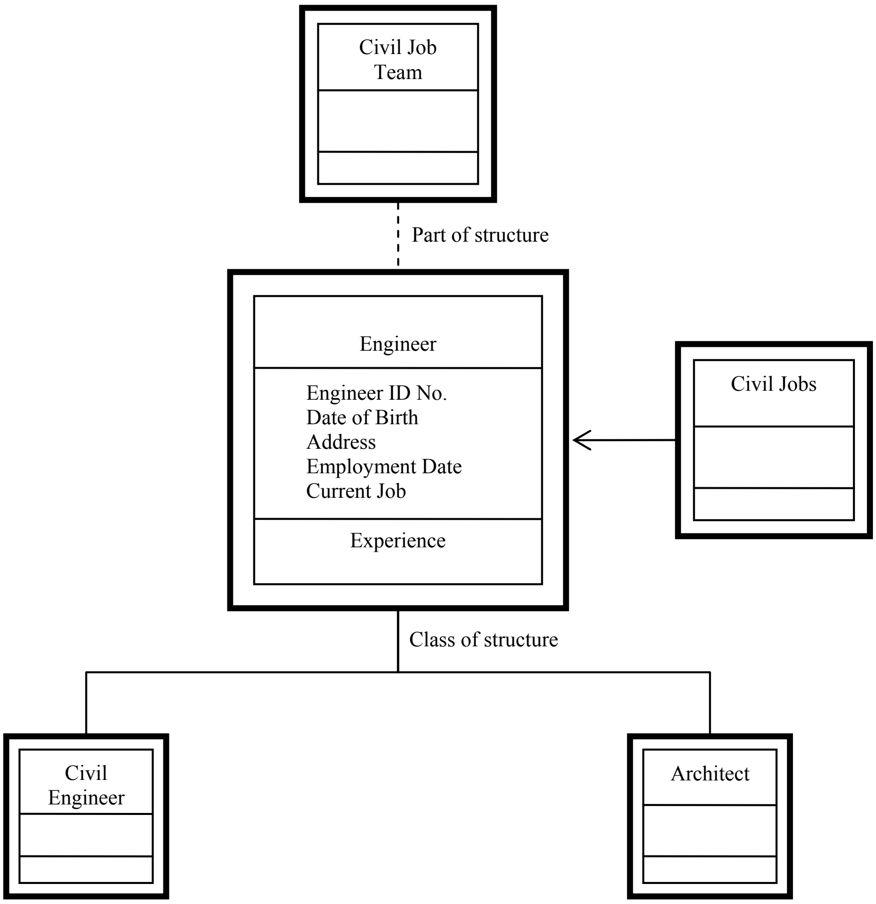


Fig 2.12.1.2 An object-oriented database design

Objects can be organized by first identifying them as a member of a class / subclass. Different objects of a particular class should possess at least one common attribute. In the fig 2.12.1.2 the dark rectangles indicate 'Engineer' as a class and 'Civil Engineer' and also 'Architect' as both subclasses of 'Engineer'. These subclasses possess all the attributes of 'Engineer' over and above each possessing at least one attribute not possessed by 'Engineer'. The line intersecting particular object classes represents the class of structure. Secondly, objects can be identified as a component of some other object. In the fig 2.12.1.2 'Engineers' are components of a 'Civil Job Team' which may have one to more than one number of member(s)

An 'Engineer' may not be a member of the 'Civil Job Team' and may not be a member of more than one team. The dotted line intersecting particular object classes represents the part of structure. Apart from possessing attributes, objects as well as possess methods or services that are responsible for changing their states. In the fig 2.12.1.2 for example, the service 'Experience' as a Civil Engineer or Architect for the object 'Engineer' calculates how much experience the engineers of these particular two subclasses have as professionals.

The motivation for development of object-oriented analysis and design of database are encapsulation and inheritance. Encapsulation indicates that the particulars of an object are hidden in capsule to keep it apart from the other objects. In the fig 2.12.1.2 for example, only minimum details about the attributes and services of an 'Engineer' is exposed to other objects. But the hiding technique weakens the coupling between the objects resulting in having fewer effects when there is a change to the system. Inheritance indicates that the object in a subclass automatically acquire or inherit the attributes and services of their class. In the fig 2.12.1.2 for example, the 'Civil Engineers' and the 'Architects' possess all the attributes and services of the class 'Engineers'. In fact inheritance develops reuse of objects and higher system reliability.

Now a day the database system is used increasingly to store –

(i) Data about manufacturing designs in which focus is given to design objects that can be composed or decomposed into other design objects (like Telco resorts to CAD-CAM techniques),

(ii) Images, graphics, audio, video which can be used to support multimedia applications.

(iii) **Client-server Database:** It is designed in a structure in which one system can connect to another system to ask it question or instruct it to perform job. The system that asks the questions and issues the instructions is the client and the system answering the queries and responding to the instructions is the server. The client machine contains the user interface logic, business logic and the database logic and the server machine contains the database. Both are coupled with a network of high bandwidth.

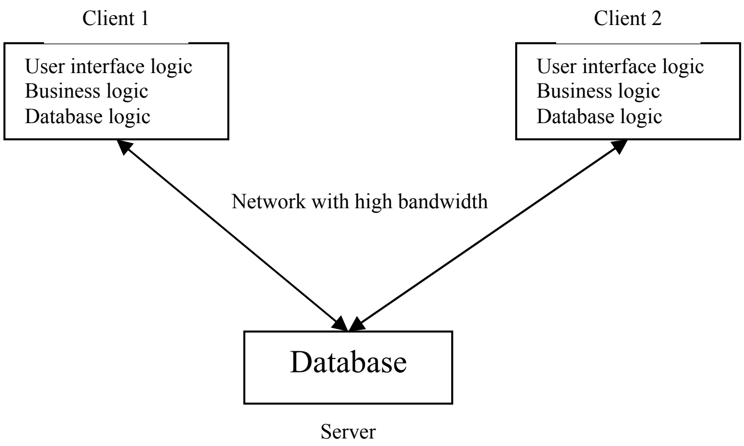


Fig 2.12.1.3 A Client-server Database Design (2-tier)

Whereas the user interface program or front end program is called the client, a back end program is called a server which interacts with share resources in an environment which can be based on heterogeneous hardware / software (Operating System) platforms of the client and the server and multi-vendor. The computational functions are shared in such a way that the server does all such higher level functions which it alone can do leaving the client to perform low level functions. The system scaleable in as much as clients may be added or removed and the shared resources may be relocated to a larger and faster server or to multiple servers.

The above is a 2-tier model implying a complicated software distribution procedure. Since all the application logic is executed on the personal computers, all these personal computers have to be updated in case of a new software release, which is bound to be very costly, time consuming, complicated and error prone. Once it reaches one of the users, the software first has to be installed and then tested for correct execution. Due to distributed character of such a procedure, it is not assured whether all clients work on the correct copy of the program.

3-tier and n-tier client-server database designs try to solve these problems by simply transferring the application logic from the client back to the server. This is accomplished by inserting an application server tier between the data server tier and the client tier. Client tier is responsible for data presentation, receiving user events and controlling the user interface. The actual business logic is not handled by the client tier; instead it is handled by the application server tier. In the light of object-oriented analysis (OOA), business objects which implement the business rules, reside in application server tier which forms the central key to solve the 2-tier problems and protects the data from direct access by the clients. Data server tier is responsible for data storage. Besides, the relational database structure, legacy system structure is often used.

(iv) **Knowledge Database:** A database system provides functions to define, create, modify, delete and read data in a system. The type data maintained in a database system historically has been *declarative data* describing the static aspects of the real world objects and their associations. A pay roll file and a personnel file can share data about pay rates for each and every employee, their positions, names, etc.

A database system can also be used to maintain *procedural data* describing the dynamic aspects of the real world objects and their associations. The database can contain for example, several amended versions of enactments in the field of labour laws to facilitate management decisions in pay negotiations. When both the declarative and procedural data are stored in a database it constitutes a knowledge database with more *powerful* data maintenance.

The emergence of voluminous databases and higher use of decision support systems (DSS) and executive information systems (EIS) have led to increased interest regarding database structures which allow recognition of patterns among data and facilitate knowledge discovery by the decision makers.

A voluminous database which contains integrated data, detailed data, summarized data, historical data and metadata (data about data) is called a ***data warehouse***. A database which contains selective data from a data warehouse meant for a specific function or department is called a ***data mart***. The process of recognizing patterns among data contained in a data warehouse or a data mart is called a process of *data mining.*

2.13 STRUCTURED QUERY LANGUAGE AND OTHER QUERY LANGUAGES

A query language is a set of commands to create, update and access data from a database allowing users to raise adhoc queries / questions interactively without the help of programmers. A structured query language (SQL) is a set of thirty (30) English like commands which has since become an adoptable standard. The structured query language syntax use some set of commands regardless of the database management system software like ‘Select’, ‘From’, ‘Where’.

SQL Statement

```
SELECT FIRST NAME, LAST NAME, MONTHLY FEE
FROM MEMBER, MEMBERSHIP PLANS
WHERE MEMBER.MEMBER ID = MEMBERSHIP PLANS.MEMBER ID
ORDER BY LAST NAME
```

SQL Statement Result

First Name	Last Name	Monthly Fee
Marcus	Green	20.25
Shannon	Murray	39.50
Adrian	Valesquez	45.50
Donna	Vandenburg	55.50
Jonah	Weinberg	45.50

Fig 2.13.1 Example of SQL Statement

Some query languages have been designed in such a way that the command used is as close to Standard English text as possible. Query languages in a user-friendly way allow users to retrieve data from database without exposure to -

(i) file / record structure,

(ii) processes that the system performs,

(iii) Languages like Common Business Oriented Language (COBOL), Beginner's All-purpose Symbolic Instruction Code (BASIC) or such other standard programming languages. Data retrieving efficiency may be improved by gaining knowledge about query shortcuts, query strategies and the types of data used in the database. A training and development program for this purpose may prove useful for the end users.

2.13.1 Natural Language: It is difficult for a system to understand natural language due to its ambiguity in sentence structure, syntax, construction and meaning. Accordingly it is not possible to design an interface given this problem. However systems can be designed to understand a subset of a language which implies the use of natural language in a restricted domain.

2.14 STORAGE

The storage structure design entails the decisions, which must be made on how to make it linear and to partition the data structure so that it can be stored on some device. The file library functions as an aspect of Operations Management Controls, takes responsibility of machine readable storage media for the management. In this context four functions must be undertaken: –

(i) Ensuring that removable storage media are stored in a secure and clean environment,

(ii) Ensuring that storage media are used for authorized purposes only,

(iii) Ensuring maintenance of storage media in good working condition and

(iv) Ensuring location of storage media at on-site / off-site facilities.

A storage media can contain critical files and hence should be housed securely. In case of mainframe operations, a separate room may be required just adjacent to computer room to house storage media required during daily operations, restricting access to the room and fixing the responsibility in the hands of a file librarian. Similar arrangements may be followed in the case of an off-site backup storage. Both on-site and off-site facilities should be maintained in a constant temperature, dust free environment. For managing a bulk of removable storage media effectively an automated library system is needed which records the following –

(i) An identifier of each storage medium,

(ii) Location where each storage medium is at present placed,

(iii) Identity of the person responsible for storage medium,

(iv) Identity of the present custodian of the storage medium,

(v) List of files stored on each medium,

(vi) List of authorized persons to access,

(vii) Date of purchase and history of use with history of difficulties in using the storage medium,

(viii) Date of expiry when contents of the storage medium can be deleted,

(ix) Date of last release from and date last return to the file library,

Use of storage media is controlled with grate care. In mainframe environments, file librarians issue removable storage media as per authorized production schedule by transporting the required media themselves to computer room and collecting it after the production runs. In other cases file librarians issue it on the basis of an authorized requisition only, side by side recording the use of removable storage media. In micro computer environments, the extent of control over its use is dependent on the criticality of the data maintained on it. At an off-site location asset safeguarding and data integrity objectives can be seriously compromised. Off-site personnel usually works for a vendor who may specialize in providing backup facilities and the off-site personnel may not have the knowledge of the customer organizations to determine who is authorized to access the storage media. Care should also be taken when multiple files are assigned to a single medium, for an application system reading one file may also read another file containing sensitive data. Actually, sensitive files should exist alone or separately on a medium. Otherwise the Operating System should be designed to exercise control over an application system to restrict access to authorized files only. To reduce the chance of exposure of sensitive data at some point of time, file should be expunged out of storage media as soon as their retention dates expire. Such media can then be reused to store other files, thereby reducing the inventory requirement.

Reliability of storage media should be monitored, especially which are used to store critical files, since the reliability decreases with age. For example, an increasing number of read / write errors are crept in the magnetic tapes and diskettes as these become older and used more. Storage media should not be kept unused for longs, otherwise the possibility of read / writes error occurring with the media increases. With a magnetic tape for example, pressure builds up towards its center on its hub as it grows older. The pressure causes bonding and compacting of the ferromagnetic material from which the magnetic tape is made resulting in unread ability of the tape. Keeping this in view, a backup storage media need to be managed. Even if the backup has to be stored for long periods, it should be retrieved at regular intervals and backup files re-written to another fresh medium.

When storage media becomes unreliable, it is best to discard it; after ensuring that all sensitive data is removed from the discarded media. Simply deleting the files on the media does not serve the purpose. It may be necessary to carry out bulk erasure followed by writing random bits to the media followed by carrying out of bulk erasure once again. In some cases, unreliable storage media can be repaired. For example magnetic tapes can be cleaned to improve its reliability and to enhance its life. If storage media is required to be sent out side the organization for cleaning or repair, care should be taken to erase any sensitive data contained. The data on magnetic tapes for example, can be erased by degaussing or demagnetization.

Removable storage media should be located on-site when these are needed to support production running of application systems and should be located off-site when intended for backup and recovery. In a mainframe environment, it is the responsibility of the file librarian to manage transport of removable storage media to and from off-site locations. These movements should have compliance with the backup schedules. Backup schedules are prepared by a team comprised of security administrator, data administrator, application project manager, system development manager, operations manager and the file librarian. In a mini computer / micro computer environment, a person still performs file librarian duties for both on-site and off-site movements. Backup is prepared for minicomputer disk storage, local area network file server storage and critical microcomputer files. Good control is assured if these responsibilities are vested for example, in the file librarian who takes responsibility for backup of the mainframe. One operation staff dealing with minicomputers and local area networks and the other operations staff dealing with microcomputer can provide backup to mainframe file librarian for transport to off-site storage. If the mainframe file librarian does not perform the above mentioned functions, the other two operation staff may perform it themselves, provided management formulates standards on it and propagates it in that way.

2.15 DOCUMENTATION AND PROGRAM LIBRARY

The documentations that are needed to support a system in an organization are–

(i) Strategic and operational plans,

(ii) Application systems and program documentation,

(iii) System software and utility program documentation,

(iv) Database documentation,

(v) Operations manuals,

(vi) User manuals,

(vii) Standard manuals.

Besides, ancillary documents like memoranda, books and journals are also the required documents to support a system. These are kept in automated form for example, computer aided systems engineering (CASE) tools are used to provide machine readable formats of dataflow diagrams or entity relationship diagrams or some software that can provide documentation on optical disks (CD-ROM) However much of the documentation is still kept in hard copy formats since it has still some advantages over online documentation.

The difficulties in the management of systems documentation are as follows –

(i) Responsibility for documentation is dispersed throughout the organization. For example, a librarian may be responsible for documentation supporting mainframe and mini computer systems, whereas documentation supporting micro computer system may be the responsibility of its users,

(ii) Documentation is maintained in multiple forms and in multiple locations. For example, some part may exist in magnetic form, some other part in hard copy form and the remaining part in the micro form,

(iii) Given the density and dispersion of documentation, proper updating, accessibility and adequate backup are not ensured.

The responsibilities of documentation librarians are ensuring that –

(i) Documentation is stored securely,

(ii) Only authorized user can have access to it,

(iii) It is updated,

(iv) Adequate backup exists for it,

Many organizations acquire a large number of software packages to support its microcomputers operations. In case the inventory of software is not managed by the documentation librarians properly, it may lead to problems like –

(i) Purchase of too many copies of the software,

(ii) Loss or theft of the software,

(iii) Loss or theft of the documentation,

(iv) Illegal copying of the software,

(v) Use of software not complying with the terms and conditions of the software license,

(vi) Absence of the software backup or improper backup.

Various types of software are available to mitigate the above hardship by taking the responsibility for maintaining the records of purchases, distributions and uses of the software and its related documentation and ensuring compliance with terms and conditions of the licensing agreements by the users. Some local area network Operation Systems for example, can provide a utility which generates a report listing all software located at workstations or file servers in the network, for review.

2.15.1 Program Library Management System Software:

(i) It provides several functional capabilities to effectively and efficiently manage data center software inventory which includes –

    a. Application Program Code,

    b. System Software Code,

    c. Job Control Statements

(ii) It possesses integrity capabilities such that –

    a. Each source program is assigned,

    b. A modification number is assigned,

    c. A version number is assigned,

    d. It is associated with a creation date

(iii) It uses –

    a. Password,

    b. Encryption,

c. Data Compression,

d. Automatic backup

(iv) It possesses update capabilities with the facilities of –

a. Addition,

b. Modification,

c. Deletion,

d. Re-sequencing library numbers

(v) It possesses reporting capabilities for being reviewed by the management and the end users by preparing lists of –

a. Additions,

b. Deletions,

c. Modifications,

d. Library catalogue,

e. Library members attributes

(vi) It possesses interface capabilities with the –

a. Operating System,

b. Job scheduling system,

c. Access control system,

d. Online program management

(vii) It controls movement of program from test to production status

(viii) At last, it changes controls to application programs.

2.15.2 Design of User Interfaces: After discussing about storage media, we now turn to design of user interface. It is important since it involves the ways in which the users will interact with the system. Elements which have to considered in designing of user interface are as follows –

(i) Source documents to capture data,

(ii) Hard copy output reports,

(iii) Screen layout for source document input,

(iv) Inquiry screens for database queries,

(v) Command languages for decision support systems,

(vi) Query languages for the database,

(vii) Graphic display and color or non-monochromatic display,

(viii) Voice output to answer users or answer queries,

(ix) Screen layout manipulation by mouse or light pen,

(x) Icons for representation of the output.

The interface design is developed as follows –

(i) Identifying system users and classifying them into homogeneous groups,

(ii) The user group characteristics are understood like whether the system will be handled by novices or experts,

(iii) Eliciting the tasks which the users wish to perform using the system,

(iv) Commencing a preliminary design of the form of interaction that will support these tasks. Prototyping tools are usually employed to refine the design aspect with the users.

2.16 BACKUP AND RECOVERY

Generally 'backup and recovery' is treated as one topic and 'disaster recovery' as another. 'Backup' is a utility program used to make a copy of the contents of database files and log files. The database files consist of a database root file, log file, mirror log file, and other database files called dbspaces.

'Recovery' is a sequence of tasks performed to restore a database to some point-in-time. Recovery is performed when either a hardware or media failure occurs. Hardware failure is a physical component failure in the machine, such as, a disk drive, controller card, or power supply. Media failure is the result of unexpected database error when processing data.

Before one begins recovery, it is a good practice to back up the failing database. Backing up the failing database preserves the situation, provides a safe location so files are not accidentally overridden, and if unexpected errors occur during the recovery process, database Technical Support may request these files be forwarded to them.

'Disaster recovery' *differs from a database recovery scenario because the operating system and all related software must be recovered before any database recovery can begin.*

2.16.1 Database files that make up a database: Databases consist of disk files that store data. When you create a database either using any database software command-line utility, a main database file or root file is created. This main database file contains database tables, system tables, and indexes. Additional database files expand the size of the database and are called dbspaces. A dbspace contains tables and indexes, but not system tables.

A **transaction log** is a file that records database modifications. Database modifications consist of inserts, updates, deletes, commits, rollbacks, and database schema changes. A transaction log is not required but is recommended. The database engine uses a transaction log to apply any changes made between the most recent checkpoint and the system failure. The checkpoint ensures that all committed transactions are written to disk. During recovery the database engine must find the log file at specified location. When the transaction log file is not specifically identified then the database engine presumes that the log file is in the same directory as the database file.

A **mirror log** is an optional file and has a file extension of **.mlg**. It is a copy of a transaction log and provides additional protection against the loss of data in the event the transaction log becomes unusable.

2.16.2 Online backup, offline backup, and live backup : Database backups can be performed while the database is being actively accessed (online) or when the database is shutdown (offline) When a database goes through a normal shutdown process (the process is not being cancelled) the database engine commits the data to the database files.

An online database backup is performed by executing the command-line or from the 'Backup Database' utility. When an online backup process begins the database engine externalizes all cached data pages kept in memory to the database file(s) on disk. This process is called a checkpoint. The database engine continues recording activity in the transaction log file while the database is being backed up. The log file is backed up after the backup utility finishes backing up the database. The log file contains all of the transactions recorded since the last database backup. For this reason the log file from an online full backup must be 'applied' to the database during recovery. The log file from an offline backup does not have to participate in recovery but it may be used in recovery if a prior database backup is used.

A **live backup** is carried out by using the BACKUP utility with the command-line option. A live backup provides a redundant copy of the transaction log for restart of your system on a secondary machine in the event the primary database server machine becomes unusable.

Full and incremental database backup: A database backup is either a full or incremental backup. For a full backup, the database backup utility copies the database and log. An incremental backup uses the DBBACKUP utility to copy the transaction log file since the most recent full backup. When you perform an incremental backup the mirror log is not backed up. When you backup and rename the log files the transaction and mirror log file is renamed and new log files are created. You must plan to manually back up the mirror log. Be aware of this when planning out your backup and recovery strategy.

2.16.3 Developing a backup and recovery strategy: The steps suggested in the development of a backup and recovery strategy consist of the following:

- Understand what backup and recovery means to your business
- Management commits time and resources for the project
- Develop, test, time, document, health check, deploy, and monitor
- Beware of any external factors that affect recovery
- Address secondary backup issues.

(i) Understand what backup and recovery means to your business: How long can my business survive without access to the corporate data? Express your answer in terms of minutes, hours, or days.

If your recovery time is in minutes then database backup and recovery is critical to your business needs and it is paramount that you implement some kind of backup and recovery strategy. If recovery can take hours then you have more time to perform the tasks. If recovery can be expressed in terms of days then the urgency to recover the database still exists, but time appears to be less of a factor.

(ii) Management commits time and resources for the project: Management must decide to commit financial resources towards the development and implementation of a backup and recovery strategy. The strategy can be basic or quite extensive depending upon the business needs of the company. After developing a backup and recovery strategy management should be informed of the expected backup and recovery times. Anticipate management countering the timings by preparing alternative solutions. These alternative solutions could be requesting additional hardware, improved backup medium, altering backup schedule, accepting a longer recovery time versus backup time. Then it will be up to management to decide what solution fits their corporate needs.

(iii) Develop, test, time, document, health check, deploy, and monitor: These phases are the core in developing a backup and recovery strategy:

- Create backup and recovery commands. Verify these commands work as designed. Does your full or incremental online backup work? Verify that your commands product the desired results.
- Time estimates from executing backup and recovery commands help to get a feel for how long will these tasks take. Use this information to identify what commands will be executed and when.
- Document the backup commands and create written procedures outlining where your backups are kept and identify the naming convention used as well as the kind of backups

performed. This information can be very important when an individual must check the backups or perform a database recovery and the data base administrator (DBA) is not available.

- Incorporate health checks into the backup procedures. You should check the database to ensure the database is not corrupt. You can perform a database health check prior to backing up a database or on a copy of the database from your backup.
- Deployment of your backup and recovery consists of setting up your backup procedures on the production server. Verify the necessary hardware is in place and any other supporting software necessary to perform these tasks. Modify procedures to reflect the change in environment. Change user id, password, server and database name to reflect the change in environment.
- Monitor backup procedures to avoid unexpected errors. Make sure any changes in the process are reflected in the documentation.

(iv) Beware of external factors that affect recovery: External factors that effect database recovery are time, hardware, and software. Allow additional recovery time for entering miscellaneous tasks that must be performed. These tasks could be as simple as entering recovery commands or retrieving and loading tapes. Factors that influence time are the size of database files, recovery medium, disk space, and unexpected errors. The more files you add into the recovery scenario, it increases the places where recovery can fail. As the backup and recovery strategy develops it may be necessary to check the performance of the equipment and software ensuring it meets your expectations.

(v) Protect database backups by performing health checks: Database health checks are run against the database and log files to ensure they are not corrupt. The database validity utility is used to scan every record in every table and looks up each record in each index on the table. If the database file is corrupt, you need to recovery from your previous database backup. A database can be validated before being backed up or against a copy of the database from your backup.

2.17 DATA WAREHOUSE

A **Data warehouse** is a repository of an organization's electronically stored data. Data warehouses are designed to facilitate reporting and supporting data analysis. The concept of data warehouses was introduced during the late 1980's. The concept was introduced to meet the growing demands for management information and analysis that could not be met by operational systems. Operational systems were unable to meet this need for a range of reasons:

- The processing load of reporting reduced the response time of the operational systems,

- The database designs of operational systems were not optimized for information analysis and reporting,
- Most organizations had more than one operational system, so company-wide reporting could not be supported from a single system, and
- Development of reports in operational systems often required writing specific computer programs which was slow and expensive

As a result, separate computer databases began to be built that were specifically designed to support management information and analysis purposes. These data warehouses were able to bring in data from a range of different data sources, such as mainframe computers, minicomputers, as well as personal computers and office automation software such as spreadsheets and integrate this information in a single place. This capability, coupled with user-friendly reporting tools, and freedom from operational impacts has led to a growth of this type of computer system. As technology improved (lower cost for more performance) and user requirements increased (faster data load cycle times and more functionality), data warehouses have evolved through several fundamental stages:

- **Offline Operational Databases -** Data warehouses in this initial stage are developed by simply copying the database of an operational system to an off-line server where the processing load of reporting does not impact on the operational system's performance.
- **Offline Data Warehouse -** Data warehouses in this stage of evolution are updated on a regular time cycle (usually daily, weekly or monthly) from the operational systems and the data is stored in an integrated reporting-oriented data structure
- **Real Time Data Warehouse -** Data warehouses at this stage are updated on a transaction or event basis, every time an operational system performs a transaction (e.g. an order or a delivery or a booking etc.)
- **Integrated Data Warehouse -** Data warehouses at this stage are used to generate activity or transactions that are passed back into the operational systems for use in the daily activity of the organization.

2.17.1 Components of a Data warehouse: The primary components of the majority of data warehouses are shown in the fig 2.17.1.1 and described in more detail below:

Data Sources: Data sources refer to any electronic repository of information that contains data of interest for management use or analytics. This definition covers mainframe databases (e.g. IBM DB2, ISAM, Adabas, etc.), client-server databases (e.g. Oracle database, Informix, Microsoft SQL Server etc.), PC databases (e.g. Microsoft Access), spreadsheets (e.g. Microsoft Excel) and any other electronic store of data. Data needs to be passed from these systems to the data warehouse either on a transaction-by-transaction basis for real-time data warehouses or on a regular cycle (e.g. daily or weekly) for offline data warehouses.

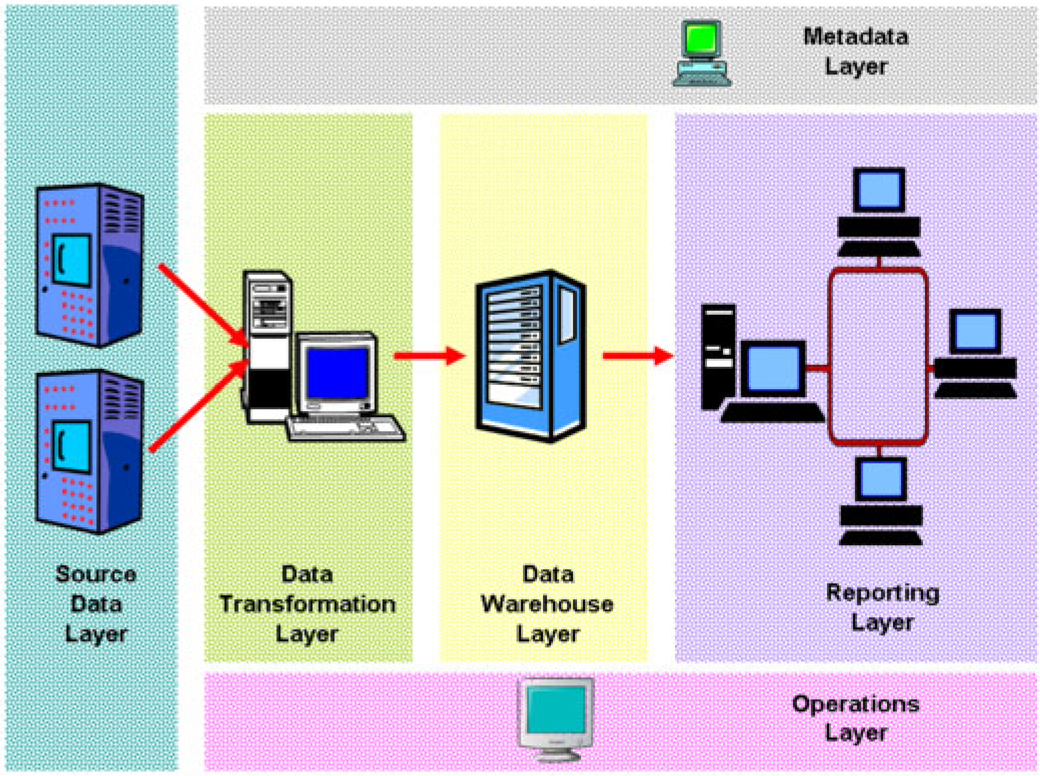


Fig 2.17.1.1 Components of Data warehouse.

Data Transformation: The Data Transformation layer receives data from the data sources, cleans and standardizes it, and loads it into the data repository. This is often called "staging" data as data often passes through a temporary database whilst it is being transformed. This activity of transforming data can be performed either by manually created code or a specific type of software could be used called an Extract, Transform and Load (ETL) tool. Regardless of the nature of the software used, the following types of activities occur during data transformation:

- Comparing data from different systems to improve data quality (e.g. Date of birth for a customer may be blank in one system but contain valid data in a second system. In this instance, the data warehouse would retain the date of birth field from the second system)
- standardizing data and codes (e.g. If one system refers to "Male" and "Female", but a second refers to only "M" and "F", these codes sets would need to be standardized)
- integrating data from different systems (e.g. if one system keeps orders and another stores customers, these data elements need to be linked)
- Performing other system housekeeping functions such as determining change (or "delta") files to reduce data load times, generating or finding surrogate keys for data etc.

Data Warehouse: The data warehouse is a relational database organized to hold information in a structure that best supports reporting and analysis.

Reporting: The data in the data warehouse must be available to the organization's staff if the data warehouse is to be useful. There are a very large number of software applications that perform this function, or reporting can be custom-developed. Examples of types of reporting tools include:

- Business intelligence tools: These are software applications that simplify the process of development and production of business reports based on data warehouse data.
- Executive information systems: These are software applications that are used to display complex business metrics and information in a graphical way to allow rapid understanding.
- Online Analytical Processing (OLAP) Tools: OLAP tools form data into logical multi-dimensional structures and allow users to select dimensions to view data.
- Data Mining: Data mining tools are software that allows users to perform detailed mathematical and statistical calculations on detailed data warehouse data to detect trends, identify patterns and analyze data.

Metadata: Metadata, or "data about data", is used to inform operators and users of the data warehouse about its status and the information held within the data warehouse. Examples of data warehouse metadata include the most recent data load date, the business meaning of a data item and the number of users that are logged in currently.

Operations: Data warehouse operations comprises of the processes of loading, manipulating and extracting data from the data warehouse. Operations also cover user management, security, capacity management and related functions.

Optional Components: In addition, the following components also exist in some data warehouses:

1. Dependent Data Marts: A dependent data mart is a physical database (either on the same hardware as the data warehouse or on a separate hardware platform) that receives all its information from the data warehouse. The purpose of a Data Mart is to provide a sub-set of the data warehouse's data for a specific purpose or to a specific sub-group of the organization.
2. Logical Data Marts: A logical data mart is a filtered view of the main data warehouse but does not physically exist as a separate data copy. This approach to data marts delivers the same benefits but has the additional advantages of not requiring additional (costly) disk space and it is always as current with data as the main data warehouse.
3. Operational Data Store: An ODS is an integrated database of operational data. Its sources include legacy systems and it contains current or near term data. An ODS may contain 30 to 60 days of information, while a data warehouse typically contains years of data. ODS's are used in some data warehouse architectures to provide near real time reporting capability in the event that the Data Warehouse's loading time or architecture prevents it being able to provide near real time reporting capability.

2.17.2 Different methods of storing data in a data warehouse: All data warehouses store their data grouped together by subject areas that reflect the general usage of the data (Customer, Product, Finance etc.) The general principle used in the majority of data warehouses is that data is stored at its most elemental level for use in reporting and information analysis. Within this generic intent, there are two primary approaches to organizing the data in a data warehouse.

The first is using a "dimensional" approach. In this style, information is stored as "facts" which are numeric or text data that capture specific data about a single transaction or event, and "dimensions" which contain reference information that allows each transaction or event to be classified in various ways. As an example, a sales transaction would be broken up into facts such as the number of products ordered, and the price paid, and dimensions such as date, customer, product, geographical location and sales person. The main advantage of a dimensional approach is it is easier to understand and use. Also, because the data is pre-processed into the dimensional form, the Data Warehouse tends to operate very quickly.

The second approach uses database normalization. In this style, the data in the data warehouse is stored in third normal form. The main advantage of this approach is that it is quite straightforward to add new information into the database, whilst the primary disadvantage of this approach is that it can be quite slow to produce information and reports.

2.17.3 Advantages of using data warehouse: There are many advantages to using a data warehouse, some of them are:

- Enhances end-user access to reports and analysis of information.

- Increases data consistency.
- Increases productivity and decreases computing costs.
- Is able to combine data from different sources, in one place. (Provides a common data model).
- It provides an infrastructure that could support changes to data and replication of the changed data back into the operational systems.

2.17.4 Concerns in using data warehouse

- Extracting, cleaning and loading data could be time consuming.
- Data warehouses can get outdated relatively quickly.
- Problems with compatibility with systems already in place e.g. transaction processing system.
- Providing training to end-users.
- Security could develop into a serious issue, especially if the data warehouse is web accessible.
- A data warehouse is usually not static and maintenance costs are high.

2.18 DATA MINING

Data mining is concerned with the analysis of data and picking out relevant information. It is the computer, which is responsible for finding the patterns by identifying the underlying rules and features in the data.

Data mining analysis tends to work from the data up and the best techniques are those developed with an orientation towards large volumes of data, making use of as much of the collected data as possible to arrive at reliable conclusions and decisions. The analysis process starts with a set of data, uses a methodology to develop an optimal representation of the structure of the data during which time knowledge is acquired. Once knowledge has been acquired this can be extended to larger sets of data working on the assumption that the larger data set has a structure similar to the sample data. Again this is analogous to a mining operation where large amounts of low grade materials are sifted through in order to find something of value.

Examples of Data mining Software's are SPSS, SAS, Think Analytics and G-Stat etc.

The following fig 2.18.1 summarizes the common stages or processes identified in data mining and knowledge discovery by Usama Fayyad & Evangelos Simoudis, two of leading exponents of this area.

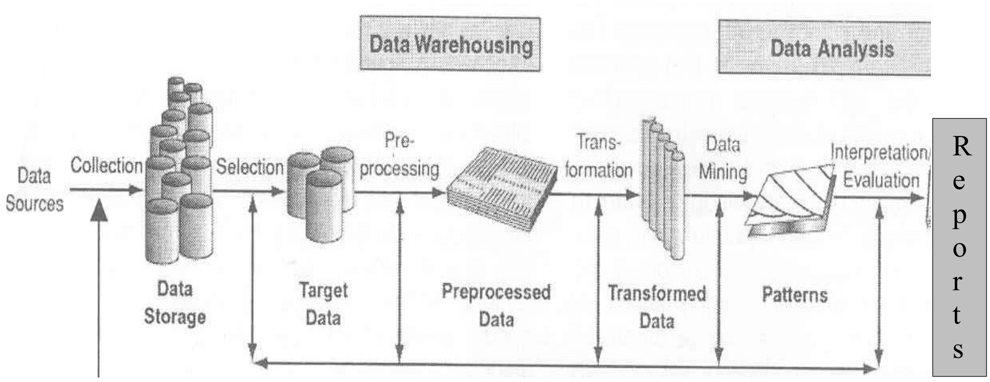


Fig 2.18.1 Components of Data mining.

The phases depicted start with the raw data and finish with the extracted knowledge which was acquired as a result of the following stages:

- **Selection -** selecting or segmenting the data according to some criteria e.g. all those people who own a car, in this way subsets of the data can be determined.
- **Preprocessing -** this is the data cleansing stage where certain information is removed which is deemed unnecessary and may slow down queries for e.g.: gender of the patient. The data is reconfig d to ensure a consistent format as there is a possibility of inconsistent formats because the data is drawn from several sources e.g. gender may be recorded as F or M and also as 1 or 0.
- **Transformation -** the data is not merely transferred, but transformed. E.g.: demographic overlays commonly used in market research. The data is made useable and navigable.
- **Data mining -** this stage is concerned with the extraction of patterns from the data. A pattern can be defined as given a set of facts(data) *F*, a language *L*, and some measure of certainty *C* a pattern is a statement *S* in *L* that describes relationships among a subset *Fs* of *F* with a certainty *c* such that *S* is simpler in some sense than the enumeration of all the facts in *Fs*.
- **Interpretation and Evaluation -** the patterns identified by the system are interpreted into knowledge which can then be used to support human decision-making e.g. prediction and classification tasks, summarizing the contents of a database or explaining observed phenomena.

Self Examination Questions

Multiple Choice Questions

1. Hard disk is __________ disk on which you can store computer data
   (a) Magnetic
   (b) Removable
   (c) Flash
   (d) Temporary.
2. __________ in a database, which contains data about definition of the data element and their relationship.
   (a) Data dictionary
   (b) Data file
   (c) Database
   (d) None of these.
3. ER diagram helps to identify the database's __________ and their _________.
   (a) Entities/ relationship
   (b) Entities/ Models
   (c) Entities/ data dependence
   (d) None of these.
4. In a Network Database model _________Structure is possible
   (a) N:1
   (b) M:N
   (c) Both a and b
   (d) None of these
5. All Candidate keys other than the primary keys are called ________
   (a) Alternate keys
   (b) Secondary keys
   (c) Eligible keys
   (d) None of these
6. Examples of RDBMS software are ___________
   (a) Oracle

(b) Sybase

(c) Informix

(d) All of these

7. In RDBMS the program and data are __________

(a) Data dependent

(b) Dependent

(c) Independent

(d) Program dependent

8. SQL is considered to be_____________

(a) 1GL

(b) 2GL

(c) 3GL

(d) 4GL

9. DBMS comprises of following components, these are ________

(a) Hardware and software

(b) People

(c) Procedures and data

(d) All of these

10. A DBMS that supports a database located at a single site is called a ______ DBMS

(a) Client Server

(b) Distributed

(c) Centralized

(d) None of these

11 The data structures are created within a __________

(a) File

(b) Wizard

(c) Database

(d) None of these

12. Physical level in DBMS is also known as _______Schema

(a) View

b) External

(c) Logical

(d) Internal

13. View level in DBMS is also known as______Schema

(a) View

(b) External

(c) Logical

(d) Internal

14. In the case of Physical data dependence, changes in ______Schema do not require applications to be rewritten

(a) Physical

(b) External

(c) Logical

(d) Internal

15. The phases in data mining includ___________

(a) Selection

(b) Transformation

(c) Pre-processing

(d) All of these

Answers

1	a	**2**	a	**3**	a	**4**	c	**5**	a	**6**	d	**7**	c	**8**	d	**9**	d
10	c	**11**	c	**12**	d	**13**	c	**14**	a	**15**	d						

Short Term Questions

1. Explain the following systems: -

(a) Decimal

(b) Binary

(c) BCD

(d) BCDIC

(e) ASCII

2. Define the following: –
   (a) Records
   (b) Fields
   (c) Date Field
   (d) Integer Filed
   (e) Double Precision Data,
   (f) Logical Data
   (g) Primary Key
   (h) Secondary Key
   (i) Foreign Key
   (j) Referential Integrity
3. In a database management system, describe the 3 level architecture with the following views: –
   (i) External or User View
   (ii) Conceptual or Global View
   (iii) Physical or Internal View
4. Define –
   (a) External Schema
   (b) Conceptual Schema
   (c) Internal Schema
5. In a database management system, there are two components –
   (a) Data Definition Language and
   (b) Data Manipulation Language

   Do you agree? If yes, discuss the above two database management system facilities.
6. Elucidate the functions of the following which are parts of structure of a database management system: –
   (i) Data Definition Language Compiler
   (ii) Data Manager
   (iii) File Manager
   (iv) Disk Manager

(v) Query Manager

(vi) Data Dictionary

7. Define the following models of Database: –

   (i) Distributed database (both replicated and partitioned)

   (ii) Client-server database (2-tier architecture and 3-tier architecture)

   (iii) Object-oriented database

   (iv) Knowledge database.

8. Define the following high level languages and their functions: –

   (a) Structured Query Language

   (b) Natural Language

9. What are the documents that are needed to support a system in an organization?

Long Term Questions

1. Discuss the comparative advantages and disadvantages of the following models of a database management system: –

   (i) Hierarchical Model,

   (ii) Network Model,

   (iii) Relational Model

2. The file Library function as an aspect of Operations Management Controls, takes responsibility of the machine readable storage media for the management by undertaking four functions. Discuss.

3. Describe how the use of storage media is controlled? How the reliability of storage media is monitored?

4. What are the difficulties in management of systems documentation? What are the responsibilities of documentation librarians?

5. Discuss the features of Program Library Management System Software.

6. What are the elements that are required to be considered in designing of user interface? How the interface design is developed?

CHAPTER 3

COMPUTER NETWORKS & NETWORK SECURITY

Learning Objectives

This Chapter enables the student to obtain knowledge about :

- The concepts of computer network.
- Classification of computer networks and its topologies.
- Communication software and network hardware
- Transmission Protocols
- Client/Server Architecture and Tier Systems.
- Disaster Recovery and Business Continuity Planning.
- Network Security, threats and vulnerabilities.

3.1 INTRODUCTION

Many organizations have multiple users of computers; some of these users are geographically remote from the organization's headquarter offices. Even within an office building, there may be hundreds or thousands of employees who use a particular computer. Users have several options to choose from in communicating data to and in receiving data from the computer. These include the following:

- People may have to depend on mail delivery or messenger service to bring data to and from the computer. This usually involves delays and dependency on intermediaries. Also, the cost of such delivery service has risen rapidly.
- Each unit of the organization can be supplied with its own computer. However, it is not frequently economically feasible to do this for all units.
- Data may be transmitted, via communications links, between remote locations and the computer. Just as the telephone and telegraph services have speeded up oral and written messages between people, so data transmission can speed up the flow of data messages.

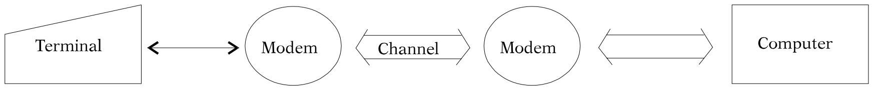


Fig 3.1.1 Data Communication

Fig. 3.1.1 shows the basic data communications schematic. This is the simplest form of computer communication. A single terminal is linked to a computer. The terminal can be the sender and the computer can be the receiver, or vice versa.

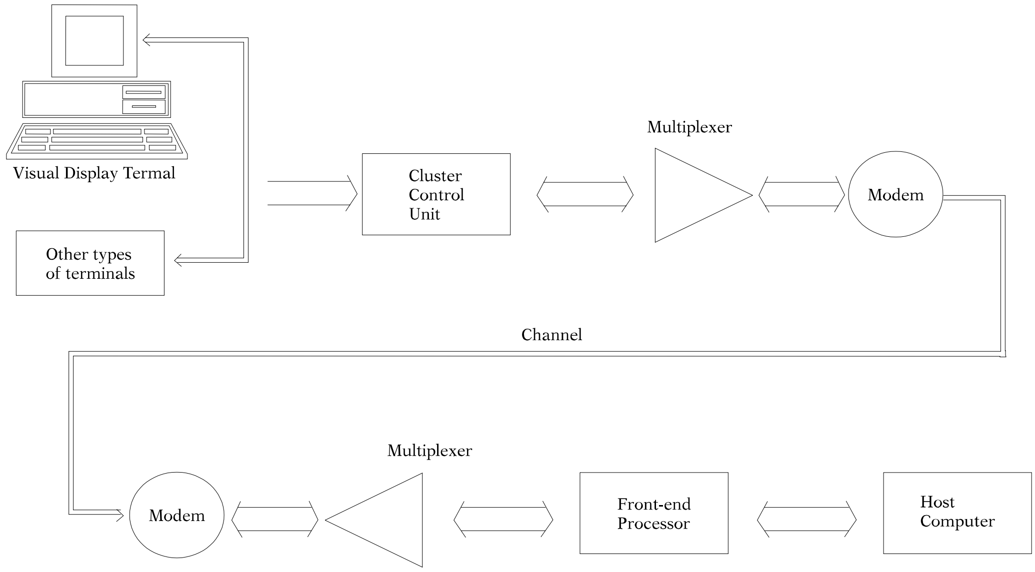


Fig 3.1.2 Expanded data communication network

Fig. 3.1.2 illustrates an expanded data communication network. These are not all of the hardware devices that can be included, but they provide a good idea of how a network might appear in a business organization.

3.2 COMPUTER NETWORKS

A network is a set of devices (also known as nodes, terminals or stations) interconnected by communication links. A computer network is a collection of computers and terminal devices connected together by a communication system. The set of computers may include large-scale computers, medium scale computers, mini computers and microprocessors. The set of terminal devices may include intelligent terminals, “dumb” terminals, workstations of various kinds and miscellaneous devices such as the commonly used telephone instruments.

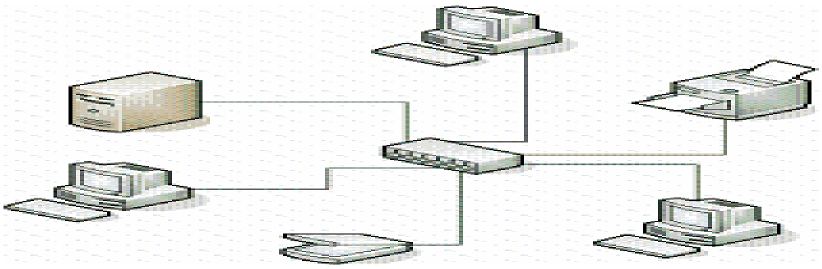


Fig 3.2.1: Example of a computer networks

Fig. 3.2.1 illustrates a computer networks with devices like server, terminal, printer, hub and communication media etc.

Many computer people feel that a computer network must include more than one computer system-otherwise; it is an ordinary on-line system. Others feel that the use of telecommunication facilities is of primary importance. Thus, there is no specific definition of a computer network. Computer networks, however, not only increase the reliability of computer resources and facilitate overall system developments, but also satisfy the primary objective of resource sharing which include device sharing, file sharing, program sharing, and program segmentation.

3.2.1 NEED AND SCOPE OF NETWORKS : Here are some of the ways a computer network can help the business:

(i) File Sharing : File sharing is the most common function provided by networks and consists of grouping all data files together on a server or servers. When all data files in an organization are concentrated in one place, it is much easier for staff to share documents and other data. It is also an excellent way for the entire office to keep files organized according to a consistent scheme. Network operating systems such as Windows 2000 allow the administrator to grant or deny groups of users access to certain files.

(ii) Print Sharing : When printers are made available over the network, multiple users can print to the same printer. This can reduce the number of printers the organization must purchase, maintain and supply. Network printers are often faster and more capable than those connected directly to individual workstations, and often have accessories such as envelope feeders or multiple paper trays.

(iii) E-Mail: Internal or "group" email enables staff in the office to communicate with each other quickly and effectively. Group email applications also provide capabilities for contact management, scheduling and task assignment. Designated contact lists can be shared by the whole organization instead of duplicated on each person's own rolodex; group events can be scheduled on shared calendars accessible by the entire staff or appropriate groups. Equally important is a network's ability to provide a simple organization-wide conduit for Internet email, so that the staff can send and receive email with recipients outside of the organization as easily as they do with fellow staff members. Where appropriate, attaching documents to Internet email is dramatically faster, cheaper and easier than faxing them.

(iv) Fax Sharing : Through the use of a shared modem(s) connected directly to the network server, fax sharing permits users to fax documents directly from their computers without ever having to print them out on paper. This reduces paper consumption and printer usage and is more convenient for staff. Network faxing applications can be integrated with email contact lists, and faxes can be sent to groups of recipients. Specialized hardware is available for high-volume faxing to large groups. Incoming faxes can also be handled by the network and forwarded directly to users' computers via email, again eliminating the need to print a hard copy of every fax - and leaving the fax machine free for jobs that require it.

(v) Remote Access: In our increasingly mobile world, staff often requires access to their email, documents or other data from locations outside of the office. A highly desirable network function, remote access allows users to dial in to your organization's network via telephone and access all of the same network resources they can access when they're in the office. Through the use of Virtual Private Networking (VPN), which uses the Internet to provide remote access to your network, even the cost of long-distance telephone calls can be avoided.

(vi) Shared Databases: Shared databases are an important subset of file sharing. If the organization maintains an extensive database - for example, a membership, client, grants or financial accounting database - a network is the only effective way to make the database available to multiple users at the same time. Sophisticated database server software ensures the integrity of the data while multiple users access it at the same time.

(vii) Fault Tolerance : Establishing Fault Tolerance is the process of making sure that there are several lines of defense against accidental data loss. Fault tolerance is an approach for fault prevention. An example of accidental data loss might be a hard drive failing, or someone deleting a file by mistake. Usually, the first line of defense is having redundant hardware, especially hard drives, so that if one fails, another can take its place without losing data. Tape backup should always be a secondary line of defense (never primary). While today's backup systems are good, they are not fail-safe. Additional measures include having the server attached to an uninterruptible power supply, so that power problems and blackouts do not unnecessarily harm the equipment.

(viii) Internet Access and Security : When computers are connected via a network, they can share a common, network connection to the Internet. This facilitates email, document transfer and access to the resources available on the World Wide Web. Various levels of Internet service are available, depending on your organization's requirements. These range from a single dial-up connection (as you might have from your home computer) to 128K ISDN to

768K DSL or up to high-volume T-1 service. A.I. Technology Group strongly recommends the use of a firewall to any organization with any type of broadband Internet connection.

(ix) Communication and collaboration: It's hard for people to work together if no one knows what anyone else is doing. A network allows employees to share files, view other people's work, and exchange ideas more efficiently. In a larger office, one can use e-mail and instant messaging tools to communicate quickly and to store messages for future reference.

(x) Organization: A variety of network scheduling software is available that makes it possible to arrange meetings without constantly checking everyone's schedules. This software usually includes other helpful features, such as shared address books and to-do lists.

3.2.2 Benefits of using networks : As the business grows, good communication between employees is needed. The organisations can improve efficiency by sharing information such as common files, databases and business application software over a computer network.

With improvements in network capacity and the ability to work wirelessly or remotely, successful businesses should regularly re-evaluate their needs and their IT infrastructure.

(i) Organisations can **improve communication** by connecting theirr computers and working on standardised systems, so that:

- Staff, suppliers and customers are able to share information and get in touch more easily
- More information sharing can make the business more efficient - eg networked access to a common database can avoid the same data being keyed multiple times, which would waste time and could result in errors
- as staff are better equipped to deal with queries and deliver a better standard of service as they can share information about customers

(ii) Organisation can **reduce costs and improve efficiency** - by storing information in one centralised database and streamlining working practices, so that:

- staff can deal with more customers at the same time by accessing customer and product databases
- network administration can be centralised, less IT support is required
- costs are cut through sharing of peripherals such as printers, scanners, external discs, tape drives and Internet access

(iii) Organisations can **reduce errors** and improve consistency - by having all staff work from a single source of information, so that standard versions of manuals and directories can be made available, and data can be backed up from a single point on a scheduled basis, ensuring consistency.

3.3 CLASSIFICATIONS OF NETWORKS

3.3.1 Introduction

Computer Networks can be classified in different ways like: Function Based, Area Coverage Based, Forwarding-based, Ownership-based and Media-based etc. Whereas area coverage based classification is an optimal way to describe different types of computer networks.

1	**Class I**	**Function Based Classification**
	Data Networks	A communications network that transmits data.
	Voice Networks	A communications network that transmits voice.
	Multimedia Networks	A communications network that transmits data, voice, image, video etc.
2	**Class II**	**Area Coverage Based Classification**
	LAN	A Local Area Network (LAN) is a group of computers and network devices connected together, usually within the same building, campus or spanned over limited distance. High speed and relatively inexpensive.
	MAN	A Metropolitan Area Network (MAN) is a larger network that usually spans in the same city or town. Cable network is an example of a MAN.
	WAN	A Wide Area Network (WAN) is not restricted to a geographical location, although it might be confined within the bounds of a state or country. The technology is high speed and relatively expensive. The Internet is an example of a worldwide public WAN.
3	**Class III**	**Forwarding-based Classification**
	Switched Networks	Switched network is a type of network that provide switched communication system and in which users are connected with each other through the circuits, packets, sometimes message switching and the control devices. Active network elements like

		switch, router, gateways etc. participate in communication. Example is public switch telephone network.
	Shared Networks	A shared network is also known as hubbed network which is connected with a hub. When packets arrive in to the network all segments can see packets. LAN using hub is an example of shared networks.
	Hybrid Networks	Network comprising the features of switched and shared networks.
4	**Class IV**	**Ownership-based Classification**
	Public Networks	Networks established for all user across the world is known as public networks. Internet is an example of public networks.
	Private Networks	Private network s used by particular organization, particular campus or particular enterprise only. This is a network that is not available to the outside world. Intranet is an example of it.
	Virtual Private Networks	A virtual private network (VPN) is a network that uses a public network, such as the Internet, to provide secure access to organization's private network. A key feature of a VPN is its ability to work over both private networks as well as public networks like the Internet. Using a method called *tunneling*, a VPN use the same hardware infrastructure as existing Internet or intranet links.
	Leased Networks	Dedicated or leased lines exist to support network communication.
5	**Class V**	**Media-based Classification**
	Wired Networks	Networks communication supported by physical (wired) medium.
	Wireless Networks	Networks communication supported by wireless medium.

Table 3.3.1: Computer Networks Classification

Area coverage based classification is discussed below:

(i) Local Area Networks (LAN) : A LAN covers a limited area. This distinction, however, is changing as the scope of LAN coverage becomes increasingly broad. A typical LAN connects as many as hundred or so microcomputers that are located in a relatively small area, such as a building or several adjacent buildings. Organizations have been attracted to LANs because they enable multiple users to share software, data, and devices. Unlike WAN which use point-to-point links between systems, LANs use a shared physical media which is routed in the whole campus to connect various systems. LANs use high-speed media (1 Mbps to 30 Mbps or more) and are mostly privately owned and operated.

Following are the salient features of LAN:

- Multiple user computers connected together
- Machines are spread over a small geographic region
- Communication channels between the machines are usually privately owned. Channels are relatively high capacity (measuring throughput in mega bits per second, Mbits/s)
- Channels are relatively error free (for example, a bit error rate of 1 in 10^9 bits transmitted)

(ii) Metropolitan Area Networks (MAN) : A metropolitan area network (MAN) is some where between a LAN and a WAN. The terms MAN is sometimes used to refer to networks which connect systems or local area networks within a metropolitan area (roughly 40 km in length from one point to another). MANs are based on fiber optic transmission technology and provide high speed (10 Mbps or so), interconnection between sites.

A MAN can support both data and voice. Cable television networks are examples of MANs that distribute television signals. A MAN just has one or two cables and does not contain switching elements.

(iii) Wide Area Networks (WAN): A WAN covers a large geographic area with various communication facilities such as long distance telephone service, satellite transmission, and under-sea cables. The WAN typically involves best computers, networks and many different types of communication hardware and software as shown in fig 3.3.1. Examples of WANs are interstate banking networks and airline reservation systems. Wide area networks typically operate at lower link speeds (about 1 Mbps). Following are the salient features of WAN:

- Multiple user computers connected together.
- Machines are spread over a wide geographic region
- Communications channels between the machines are usually furnished by a third party (for example, the Telephone Company, a public data network, a satellite carrier)
- Channels are of relatively low capacity (measuring through put in kilobits per second, k bits)

- Channels are relatively error-prone (for example, a bit error rate of 1 in 10^5 bits transmitted)

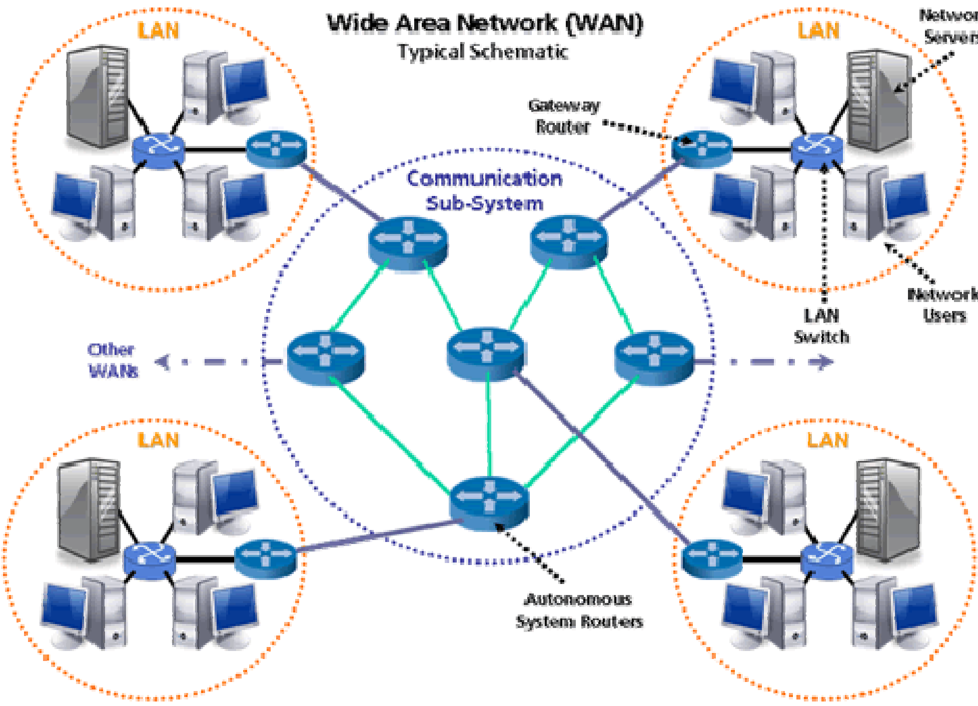


Fig 3.3.1: A typical WAN

3.3.2 Network Models

Every computer networks supports two basic network models: **Client-Server** and **Peer-to-Peer.**

1. Client-Server: Client-Server networks consist of servers and clients. Servers are typically powerful computers running advanced network operating systems and user workstations (clients) which access data or run applications located on the servers. Fig 3.3.2.1 shows one server and five client machines are connected to this server. Servers can host e-mail; store common data files and serve powerful network applications such as Microsoft's SQL Server. As a centerpiece of the network, the server validates logins to the network and can deny access to both networking resources as well as client software. Servers are typically the center of all backup and power protection schemas.

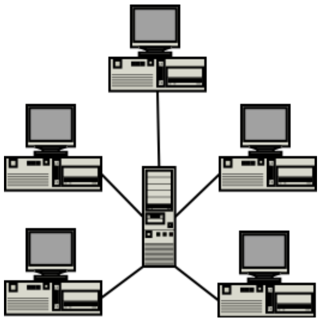


Fig 3.3.2.1: Example of Client Server

While it is technically more complex and secure, the Client-Server network easier than ever to administer due to new centralized management software. It is also the most "scaleable" network configuration; additional capabilities can be added with relative ease. The drawbacks to the Client-Server model are mostly financial. There is a large cost up front for specialized hardware and software. Also, if there are server problems, down time means that users lose access to mission-critical programs and data until the server can be restored.

2. Peer-to-peer: In peer-to-peer architecture, there are no dedicated servers. All computers are equal, and therefore, are termed as peer and shown in fig 3.3.2.2. Normally, each of these machines functions both as a client and a server. This arrangement is suitable for environments with a limited number of users (usually ten or less) Moreover, the users are located in the same area and security is not an important issue while the network is envisaged to have a limited growth. At the same time, users need to freely access data and programs that reside on other computers across the network.

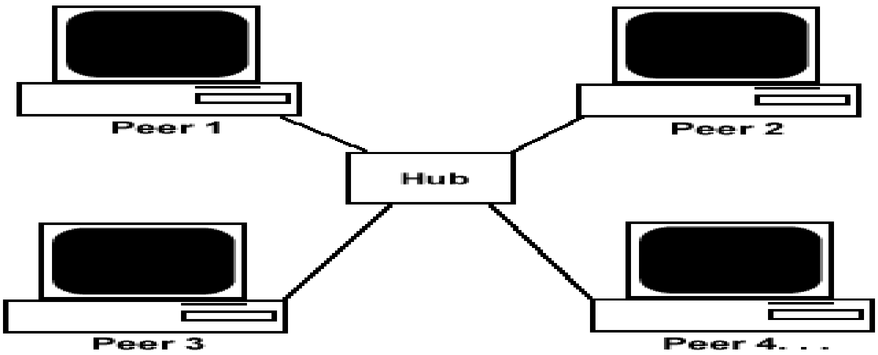


Fig. 3.3.2.2: Peer-to-Peer Networks

The basic advantage of this architecture is simplicity of design and maintenance. Since there is no server, all nodes on the network are fully employed and independent. Peer-to-peer networks are also known as workgroup. Computers participating in peer-to-peer network all are equal, so named as peer. No single computer holds the control of entire networks. Each system can install or upgrade their application/system software independently.

A failure of a node on a peer-to-peer network means that the network can no longer access the applications or data on that node but other node can function properly. Lack of centralized control leads it is advisable to use less number of user system like 10 to 12 users. If the network size is higher than threshold then performance of network degraded.

3.4 COMPONENTS OF A NETWORK

There are five basic components in any network (whether it is the Internet, a LAN, a WAN, or a MAN):

1. The sender (Source Host)
2. The communications interface devices
3. The communications channel (Medium)
4. The receiver (Destination Host)
5. Communications software

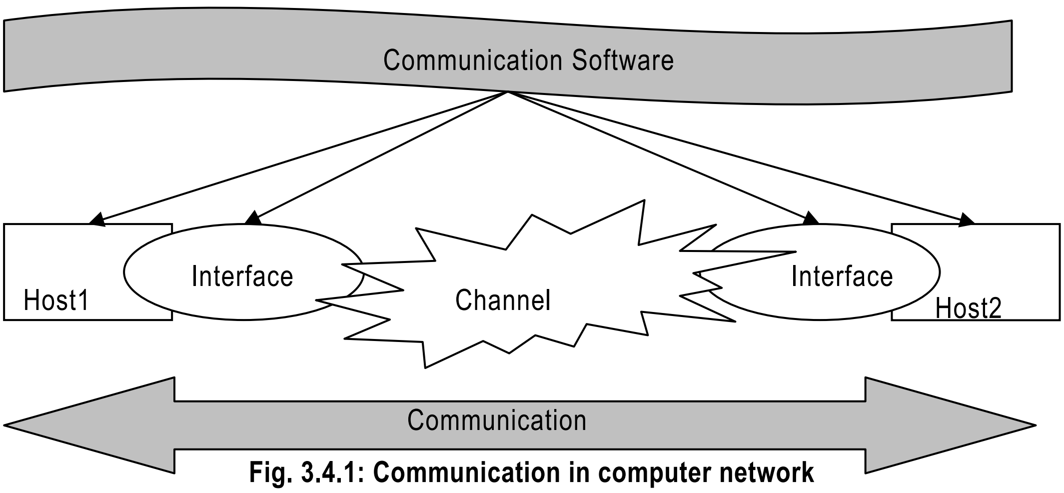


Fig. 3.4.1: Communication in computer network

In fig 3.4.1 source machine sends data through network interface devices on communication channel. At the receiving end network interface devices forward data to destination machine.

Source & destination hosts and network interface devices are installed with communication software. Communication shown is bidirectional.

3.4.1 Source/Destination Host

A host is any computer on a network that is a repository for services available to other computers on the network. A host is simply an endpoint where users gain access to the networks. This could be a mainframe computer, personal computer, workstation etc.

3.4.2 Communication Interface Devices

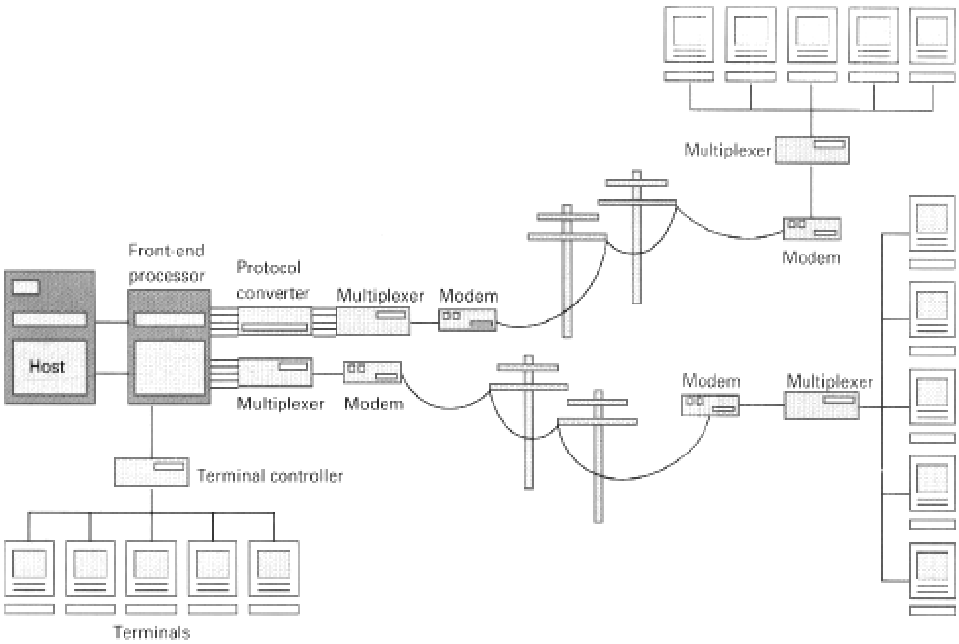


Fig 3.4.2.1: Communication using interface devices

In fig 3.4.2.1, some of the communication devices are shown. We will now briefly describe the most commonly used communication devices.

(i) Network Interface Cards : Every computer in a network has a special card called a network interface card (NIC). An NIC first of all, provides the connector to attach the network cable to a server or a workstation. The on-board circuitry then provides the protocols and commands required to support this type of network card. An NIC has additional memory for buffering incoming and outgoing data packets, thus improving the network throughput. A slot may also be available for remote boot PROM, permitting the board to be mounted in a diskless workstation. Network interface cards are available in 8-bit bus or in faster 16-bit bus standards. Characteristics of NICs include following:

- NIC construct, transmits, receives, and processes data to and from a host to network.
- Each NIC has a manufacturer provided 8 bytes permanent and unique MAC(media access control) address. This address is also known as physical address.
- The NIC requires drivers to operate.

(ii) Switches and Routers are hardware devices used to direct messages across a network, switches create temporary point to point links between two nodes on a network and send all data along that link. Router computers are similar to bridges but have the added advantage of supplying the user with network management utilities.

A switch is a kind of multi port connecting device which makes intelligent routing decisions on the basis of hardware (physical) addresses. It regenerates incoming signals and forwards it.

Fig 3.4.2.2: Switch and Router

Router is a kind of connecting device which makes forwarding decisions of data packet on the basis of network addresses. Routers are the backbone of the Internet, as they can be used to interconnect different types of networks. Routers help administer the data flow by such means as redirecting data traffic to various peripheral devices or other computers. In an Internet work communication, routers not only pass on the data as necessary but also select appropriate routes in the event of possible network malfunctions or excessive use. Fig. 3.4.2.2 shows Switch and Router.

The primary purpose of a router is to examine the source and destination IP addresses of data packets it receives and to direct those packets out the appropriate port and over the best path available at the time. Routers accomplish this by using routing protocols and routing algorithms.

(iii) Hubs: A hub is a multi port connecting device that is used to interconnect LAN devices. Each node is connected to the hub by means of simple twisted pair wires. The hub then provides a connection over a higher speed link to other LANs, the company's WAN, or the Internet. A hub can be used to extend the physical length of a network. Hubs can be active and passive. In case of passive hub incoming signal is sent as it as output. Active hub can regenerate incoming signal. It supports homogeneous network only.

(iv) Bridges, repeaters and gateways: Workstations in one network often need access to computer resources in another network or another part of a WAN. For example, an office manager using a local area network might want to access an information service that is offered by a VAN over the public phone system. In order to accommodate this type of need, bridges and routers are often necessary.

Bridges*:* The main task of a bridge computer is to receive and pass data from one LAN to another. In order to transmit this data successfully, the bridge magnifies the data transmission signal. This means that the bridge can act as a repeater as well as a link.

Repeaters are devices that solve the snag of signal degradation which results as data is transmitted along the various cables. What happens is that the repeater boosts or amplifies the signal before passing it through to the next section of cable.

Gateways*:* Gateways are also similar to bridges in that they relay data from network to network. They do not, as a rule, possess the management facilities of routers but like routers they can translate data from one protocol to another. Gateways are usually used to link LANs of different topologies, e.g., Ethernet and Token Ring, so enabling the exchange of data.

The major point of distinction between gateways, bridge, and a router is that a gateway is a collection of hardware and software facilities that enables devices on one network to communicate with devices on another, dissimilar network. *Bridges* have the same general characteristics as gateways, but they connect networks that employ similar protocols and topologies. Routers are similar to bridges in that they connect two similar networks.

(v) MODEM : Data communication discussed above could be achieved due to the development of encoding/decoding devices. These units covert the code format of computers to those of communication channels for transmission, then reverse the procedure when data are received. These communication channels include telephone lines, microwave links or satellite transmission. The coding/encoding device is called a modem.

MODEM stands for Modulator/Demodulator. In the simplest form, it is an encoding as well as decoding device used in data transmission. It is a device that converts a digital computer signal into an analog telephone signal (i.e. it modulates the signal) and converts an analog telephone signal into a digital computer signal (i.e. it demodulates the signal) in a data communication system. Modems are used for handling data streams from a peripheral device to the CPU and vice versa through the common carrier network. Modems are required to tele-communicate computer data with ordinary telephone lines because computer data is in digital form but telephone lines are analogue. Modems are built with different ranges of transmission speeds.

One of the greatest benefits of a modem is that it confers the ability to access remote computers. One advantage of this capability is that it allows many employees to work at home and still have access to the computer system at the office. By dialing the company's network number with a modem, an employee can access data and trade files with other employees, and exchange e-mail message. Salespersons who are on road often communicate with their office via modem. A communications software package is used to establish the connection between the salesperson's portable computer and a computer in the office. His data can then be transmitted over telephone lines.

MODEMs can be categorized according to speed, price and other features. But most commonly, people classify them as internal and external. Internal modems look like the sound cards and video cards that fit inside the computer. Once it is in the computer, it is not accessible to the user unless he/she opens the computer. External modems, on the other hand, connect to the serial port of the computer. This sort of modem usually sits on the top of the CPU of the computer. There is another category of modems called PCMCIA. These modems are used only with laptop computers. They are small—about the size of a visiting card and are quite expensive.

There are also modems that connect to the parallel port of the computer, leaving the serial port free for other uses. But these parallel port modems are rare.

Both internal and external modems work pretty well but people have found external modems to be better because they can see and control them better. External modems connect to the computer like any other device does and can be set up more easily. These can be switched off or on easily too. The lights on the external modem also inform about the status of transmission of data. Internal modems, which are cheaper, are a little more difficult for a novice to set up. If an internal modem disconnects or gets stuck in its operations for some reasons, it can not be reset easily since it is inside the computer. The user has to only restart the computer.

The speed of modems is measured in Kbps (Kilo bits per second). Today a modem is available from Rs. 1,500 and more depending on the features available.

MODEMs in turn are connected to receivers that can actually be any of the several types of devices such as a computer, a multiplexer etc.

(vi) Multiplexer : This device enables several devices to share one communication line. The multiplexer scans each device to collect and transmit data on a single line to the CPU. It also communicates transmission from the CPU to the appropriate terminal linked to the Multiplexer. The devices are polled and periodically asked whether there is any data to transmit. This function may be very complex and on some systems, there is a separate computer processor devoted to this activity and this is called a "front-end-processor".

(vii) Front-end communication processors : These are programmable devices which control the functions of communication system. They support the operations of a mainframe computer by performing functions, which it would otherwise be required to perform itself. These functions include code conversions, editing and verification of data, terminal recognition and control of transmission lines. The mainframe computer is then able to devote its time to data processing rather than data transmission.

(viii) Protocol converters : Dissimilar devices can not communicate with each other unless a strict set of communication standards is followed. Such standards are commonly referred to as protocols. A protocol is a set of rules required to initiate and maintain communication between a sender and receiver device.

Because an organization's network typically evolved over numerous years, it is often composed of a mixture of many types of computers, transmission channels, transmission modes, and data codes. To enable diverse systems components to communicate with one another and to operate as a functional unit, protocol conversion may be needed. For example, it may be necessary to convert from ASCII to EBCDIC. Protocol conversion can be accomplished via hardware, software, or a combination of hardware and software.

(ix) Remote Access Devices: Remote access devices are modem banks that serve as gateways to the Internet or to private corporate networks. Their function is to properly route all incoming and outgoing connections.

3.4.3 Communication Channel (Medium):

Communication media comprises different types of cables and wireless techniques that are used to connect network devices in a Local Area Network (LAN), Wireless Local Area Network (WLAN) or Wide Area Network (WAN). Choice of correct type of media is very important for the implementation of any network. Communication media is divided into two groups:

(i) Guided Media : Twisted Pair, Coaxial cable and Optical fiber.

(ii) Unguided Media : Wireless

Twisted-Pair cables are most commonly used transmission media to transmit electrical signal as shown in fig 3.4.3.1. Twisted-Pair cables contain pairs of insulated copper wires twisted together. Twisting reduces the impact of interferences. There are two types of twisted-pair cables called Unshielded Twisted-Pair (UTP) cable and Shielded Twisted-Pair (STP) cable. Main difference between both cables is that 8-wires in Shielded Twisted-Pair (STP) cables are surrounded by an additional braided shielding, which makes STP cables more secure, less prone to interferences but expensive. Cost of these cable are comparably very low. Twisted-Pair cables can carry data at a speed of 10 Mbps, 100Mbps and 1000Mbps and can transmit data up to 100 meters.

Fig 3.4.3.1: Twisted Pair

Co-axial cable (also called as coax) contains central copper wire as its core that is surrounded by two layers of protective shielding as shown in fig 3.4.3.2. This shielding reduces electromagnetic interference. Co-axial cables used in computer networks are of two type thick co-axial and thin co-axial cable. Coax can transmit data at a maximum speed of 10Mbps up to 500 meters without using repeaters.

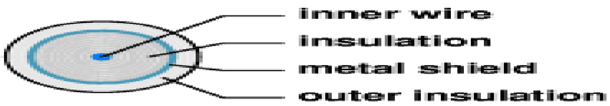


Fig 3.4.3.2: Coaxial Cable

Wireless networks do not require any physical media or cables for data transmission. Radio waves and Infrared signals are used for communication. Microwave is also used in different scenario. Radio waves are most commonly used transmission media in the wireless Local Area Networks. Radio waves of different frequencies are used in a wide range of wireless communications such as AM radio (300 to 3000 KHz), FM radio (30 to 300 MHz),

An optical fiber (or fiber) as shown in fig 3.4.3.3, is a glass or plastic fiber that carries light along its length. Fiber optics is the overlap of applied science and engineering concerned with the design and application of optical fibers. Optical fibers are widely used in fiber-optic communications, which permits transmission over longer distances and at higher data rates (a.k.a "bandwidth"), than other forms of communications. Fibers are used instead of metal wires because signals travel along them with less loss, and they are immune to electromagnetic interference. Fibers are also used for illumination, and in bundles can be used to carry images, allowing viewing in tight spaces. Specially designed fibers are used for a variety of other applications, including as sensors and fiber lasers.

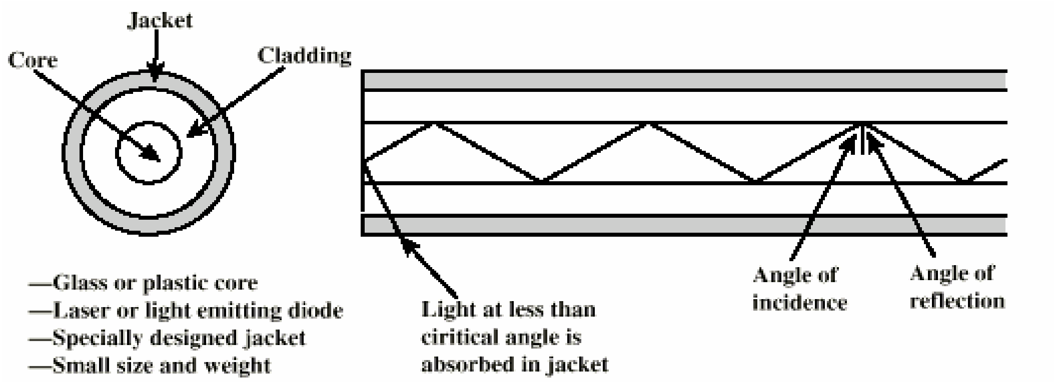


Fig 3.4.3.3: Optical Fiber

Cellular telephone & Personal Communications Systems (300 to 3000MHz), Satellite communications (radio waves of frequency more than 1GHz commonly called Microwaves) and Wireless Local Area Networks (1 to 10GHz). Infrared light (300GHz to 400 THz) is also used in the Wireless Local Area Networks. These networks are only limited within a room, as infrared light cannot pass through the walls. Another disadvantage of infrared light is that it can easily interfere with infrared radiations generated by sun.

3.4.4 Communications Software : Communications software manages the flow of data across a network. Communications software is written to work with a wide variety of protocols, which are rules and procedures for exchanging data..It performs the following functions:

- ***Access control***: Linking and disconnecting the different devices; automatically dialing and answering telephones; restricting access to authorized users; and establishing parameters such as speed, mode, and direction of transmission.
- ***Network management***: Polling devices to see whether they are ready to send or receive data; queuing input and output; determining system priorities; routing messages; and logging network activity, use, and errors.
- ***Data and file transmission***: Controlling the transfer of data, files, and messages among the various devices.
- ***Error detection and control:*** Ensuring that the data sent was indeed the data received.
- ***Data security:*** Protecting data during transmission from unauthorized access.

3.5 NETWORK STRUCTURE OR TOPOLOGY

The geometrical arrangement of computer resources, remote devices, and communication facilities is known as network structure or network topology. A compute network is comprised of nodes and links. A *node* is the end point of any branch in a computer, a terminal device, workstation or an interconnecting equipment facility. A link is a communication path between two nodes. The terms “circuit” and “channel” are frequently used as synonyms for link.

A network structure determines which elements in a computer network can communicate with each other. Four basic network structures are discussed below.

(i) Star topology : The most common structure or topology known as star network is characterized by communication channels emanating from centralized control as shown in fig 3.5.1.

That is, processing nodes in a star network interconnect directly with a central system. Each terminal, small computer, or large main frame can communicate only with the central site and not with other nodes in the network. If it is desired to transmit information from one node to another, it can be done only by sending the details to the central node, which in turn sends them to the destination.

A star network is particularly appropriate for organisations that require a centralized data base or a centralized processing facility. For example, a star network may be used in banking for centralized record keeping in an on-line branch office environment.

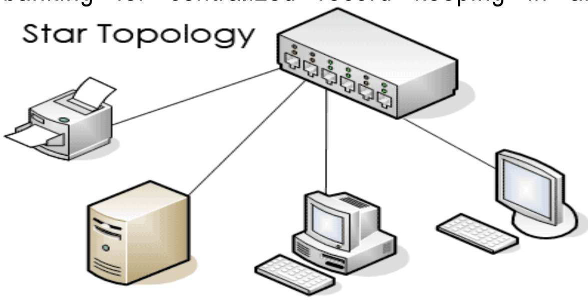


Fig. 3.5.1: Star arrangement

Advantages:

- It is easy to add new and remove nodes.
- A node failure does not bring down the entire network
- It is easier to diagnose network problems through a central hub.

Disadvantages:

- If the central hub fails, the whole network ceases to function.
- It costs more to cable a star configuration than other topologies (more cable is required than for a bus or ring configuration)

(ii) Bus topology : This structure is very popular for local area networks. In this structure or topology, a single network cable runs in the building or campus and all nodes are linked along with this communication line with two endpoints called the bus or backbone as shown in fig 3.5.2. Two ends of the cable are terminated with terminators.

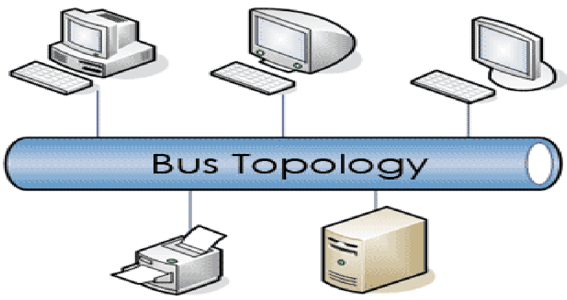


Fig 3.5.2: Bus Topology

Advantages:

- Reliable in very small networks as well as easy to use and understand.
- Requires the least amount of cable to connect the computers together and therefore is less expensive than other cabling arrangements.
- Is easy to extend. Two cables can be easily joined with a connector, making a longer cable for more computers to join the network.
- A repeater can also be used to extend a bus configuration.

Disadvantages:

- Heavy network traffic can slow a bus considerably. Because any computer can transmit at any time. But networks do not coordinate when information is sent. Computers interrupting each other can use a lot of bandwidth.
- Each connection between two cables weakens the electrical signal.
- The bus configuration can be difficult to trouble shoot. A cable break or malfunctioning computer can be difficult to find and can cause the whole network to stop functioning.

(iii) Ring topology : This is yet another structure for local area networks. In this topology, the network cable passes from one node to another until all nodes are connected in the form of a loop or ring. There is a direct point-to-point link between two neighboring nodes. These links are unidirectional which ensures that transmission by a node traverses the whole ring and comes back to the node, which made the transmission as shown in Fig. 3.5.3.

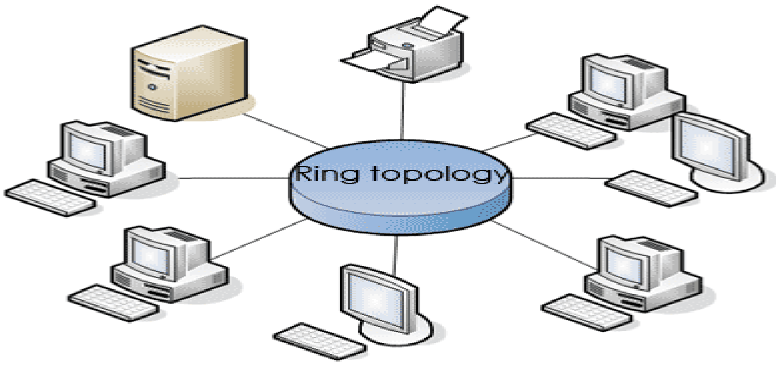


Fig 3.5.3: Ring topology

Advantages:

- Ring networks offer high performance for a small number of workstations or for larger networks where each station has a similar workload.
- Ring networks can span longer distances than other types of networks.
- Ring networks are easily extendable.

Disadvantages:

- Relatively expensive and difficult to install.
- Failure of one computer on the network can affect the whole network.
- It is difficult to trouble shoot a ring network.
- Adding or removing computers can disrupt the network

(iv) Mesh network : In this structure, there is random connection of nodes using communication links. In real life, however, network connections are not made randomly. Network lines are expensive to install and maintain. Therefore, links are planned very carefully after serious thoughts, to minimize cost and maintain reliable and efficient traffic movement. A mesh network may be fully connected (as shown in fig 3.5.4) or connected with only partial links. In fully interconnected topology, each node is connected by a dedicated point to point link to every node. This means that there is no need of any routing function as nodes are directly connected. The reliability is very high as there are always alternate paths available if direct link between two nodes is down or dysfunctional. Fully connected networks are not very common because of the high cost. Only military installations, which need high degree of redundancy, may have such networks, that too with a small number of nodes.

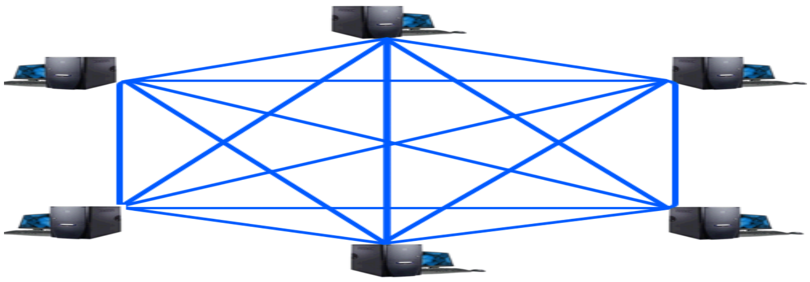


Fig 3.5.4: Mesh topology

Partially connected mesh topology is the general topology for wide area networks. Here computer nodes are widely scattered and it is the only choice. The function of routing information from one node to another is done using routing protocol or procedures.

Advantages:

- Yields the greatest amount of redundancy in the event that one of the nodes fails where network traffic can be redirected to another node.
- Network problems are easier to diagnose.

Disadvantages:

- The cost of installation and maintenance is high (more cable is required than any other configuration)

For any network to exist there must be connections between computers and agreements or what is termed as protocols about the communications language. However, setting up connections and agreements between dispersed computers (from PCs to mainframes) is complicated by the fact that over the last decade, systems have become increasingly heterogeneous in their software and hardware, as well as their intended functionality.

3.6 TRANSMISSION TECHNOLOGIES

A given transmission on a communications channel between two machines can occur in several different ways. The transmission is characterized by:

- the direction of the exchanges
- the transmission mode: the number of bits sent simultaneously
- synchronization between the transmitter and receiver

3.6.1 Serial versus Parallel Transmission : The transmission mode refers to the number of elementary units of information (bits) that can be simultaneously translated by the communications channel. There are two modes of transmitting digital data. These methods are Parallel and Serial Transmissions.

- **Serial Transmission:** In serial transmission, the bits of each byte are sent along a single path one after another as illustrated in Fig 3.6.1.1. An example is the serial port (RS-232) for the mouse or MODEM.

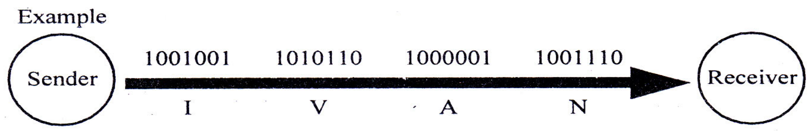


Fig. 3.6.1.1 Serial Transmission

- **Parallel Transmission:** In parallel transmission, there are separate, parallel path corresponding to each bit of the byte so that all character bits are transmitted simultaneously as shown in Fig 3.6.1.2. Example of this transmission is the parallel port (Centronic port) used for printer.

Example

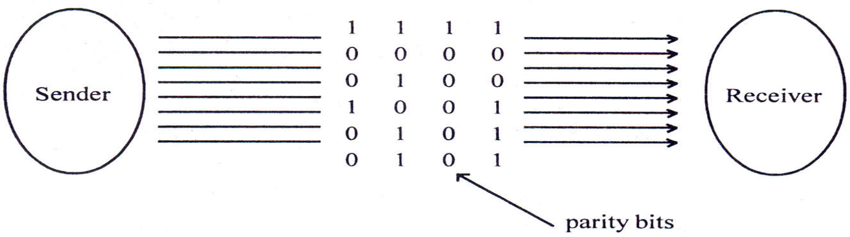


Fig. 3. 6.1.2 Parallel Transmission

Differences between Serial Transmission and Parallel Transmission shown in Table 3.6.1.1

S.No	SERIAL TRANSMISSION	PARALLEL TRANSMISSION
1	In this, the data bits are transmitted serially one after another.	In this, the data bits are transmitted simultaneously.
2	Data is transmitted over a single wire.	Data is transmitted over 8 different wires.
3	It is a cheaper mode of transferring data.	Relatively expensive.

4	Applicable for long distance data transmissions.	Not practical for long distance communications as it uses parallel path, so cross talk may occur.
5	Relatively slower	Relatively faster.

Table 3.6.1.1 Serial vs Parallel Transmission

3.6.2Synchronous versus Asynchronous Transmission: As in serial connections, wherein a single wire transports the data, the problem is how to synchronize the transmitter and receiver, in other words, the receiver can not necessarily distinguish the characters (or more generally the bit sequences) because the bits are sent one after the other. When a computer sends the data bits and parity bit down the same communication channel, the data are grouped together in predetermined bit patterns for the receiving devices to recognize when each byte (character) has been transmitted. There are two basic ways of transmitting serial binary data: synchronous and asynchronous. There are two types of transmission that address this problem:

- **Asynchronous Transmission:** In this, each character is sent at irregular intervals in time (for example a user sending characters entered at the keyboard in real time). So, for example, imagine that a single bit is transmitted during a long period of silence... the receiver will not be able to know if this is 00010000, 10000000 or 00000100... To correct this problem, each character is preceded by some information indicating the start of character transmission (the transmission start information is (called a START bit usually 0) and ends by sending end-of-transmission information (called STOP bit usually 1), as shown in fig 3.6.2.1.

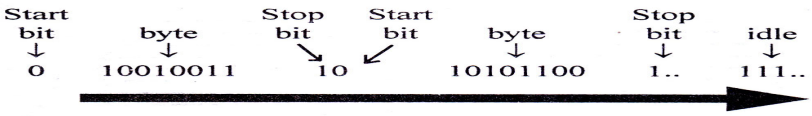


Fig. 3. 6.2.1 Asynchronous Transmission

- **Synchronous Transmission:** In this, the transmitter and receiver are paced by the same clock. The receiver continuously receives (even when no bits are transmitted) the information at the same rate the transmitter send it. This is why the transmitter and receiver are paced at the same speed. In addition, supplementary information is inserted to guarantee that there are no errors during transmission, as shown in fig 3.6.2.2

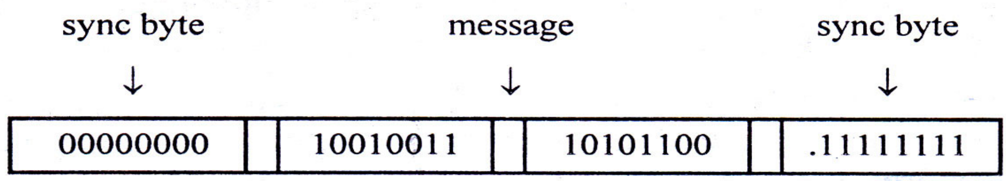


Fig. 3. 6.2.2 Synchronous Transmission

During synchronous transmission, the bits are sent successively with no separation between each character, so it is necessary to insert synchronization elements; this is called **character-level synchronization**. A group of synchronization bits must be placed at the beginning and ending of each block to maintain synchronization.

S.No	ASYNCHRONOUS TRANSMISSION	SYNCHRONOUS TRANSMISSION
1	Each data word is accompanied by start and stop bits.	Allows characters to be sent down the line without start-stop bits.
2	Extra Start and Stop bits slow down the transmission process relatively.	Transmission is faster as in absence of start and stop bits, many data words can be transmitted per second.
3	Relatively cheaper.	The synchronous device is more expensive to build as it must be smart enough to differentiate between the actual data and the special synchronous characters.
4	More reliable as the start and stop bits ensure that the sender and the receiver remain in step with one another.	Chances of data loss is relatively higher.
5	Less efficient.	More efficient.

Table 3.6.2.1 Asynchronous vs Synchronous Transmission

3.6.3 Transmission Modes

Simplex, half-duplex and full-duplex connections: There are 3 different transmission modes characterized according to the direction of the exchanges:

- **Simplex Connection: A simplex connection** is a connection in which the data flows in only one direction, from the transmitter to the receiver. Simplex mode is seldom used because a return path is generally needed to send acknowledgements, control or error signals. This type of connection is useful if the data do not need to flow in both directions (for example, from your computer to the printer or from the mouse to your computer.).

- **Half-duplex Connection: A half-duplex connection** (sometimes called an *alternating connection* or *semi-duplex*) is a connection in which the data flows in one direction or the other, but not both at the same time. With this type of connection, each end of the connection transmits in turn. This type of connection makes it possible to have bidirectional communications using the full capacity of the line. For example: Walkie Talkie.
- **Full-Duplex Connection: A full-duplex connection** is a connection in which the data flow in both directions simultaneously. Each end of the line can thus transmit and receive at the same time, which means that the bandwidth is divided in two for each direction of data transmission if the same transmission medium is used for both directions of transmission.

3.6.4 Transmission Techniques

(i) Circuit Switching : A **Circuit Switching** network is one that establishes a fixed bandwidth circuit (or channel) between nodes and terminals before the users may communicate, as if the nodes were physically connected with an electrical circuit. In circuit-switching, this path is decided upon before the data transmission starts. The system decides on which route to follow, based on a resource-optimizing algorithm, and transmission goes according to the path. For the whole length of the communication session between the two communicating bodies, the route is dedicated and exclusive, and released only when the session terminates.

Circuit switching is what most of us encounter on our home phones. We place a call and either get our destination party or encounter a busy signal, we can not transmit any message. A single circuit is used for the entire duration of the call.

(ii) Message Switching **:** Some organizations with a heavy volume of data to transmit use a special computer for the purpose of data message switching. The computer receives all transmitted data ; stores it ; and, when an outgoing communication line is available, forwards it to the receiving point.

(iii) Packet switching : It is a sophisticated means of maximizing transmission capacity of networks. Packet switching refers to protocols in which messages are broken up into small transmission units called packets, before they are sent. Each packet is transmitted individually across the net. The packets may even follow different routes to the destination, depends on the type of packet switching. Thus, each packet has header information which enables to route the packet to its destination. At the destination the packets are reassembled into the original message. . Passwords and all types of data can be included within the packet and the transmission cost is by packet and not by message, routes or distance. Sophisticated error and flow control procedures are applied on each link by the network.

To prevent unpredictably long delays and ensure that the network has a reliably fast transit time, a maximum length is allowed for each packet. It is for this reason that a message submitted to the transport layer may first have to be divided by the transport protocol entity into a number of smaller packet units before transmission. In turn, they will be reassembled into a single message at the destination.

S.No	CIRCUIT SWITCHING	PACKET SWITCHING
1	A dedicated path is used throughout the data transmission.	Each packet is transmitted through different routes.
2	Circuit-switching is more reliable than packet-switching because of the availability of a circuit dedicated for a session.	Relatively less reliable.
3	Circuit switching is old and expensive	Packet switching is more modern.

Table 3.6.4.1 Circuit Switching vs Packet Switching

3.7 TRANSMISSION PROTOCOLS

For any network to exist , there must be connections between computers and agreements or what is termed as protocols about the communications language. However, setting up connections and agreements between dispersed computers (from PCs to mainframes) is complicated by the fact that over the last decade, systems have become increasingly heterogeneous in their software and hardware, as well as their intended functionality.

3.7.1 Introduction: Protocols are software that perform a variety of actions necessary for data transmission between computers. Stated more precisely, protocols are a set of rules for inter-computer communication that have been agreed upon and implemented by many vendors, users and standards bodies. Ideally, a protocols standard allows heterogeneous computers to talk to each other.

At the most basic level, protocols define the physical aspects of communication, such as how the system components will be interfaced and at what voltage levels will be transmitted.

At higher levels, protocols define the way that data will be transferred, such as the establishment and termination of “sessions” between computers and the synchronization of those transmissions. At still higher levels, protocols can standardize the way data itself is encoded and compressed for transmission.

Thus we can say that,

Network protocols which are essentially software, are sets of rules for –

- ♦ Communicating timings, sequencing, formatting, and error checking for data transmission.
- ♦ Providing standards for data communication

A transmission protocols is a set of conventions or rules that must be adhered to by both the communicating parties to ensure that the information being exchanged between the two parties is received and interpreted correctly. A protocol defines the following three aspects of digital communication.

(a) Syntax*:* The format of data being exchanged, character set used, type of error correction used, type of encoding scheme (e.g., signal levels) being used.

*(**b) Semantics**:* Type and order of messages used to ensure reliable and error free information transfer.

(c) Timing: Defines data rate selection and correct timing for various events during data transfer.

As stated earlier, communication protocols are rules established to govern the way the data are transmitted in a computer network. Communication protocols are defined in layers, the first of which is the physical layer or the manner in which nodes in a network are connected to one another. Both the network software and the network-interface card (NIC) have to adhere to a network protocol. The RS-232C connector is the standard for some communication protocols. Subsequent layers, the number of which vary between protocols, describe how messages are packaged for transmission, how messages are routed through the network, security procedures, and the manner in which messages are displayed.

A number of different protocols are in common use. For example, X. 12 is the standard for electronic data interchange (EDI-discussed later in the chapter); X.75 is used for interconnection between networks of different countries; XON/XOFF is the de-facto standard for microcomputer data communication; and XMODEM is used for uploading and downloading files.

These rules are embedded or built into the software which reside either in –

(i) Computer's memory or

(ii) Memory of transmission device

Different protocols cannot talk to each other hence standard protocols have been structure to resolve the problem. The entire operation of data transmission over a network is broken down into discrete systematic steps. Each step has its won rules or protocol. Steps must be carried out in consistent order for every computer in the network, either receiving or sending data.

At the sending computer, protocols –

(i) Break data down into packets,

(ii) Add destination address to the packet,

(iii) Prepares data for transmission through Network Interface Card (NIC)

At the receiving computer, protocols –

(i) Take data packets off the cable

(ii) Bring packets into computer through Network Interface Card (NIC)

(iii) Strip the packets off any transmitting information,

(iv) Copy data from packet to a buffer for reassembly,

(v) Pass the reassembled data to the application,

A protocol stack is a combination of a set of protocols. Each layer specifies a different protocol–

(i) For handling a function or,

(ii) As a subsystem of the common process,

(iii) Each layer has its won set of rules, for example the protocol stack of the Application Layer initiates or accepts a request from the user. The Presentation Layer adds formatting, displays and encrypts information to the packet. The Session Layer adds traffic flow information to determine when the packet gets sent or received. Transport Layer adds error handling information like CRC. The Network Layer does sequencing and adds address information in the packet. The data Link Layer adds error checking information and prepares the data for going on to the destination.

3.7.2 OPEN SYSTEM INTERCONNECTION MODEL (OSI MODEL) has been outlined by **International Organization for Standardization (ISO)** to facilitate communication of heterogeneous hardware or software platforms with each other.

OSI Model is an abstract description for layered communications and computer network protocol design. It was developed as part of the Open Systems Interconnection (OSI) initiative. In its most basic form, it divides network architecture into seven , wherein a layer is a collection of layers which, from top to bottom, are the Application, Presentation, Session, Transport, Network, Data-Link, and Physical Layers. It is therefore often referred to as the **OSI Seven Layer Model**..

A layer is a collection of conceptually similar functions that provide services to the layer above it and receives services from the layer below it.

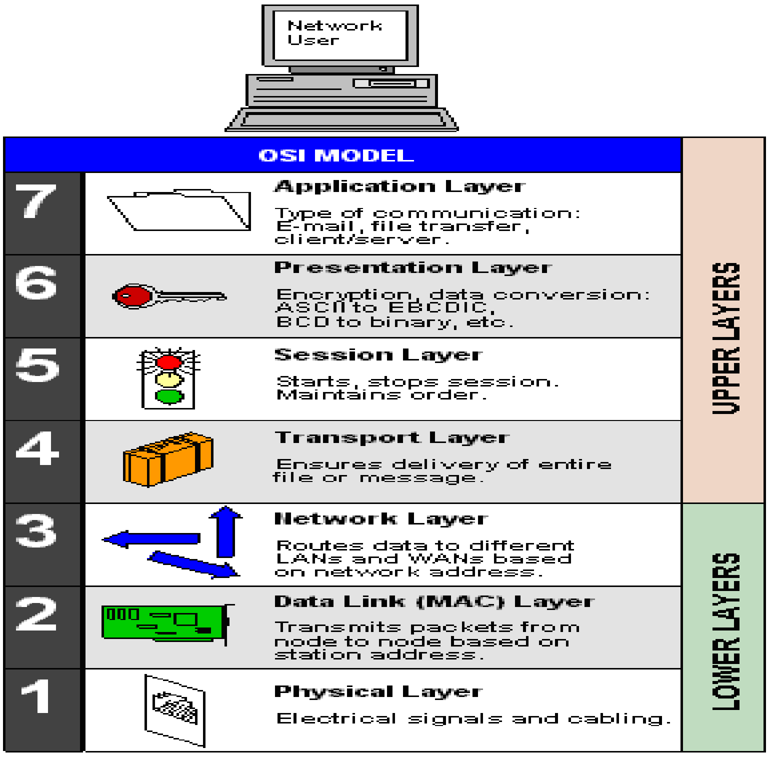


Fig 3.7.2.1 OSI Layers

Description of OSI layers (as shown in Fig 3.7.2.1)

Layer 7 or Application Layer: The application layer is the OSI layer is closest to the end user, which means that both the OSI application layer and the user interact directly with the software application. This layer interacts with software applications and provides user services by file transfer, file sharing, etc. Database concurrency and deadlock situation controls are undertaken at this layer level. This is the layer at which communication partners are identified, quality of service is identified, user authentication and privacy are considered, and any constraints on data syntax are identified

Layer 6 or Presentation Layer: This layer at times referred as Syntax Layer also, is usually a part of an operating system, that converts incoming and outgoing data from one presentation format to another (for example, from a text stream into a popup window with the newly arrived text). The presentation service data units are then encapsulated into Session Protocol Data Units, and moved down the stack.. It further controls on screen display of data, transforms data to a standard application interface. Encryption, data compression can also be undertaken at this layer level.

Layer 5 or Session Layer: This layer sets up, coordinates, and terminates conversations, exchanges, and dialogs between the applications at each end. It deals with session and connection coordination. It provides for full-duplex, half-duplex, or simplex operation, and establishes checkpointing, adjournment, termination, and restart procedures. The OSI model made this layer responsible for "graceful close" of sessions also.

Layer 4 or Transport Layer : This layer also ensures reliable and transparent transfer of data between user processes, assembles and disassembles message packets, provides error recovery and flow control. Multiplexing and encryption are undertaken at this layer level. This means that the Transport Layer can keep track of the segments and retransmit those that fail.

Layer 3 or Network Layer: The Network Layer provides the functional and procedural means of transferring variable length data sequences from a source to a destination via one or more networks, while maintaining the quality of service requested by the Transport Layer. The Network Layer makes a choice of the physical route of transmission, creates a virtual circuit for upper layers to make them independent of data transmission and switching, establishes, maintains terminates connections between the nodes, ensure proper routing of data,

Layer 2 or Data Link Layer: The Data Link Layer responds to service requests from the Network Layer and issues service requests to the Physical Layer.. The Data Link Layer is the protocol layer which transfers data between adjacent network nodes in a wide area network or between nodes on the same local area network segment.

This layer is also a hardware layer which specifies channel access control method and ensures reliable transfer of data through the transmission medium. It provides the functional and procedural means to transfer data between network entities and to detect and possibly correct errors that may occur in the Physical Layer.

Layer 1 or Physical Layer: The Physical Layer is a hardware layer which specifies mechanical features as well as electromagnetic features of the connection between the devices and the transmission. In particular, it defines the relationship between a device and a physical medium. This includes the layout of pins, voltages, cable specifications, Hubs, repeaters, network adapters, Host Bus Adapters (HBAs used in Storage Area Networks) and more.

The major functions and services performed by the Physical Layer are:

- Establishment and termination of a connection to a communications medium.
- Participation in the process whereby the communication resources are effectively shared among multiple users. For example, contention resolution and flow control.
- Modulation, or conversion between the representation of digital data in user equipment and the corresponding signals transmitted over a communications channel. These are signals operating over the physical cabling (such as copper and optical fiber) or over a radio link.

Remembering The OSI Layers

Various mnemonics have been created over the years to help remember the order of the OSI layers. Often cited are the following:

- **P**lease **D**o **N**ot **T**hrow **S**ausage **P**izza **A**way
- **A**ll **P**eople **S**eem **T**o **N**eed **D**ata **P**rocessing

3.7.3 TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL

The protocols used on the Internet is called **TCP/IP (transmission Control Protocol/Internet Protocol)** A TCP/IP protocol which has two parts–

(i) TCP deals with exchange of sequential data

(ii) IP handles packet forwarding and is used on the Internet

TCI/IP has four layers–

(i) The **Application Layer** which provides services directly the users such as e-mail.

(ii) The **Transport Layer** which provides end-to-end communication between applications and verifies correct packet arrival.

(iii) The **Internet Layer** which provides packet routing for error checking and addressing and integrity.

(iv) The **Network Interface Layer** which provides an interface to the network hardware and device drivers. This can also be called the Data Link Layer.

TCP/IP creates a packet-switching network. When a message, whether it is a file or just e-mail, is ready to be sent over the Internet, the TCP protocol breaks it up into small packets. Each packet is then given a header, which contains the destination address. The packets are then sent individually over the Internet. The IP protocol guides the packets so that they arrive at the proper destination. Once there, the TCP protocol resembles the packets into the original message.

Fig 3.7.3.1 shows the pictorial difference between OSI and TCP/IP.

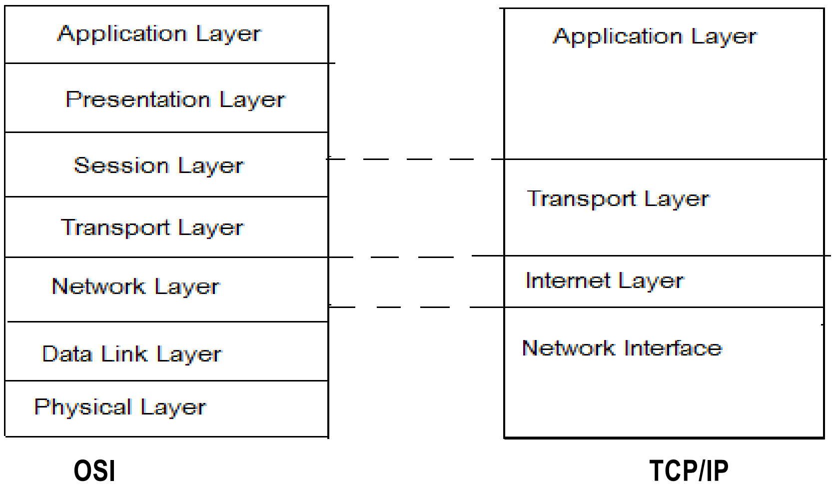


Fig 3.7.3.1 OSI vs TCP / IP

Table 3.7.3.1 highlights the difference between OSI model and TCP/IP.

S.No	OSI MODEL	TCP/IP MODEL
1	It has seven Layers	It has four Layers.
2	These are different layers.	The Internet Application Layer includes the OSI Application Layer, Presentation Layer, and most of the Session Layer
3	The OSI reference model was devised before the protocols were invented.	In this, the protocols came first and the model came late.

Table 3.7.3.1 Difference between OSI model and TCP/IP

3.8 LOCAL AREA NETWORKS

A local area network is best defined in terms of the purpose it is meant to serve rather than in terms of how it does it. **A local area network is primarily a data transmission system intended to link computers and associated devices within a restricted geographical area; however, many suppliers propose to include speech in their systems**. The linked computers and related equipments may be anything from full-scale mainframe computing systems to small desk-top office workstations, terminals, peripherals, etc. The key characteristic of a local area network is the fact that the whole of the network, confined to one site, is completely under the control of one organization. This does not prevent communications taking place between users of the local area network on one site and others elsewhere. This would be achieved using wide area networks with special bridging equipment common to both the local and wide area network to perform the function of taking messages from one network and putting them on the other. Local area networks could conceivably be used as device concentrators for a wide area network.

3.8.1 Introduction: A **local area network (LAN)** is a computer network covering a small physical area, like a home, office, or small group of buildings, such as a school. The defining characteristics of LANs, in contrast to wide-area networks (WANs), include their usually higher data-transfer rates, smaller geographic range, and lack of a need for leased telecommunication lines.. A LAN is useful for sharing resources like files, printers, games or other applications. A LAN in turn often connects to other LANs, and to the Internet or other WAN.

The smallest home LAN can have exactly two computers; a large LAN can accommodate many thousands of computers. Many LANs are divided into logical groups called subnets.

Since a local area network is confined to a small area, it is possible to employ vastly different transmission methods from those commonly used on other telecommunication systems. Inexpensive line-driving equipment can be employed instead of the relatively complex modems needed for public analogue network. High data transmission speed can be achieved by utilizing the advantages of short distances and the latest electronic circuits. Thus, local area networks are typified by short distances (up to 10 km. although 1 km. is more usual), by a high transmission rate (0.1 to 30 Mbps), and by a low error rate. It is equally important to stress that local area networks are cheap to install and run, and provide a convenient method for interconnecting a large number of computer based devices on a single site (e.g. word processors, personal computers, as well as ordinary computers)

The main attributes of present-day local area networks can be summarized :

- inexpensive transmission media;
- inexpensive devices (modems, repeaters and transceiver) to interface to the media;
- easy physical connection of devices to the media;
- high data transmission rates;
- network data transmissions are independent of the rates used by the attached devices, making it easier for devices of one speed to send information to devices of another speed;
- a high degree of inter-connection between devices;
- every attached device having the potential to communicate with every other device on the network;

- there is seldom a central controlling processor which polls the attached devices on the network;
- in the majority of cases, each attached device hears (but does not process) messages intended for other devices as well as for itself.

It is important to note that neither the actual data transmission rate used, the access method not the topology of the network are essential characteristics.

There are many different types of LANs Ethernets being the most common for PCs. Most Apple Macintosh networks are based on Apple's AppleTalk network system, which is built into Macintosh computers.

The following characteristics differentiate one LAN from another:

a) Topology : The geometric arrangement of devices on the network. For example, devices can be arranged in a ring or in a straight line.

b) Protocols : The rules and encoding specifications for sending data. The protocols also determine whether the network uses a peer-to-peer or client/server architecture.

c) Media : Devices can be connected by twisted-pair wire, coaxial cables, or fiber optic cables. Some networks do without connecting media altogether, communicating instead via radio waves.

LANs are capable of transmitting data at very fast rates, much faster than data can be transmitted over a telephone line; but the distances are limited, and there is also a limit on the number of computers that can be attached to a single LAN.

3.8.2 The Emergence of Local Area Networks : The advent of IBM PCs in the early 1980s set a whole new standard in both business and personal computing. Along with PCs came a new operating system called DOS. DOS provided an easy programming environment for software vendors developing and publishing software. The significance of the DOS standard is that it stimulates growth of new products by providing software and hardware vendors with an open development platform to build both accessories and software products. Since this brought in an abundance of software, the use of personal computers increased. As more and more people began to use computers, it became obvious that a way of connecting them together would provide many useful benefits, such as printer and hard disk sharing, especially when budgets became a constraint. This gave birth to the Local Area Network (LAN) concept.

3.8.3 The Concept : While personal computers were becoming more powerful through the use of advanced processors and more sophisticated software, users of mainframes and minicomputers began to break with the tradition of having a centralized information systems division. PCs were easy to use and provided a better and more effective way of maintaining data on a departmental level. In the mainframe and mini environment, the data required by individual departments was often controlled by the management information system department or some such similar department. Each user was connected to the main system through a dumb terminal that was unable to perform any of its own processing tasks. In the mainframe and minicomputer environment, processing and memory are centralized.

The host computer became the center of the computing environment, and was managed by a team of data processing DP professionals whose sole task was to operate the system and provide reports to the various departments in the organization. While this method of computerization had its merits, the major minus point was that the system could get easily overloaded as the number of users and consequently, terminals, increased. Secondly, most of the information was centralized to one pool of people, the systems professionals, rather than the end users.

This type of centralized processing systems differ from the distributed processing systems used in LANs.

In distributed processing systems, most of the processing is done in the memory of the individual PCs, or workstations. The file server or host system becomes the central point for storing files, connecting and sharing printers or other network resources and for managing the network.

Having decided to restrict the range of the network to within one site, various options are open to the designer. The network can have one shape (topology) among several, and many methods of transmitting the information can be used. It is unrealistic to attempt to define local area networks in terms of the topology or transmission technology as these can have mush wider applicability. Local area networks can be used in the manner suited to the organization which owns them, and can be completely independent of the constraints imposed by public telephone authorities, or other public services.

3.8.4 Why LANs ? - One of the original reasons for users going in for LANs was that such a distributed environment gave them the ability to have their own independent processing stations while sharing expensive computer resources like disk files, printers and plotters. Today, however, more critical reasons have emerged for users to increasingly move towards LAN solutions. These include :

(i) Security - Security for programs and data can be achieved using servers that are locked through both software and by physical means. Diskless nodes also offer security by not allowing users to download important data on floppies or upload unwanted software or virus.

(ii) Expanded PC usage through inexpensive workstation **-** Once a LAN has been set up, it actually costs less to automate additional employees through diskless PCs. Existing PCs can be easily converted into nodes by adding network interface cards.

(iii) Distributed processing **-** Many companies operate as if they had distributed system in place. If numerous PCs are installed around the office, these machines represent the basic platform for a LAN with inter-user communication and information exchange.

(iv) Electronic mail and Message Broadcasting **-** Electronic mail allows users to communicate more easily among themselves. Each user can be assigned a mail-box on the server. Messages to other users can then be dropped into the mail-box and read by them when they log into the network.

(v) Organizational Benefits : Benefits of LANs are numerous. These include reduced costs in computer hardware, software and peripherals, and a drastic reduction in the time and cost of training or re-training manpower to use the systems. In addition, the fact that you are networked helps managers and executive to communicate with each other more easily and faster, without any logistical constraints. Information flow too becomes a lot smoother with various departments having the ability to access or request for information and data pertinent to them.

(vi) Data management benefits **-** Since data is located centrally on the server, it becomes much easier to mange it, as well as back it up. No file is transferred between users through floppies.

(vii) Software cost and up-gradation **-** If the organization is concerned about using licensed software purchasing a network version can save a lot of money, since there would be no need to buy multiple copies of the same software for every machine in the organization. Therefore, software upgrades are much easier as any given package is stored centrally on the server.

3.8.5 LAN Requirements - There are certain features that every LAN should have and users would do well to keep note of these when they decide to implement their own network. These features essentially invoice hardware and software components. Broadly, these are :

(i) Compatibility **-** A local area network operating system must provide a layer of compatibility at the software level so that software can be easily written and widely distributed. A LAN operating system must be flexible, which means that it must support a large variety of hardware. Novell Net Ware is a network operating system that can provide these features, and has today, become an industry standard.

(ii) ***Internetworking*** - Bridging of different LANs together is one of the most important requirements of any LAN. Users should be able to access resources from all workstations on the bridge network in a transparent way; no special commands should be required to cross the bridge. A network operating system must be hardware independent, providing the same user interface irrespective of the hardware.

(iii) ***Growth Path and Modularity***. - One of the most important requirements of a LAN is its modularity. A set of PCs should get easily converted into a LAN which can grow in size simply by adding additional workstations. If more storage is required, one should be able to add another hard disk drive, or another server. If you need to connect with a user on another LAN, you should be able to install a bridge.

(iv) ***System Reliability and Maintenance***. - All computers are prone to system lockups, power failures and other catastrophes. If a centralized processing system goes down, all users connected to it are left without a machine to work on. Such a situation can arise even in a distributed or local area network system. However, a LAN operating system should be powerful enough to withstand accidents. In fact, Novells SFT Level I and Level II include fault-tolerance as a feature.

3.8.6 Components of a LAN - A typical local area network running under Novell NetWare has five basic components that make up the network. These are :

- File Servers
- Network operating system
- Personal Computers, Workstations or Nodes
- Network Interface Cards
- Cabling

(i) ***File Server*** - A network file server is a computer system used for the purpose of managing the file system, servicing the network printers, handling network communications, and other functions. A server may be dedicated in which case all of its processing power is allocated to network functions, or it may be non-dedicated which means that a part of the servers functions may be allocated as a workstation or DOS-based system.

(ii) ***The network operating system*** - It is loaded into the server's hard disk along with the system management tools and user utilities. When the system is restarted, NetWare boots and the server comes under its control. At this point, DOS or Windows is no longer valid on the network drive, since it is running the network operating system or NetWare; however most DOS/Windows programs can be run as normal. No processing is done on the server, and hence it is called a Passive Device. The choice of a dedicated or non-dedicated network server is basically a trade-off between the cost and performance, and

operation of a network. The larger the network, the more important it becomes to have a high performance server. Larger amounts of RAM are required to support disk caches and printer queues (which are created due to sharing of same hard disk and printers by number of nodes on the network) The server should be matched with anticipated throughout as closely as possible. While most IBM systems are satisfactory for NetWare, a Pentium system is preferable for better overall performance of the network.

(iii) Workstations **-** Workstations are attached to the server through the network interface card and the cabling. The dumb terminals used on mainframes and minicomputer systems are not supported on networks because they are not capable of processing on their own. Workstations are normally intelligent systems, such as the IBM PC. The concept of distributed processing relies on the fact that personal computers attached to the networks perform their own processing after loading programs and data from the server. Hence, a workstation is called an Active Device on the network. After processing, files are stored back on the server where they can be used by other workstations.

The workstation can also be a diskless PC, wherein loading of operating system takes place from the file server. In short, a PC + a LAN card = a Workstation.

(iv) Network interface card (NIC): *A*s discussed earlier, every device connected to a LAN needs a Network interface card(NIC) to plug into the LAN. For example, a PC may have an Ethernet card installed in it to connect to an Ethernet LAN.

(v) Network Cabling **-** Once the server, workstations and network interface cards are in place, network cabling is used to connect everything together. The most popular type of network cable is the shielded twisted-pair, co-axial and fiber optic cables.

3.8.7 Wireless LAN (WLAN)

Wireless networks do not require any physical media or cables for data transmission. Radio waves and Infrared signals are used for communication. Radio waves are most commonly used transmission media in the wireless Local Area Networks.

A wireless local area network (LAN) is a flexible data communications system implemented as an extension to a wired LAN as shown in fig 3.8.7.1. Using radio frequency (RF) technology, wireless LANs transmit and receive data over the air, minimizing the need for wired connections. With wireless LANs, users can access shared information without any plug in or without any physical connection with wired infrastructure. Flexibility and mobility make wireless LANs both effective extensions and attractive alternatives to wired networks. Wireless LANs provide all the functionality of wired LANs, without the physical constraints of the wire itself. Wireless LAN configurations range from simple peer-to-peer topologies to complex networks offering distributed data connectivity and roaming.

Fig 3.8.7.1 Wireless LAN

How wireless LANs Work?

Wireless LANs use electromagnetic airwaves (radio or infrared) to communicate information from one point to another without relying on any physical connection. Radio waves are radio carriers and they simply perform the function of delivering signal to a remote receiver. The data being transmitted is superimposed on the radio carrier so that it can be accurately extracted at the receiving end.

In a typical wireless LAN configuration, a transmitter/receiver (transceiver) device, called an access point, connects to the wired network from a fixed location using standard cabling. At a minimum, the access point receives, buffers, and transmits data between the wireless LAN and the wired network infrastructure. A single access point can support a small group of users and can function within a range of less than one hundred to several hundred feet. The access point (or the antenna attached to the access point) is usually mounted high but may be mounted essentially anywhere that is practical as long as the desired radio coverage is obtained. End users access the wireless LAN through wireless-LAN adapters, which are implemented as PC cards in notebook or palmtop computers, as cards in desktop computers, or integrated within hand-held computers. Wireless LAN adapters provide an interface between the client network operating system (NOS) and the airwaves via an antenna.

3.9 CLIENT / SERVER TECHNOLOGY

Recently, many organizations have been adopting a form of distributed processing called client / server computing. It can be defined as " a form of shared, or distributed, computing in which tasks and computing power are split between servers and clients (usually workstations or personal computers) Servers store and process data common to users across the enterprise, these data can then be accessed by client system. In this section we will discuss various aspects of client/server technology. But before that, let first look at the characteristics of the traditional computing models and various limitations that led to the client/ server computing.

3.9.1 Limitation of the traditional computing models

(i) Mainframe architecture*:* With mainframe software architectures, all intelligence is within the central host computer (processor) Users interact with the host through a dump terminal that captures keystrokes and sends that information to the host. Centralized host-based computing models allow many users to share a single computer's applications, databases, and peripherals. Mainframe software architectures are not tied to a hardware platform. User interaction can be done using PCs and UNIX workstations.

A limitation of mainframe software architectures is that they do not easily support graphical user interfaces or access to multiple databases from geographically dispersed sites. They cost literally thousands of times more than PCs, but they sure don't do thousands of times more work.

(ii) Personal Computers*:* With introduction of the PC and its operating system, independent-computing workstations quickly became common. Disconnected, independent personal computing models allow processing loads to be removed from a central computer. Besides not being able to share data, disconnected personal workstation users cannot share expensive resources that mainframe system users can share: disk drives, printers, modems, and other peripheral computing devices. The data (and peripheral) sharing problems of independent PCs and workstations, quickly led to the birth of the network/file server computing model, which links PCs and workstations together in a Local Area Network-LAN, so they can share data and peripherals.

(iii) File sharing architecture*:* The original PC networks were based on file sharing architectures, where the server downloads files from the shared location to the desktop environment. The requested user job is then run in the desktop environment.

The traditional file server architecture has many disadvantages especially with the advent of less expensive but more powerful computer hardware. The server directs the data while the workstation processes the directed data. Essentially this is a dumb server-smart workstation relationship. The server will send the entire file over the network even though the workstation only requires a few records in the file to satisfy the information request. In addition, an easy to use graphic user interface (GUI) added to this model simply adds to the network traffic, decreasing response time and limiting customer service.

Unfortunately two defects limit a file server for multi-user applications.

- The file server model does not support data concurrence (simultaneous access to a single data set by multiple user) that is required by multi-user applications.
- If many workstations request and send many files in a LAN, the network can quickly become flooded with traffic, creating a block that degrades overall system performance. (It can only satisfy about 12 users simultaneously)

3.9.2 Need for Client Server Model: Client server technology, on the other hand, intelligently divides the processing work between the server and the workstation. The server handles all the global tasks while the workstation handles all the local tasks. The server only sends those records to the workstation that are needed to satisfy the information request. Network traffic is significantly reduced. The result of this system is that is fast, secure, reliable, efficient, inexpensive, and easy to use.

3.9.3 What is Client/Server? :Client/Server (C/S) refers to computing technologies in which the hardware and software components (i.e., clients and servers) are distributed across a network. The client/server software architecture is a versatile, message-based and modular infrastructure that is intended to improve usability, flexibility, interoperability, and scalability as compared to centralized, mainframe, time sharing computing. This technology includes both the traditional database-oriented C/S technology, as well as more recent general distributed computing technologies. The use of LANs has made the client/server model even more attractive to organizations.

3.9.4 Why Change to Client/Server Computing : Client/server is described as a `cost-reduction' technology. This technology allows doing what one may be currently doing with computers much less expensively. These technologies include client/server computing, open systems, fourth generation languages, and relational databases. Cost reductions are usually quoted as the chief reasons for changing to client/server. However, the list of reasons has grown to include improved control, increased data integrity and security, increased performance, and better connectivity. The key business issues dividing adoption are:

- Improving the Flow of Management Information
- Better Service to End-User Departments.
- Lowering IT costs
- The ability to manage IT costs better
- Direct access to required data
- High flexibility of information processing
- Direct control of the operating system

Client/ server has been defined as "the provision of information that is required by a user, which is easily accessed despite the physical location of the data within the organization.

3.9.5 Implementation examples of client / server technology:

- Online banking application
- Internal call centre application
- Applications for end-users that are stored in the server
- E-commerce online shopping page
- Intranet applications
- Financial, Inventory applications based on the client Server technology.
- Tele communication based on Internet technologies

3.9.6 Benefits of the Client /Server Technology

Client/server systems have been hailed as bringing tremendous benefits to the new user, especially the users of mainframe systems. Consequently, many businesses are currently in the process of changing or in the near future will change from mainframe (or PC) to client / server systems. Client / Server has become the IT solution of choice among the country's largest corporations. In fact, the whole transition process, that a change to a client/ server invokes, can benefit a company's long run strategy.

- People in the field of information systems can use client/server computing to make their jobs easier.
- Reduce the total cost of ownership.
- Increased Productivity
- End user productivity
- Developer productivity
- Takes less people to maintain a client/server application than a mainframe
- The expenses of hardware and network in the client/server environment are less than those in the mainframe environment
- Users are more productive today because they have easy access to data and because applications can be divided among many different users so efficiency is at its highest.
- Client/server applications make organizations more effective by allowing them to port applications simply and efficiently.

- Reduce the cost of the client's computer: the server stores data for the clients rather than clients needing large amounts of disk space. Therefore, the less expensive network computers can be used instead.
- Reduce the cost of purchasing, installing, and upgrading software programs and applications on each client's machine: delivery and maintenance would be from one central point, the server.
- The management control over the organization would be increased.
- Many times easier to implement client/server than change a legacy application.
- Leads to new technology and the move to rapid application development such as object oriented technology.
- Long term cost benefits for development and support.
- Easy to add new hardware to support new systems such as document imaging and video teleconferencing which would not be feasible or cost efficient in a mainframe environment.
- Can implement multiple vendor software tools for each application.

3.9.7 Characteristics of Client / Server Technology

There are ten characteristics that reflect the key features of a client / server system. These ten characteristics are as follows:

1. Client/server architecture consists of a client process and a server process that can be distinguished from each other.
2. The client portion and the server portions can operate on separate computer platforms.
3. Either the client platform or the server platform can be upgraded without having to upgrade the other platform.
4. The server is able to service multiple clients concurrently; in some client/server systems, clients can access multiple servers.
5. The client/server system includes some sort of networking capability.
6. A significant portion of the application logic resides at the client end.
7. Action is usually initiated at the client end, not the server end.
8. A user-friendly graphical user interface (GUI) generally resides at the client end.
9. A structured query language (SQL) capability is characteristic of the majority of client/ server systems.
10. The database server should provide data protection and security.

3.9.8 Components of Client Server architecture

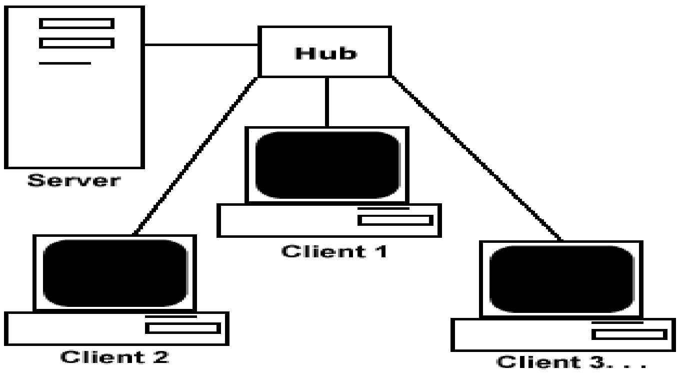


Fig 3.9.8.1 Client/Server Components

Client: As shown in Fig 3.9.8.1, Clients, which are typically PCs, are the "users" of the services offered by the servers described above. There are basically three types of clients. Non-Graphical User Interface (GUI) clients require a minimum amount of human interaction; non-GUIs include ATMs, cell phones, fax machines, and robots. Second, GUI-Clients are human interaction models usually involving object/action models like the pull-down menus in Windows 3-X. Object-Oriented User Interface (OOUI) Clients take GUI-Clients even further with expanded visual formats, multiple workplaces, and object interaction rather than application interaction. Windows 95 is a common OOUI Client.

Server: Servers await requests from the client and regulate access to shared resources. File servers make it possible to share files across a network by maintaining a shared library of documents, data, and images. Database servers one their processing power to executed Structured Query Language (SQL) requests from clients. Transaction servers execute a series of SQL commands, an online transaction-processing program (OLTP), as opposed to database servers, which respond to a single client command. Web servers allow clients and servers to communicate with a universal language called HTTP.

Middleware: The network system implemented within the client/server technology is commonly called by the computer industry as middleware. Middleware is all the distributed software needed to allow clients and servers to interact. General middleware allows for communication, directory services, queuing, distributed file sharing, and printing. Service-specific software like ODBC. The middleware is typically composed of four layers, which are Service, Back-end Processing, Network Operating System, and Transport Stacks. The Service layer carries coded instructions and data from software applications to the Back-end Processing layer for encapsulating network-routing instructions. Next, the

Network Operating System adds additional instructions to ensure that the Transport layer transfers data packets to its designated receiver efficiently and correctly. During the early stage of middleware development, the transfer method was both slow and unreliable.

Fat-client or Fat-server: Fat-client or fat-server are popular terms in computer literature. These terms serve as vivid descriptions of the type of client/server systems in place. In a fat-client system, more of the processing takes place on the client, like with a file server or database server. Fat-servers place more emphasis on the server and try to minimize the processing done by clients. Examples of fat-servers are transaction, GroupWare, and web servers. It is also common to hear fat-clients referred to as “2-Tier” systems and fat-servers referred to as “3-Tier” systems.

Network: The network hardware is the cabling, the communication cords, and the device that link the server and the clients. The communication and data flow over the network is managed and maintained by network software. Network technology is not well understood by business people and end users, since it involves wiring in the wall and function boxes that are usually in a closet.

3.10 VIRTUAL PRIVATE NETWORK(VPN)

A VPN is a private network that uses a public network (usually the Internet) to connect remote sites or users together. Instead of using a dedicated, real-world connection such as leased line, a VPN uses "virtual" connections routed through the Internet from the company's private network to the remote site or employee. There are two common types of VPN.

(a) Remote-access, also called a **virtual private dial-up network** (**VPDN**), is a user-to-LAN connection used by a company that has employees who need to connect to the private network from various remote locations. Typically, a corporation that wishes to set up a large remote-access VPN will outsource to an **enterprise service provider** (**ESP**) The ESP sets up a **network access server** (**NAS**) and provides the remote users with desktop client software for their computers. The telecommuters can then dial a toll-free number to reach the NAS and use their VPN client software to access the corporate network.

A good example of a company that needs a remote-access VPN would be a large firm with hundreds of sales people in the field. Remote-access VPNs permit secure, encrypted connections between a company's private network and remote users through a third-party service provider.

(b) Site-to-Site VPN : Through the use of dedicated equipment and large-scale encryption, a company can connect multiple fixed sites over a public network such as the Internet. Site-to-site VPNs can be one of two types:

- **Intranet-based** - If a company has one or more remote locations that they wish to join in a single private network, they can create an intranet VPN to connect LAN to LAN.
- **Extranet-based** - When a company has a close relationship with another company (for example, a partner, supplier or customer), they can build an extranet VPN that connects LAN to LAN, and that allows all of the various companies to work in a shared environment. Different examples of VPN are shown in Fig 3.10.1

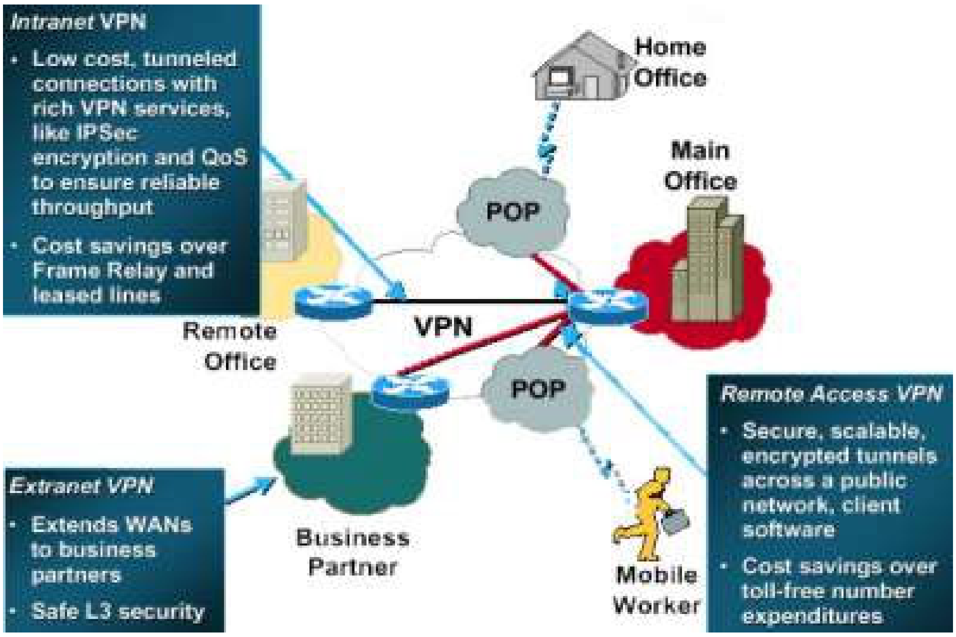


Fig 3.10.1 : Examples of VPN

3.11 BROAD BAND NETWORKS (ISDN):

Integrated Services Digital Network (ISDN) is a system of digital phone connections to allow simultaneous voice and data transmission across the world. Such voice and data are carried by bearer channels (B channels) having a bandwidth of 64 kilobits per second. A data channel can carry signals at 16kbps or 64kbps, depending on the nature of service provided. There are two types of ISDN service – Basic Rate Interface (BRI) and Primary Rate Interface (PRI) BRI consists of two 64 kbps B channels and one 16kbps D channel for a total of 144kbps and is suitable for individual users. PRI consists of twenty three B channels and one 64kbps D channel for a total of 1536kbps and is suitable for users with higher capacity requirements. It is possible to support multiple primary PRI lines with one 64kbps D channel using Non Facility Associated Signaling (NFAS)

***Advantages*:**

(i) ISDN allows multiple digital channels to be operated simultaneously through the same regular phone cable meant for analog signals. However, that is possible if the telephone company's switches can support digital connections. The digital scheme permits a much higher data transfer rate than analog lines. BRI ISDN, after using a channel aggregation protocol like 'Bonding' or Multilink-PPP can support a clear text data transfer at a speed of 128kbps apart from bandwidth for overhead and signaling. Besides, the amount of time it takes for a communication to start up or the latency time period is about half of that of an analog line.

(ii) With ISDN it is possible to combine many different digital data sources and have the information routed to the proper destination. In a digital line it is easier to keep noise and interference out even after combining these signals.

(iii) The phone company sends a ring voltage signal to ring the bell which is an In Band signal. However ISDN sends a digital packet on a separate channel which is an Out Band signal without disturbing the established connections, without taking any bandwidth from data channels and setting up call much faster. The signaling also indicates who is calling, whether it is a data or voice and what number was dialed. Then the ISDN phone equipment makes intelligent decisions on how to direct the call.

(iv) Usually the telephone company provides the BRI customers with a U interface which is nothing but a single pair of twisted wire from the phone switch just like the same interface provided for the telephone lines. It can transmit full duplex data and therefore only a single device can be connected with a U interface, which is known as Network Termination 1

3.12 TYPES OF SERVERS

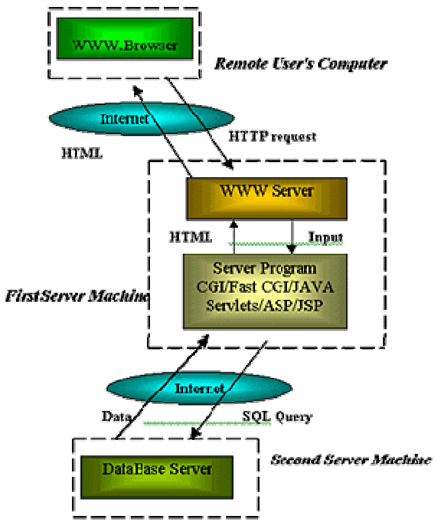
3.12.1 Database Servers: Database management systems (DBMS) can be divided into three primary components: development tools, user interface, and database engine. The database engine does all the selecting, sorting, and updating. Currently, most DBMS combine the interface and engine on each user's computer. Database servers split these two functions, allowing the user interface software to run on each user's PC (the client), and running the database engine in a separate machine (the database server) shared by all users. This approach can increase database performance as well as overall LAN performance because only selected records are transmitted to the user's PC, not large blocks of files. However, because the database engine must handle multiple requests, the database server itself can become a bottleneck when a large number of requests are pending.

Database servers offer real potential for remote database access and distributed databases. Because the database server only returns selected database record(s) to the client machine (instead of large blocks of data), remote access over relatively slow telephone lines can provide acceptable performance. In addition, a client computer can make requests of multiple servers regardless of physical location.

A database server is a computer program that provides database services to other computer programs or computers, as defined by the client-server model. The term may also refer to a computer dedicated to running such a program. Database management systems frequently provide database server functionality, and some DBMS's (e.g., MySQL) rely exclusively on the client-server model for database access.

In a master-slave model, database master servers are central and primary locations of data while database slave servers are synchronized backups of the master acting as proxies.

3.12.2 Application Servers : An application server is a server program that resides in the server (computer) and provides the business logic for the application program. The server can be a part of the network, more precisely the part of the distributed network. The server program is a program that provides its services to the client program that resides either in the same computer or on another computer connected through the network.



Application servers are mainly used in Web-based applications that have a 3-tier architecture.

- First Tier: Front End - Browser (Thin Client) - a GUI interface lying at the client/workstation.
- Second Tier: Middle Tier - Application Server - set of application programs
- Third Tier: Back End - Database Server.

The application server is a second/middle tier of the three-tier architecture. In other words, application servers are now an integral part of the three-tier architecture.

Fig 3.12.2.1 Application Server

The application server syncs and combines with the Web server for processing the request made by the client. (as shown in fig 3.12.2.1).

If we look at the request-response flow between client, Web server and application server, we come to know that the client's request first goes to the Web server, which then sends the required information to the application server. It then sends the response back to the Web server after taking an appropriate action. The Web server then sends the processed information back to the client. Web servers use different approaches or technology for forwarding or receiving back processed information. Some of the most common approaches are given below.

CGI (Common Gateway Interface)	:	Can be written either in JAVA, C, C++, or Perl.
ASP (Active Server Pages)	:	A Microsoft Technology
JSP (Java Server Pages)	:	Java Servlets - Sun's Technology
Java Script (Server Side)	:	NetScape Technology requires livewire for database connectivity.

Features of the Application Servers

Component Management: Provides the manager with tools for handling all the components and runtime services like session management, and synchronous/asynchronous client notifications, as well as executing server business logic.

Fault Tolerance: Ability of the application server with no single point of failure, defining policies for recovery and fail-over recovery in case of failure of one object or group of objects.

Load Balancing: Capability to send the request to different servers depending on the load and availability of the server.

Transaction Management.

Management Console: Single point graphical management console for remotely monitoring clients and server clusters.

Security: There are Security features for applications security

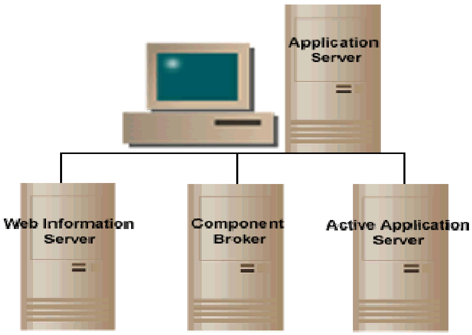


Fig 3.12.2.2 Categories of Application Server

Application servers are mainly categorized into three types: (As shown in fig 3.12.2.2)

Web Information Servers: This type of server employs HTML templates and scripts to generate pages incorporating values from the database in them. These types of servers are stateless servers. Such servers include Netscape Server, HAHT, Allaire, Sybase, and SilverStream.

Component Servers: The main purpose of these servers is to provide database access and transaction processing services to software components including DLLs, CORBA, and JavaBeans. First, they provide environment for server-side components. Second, they provide access to database and other services to the component. These types of servers are stateless. Examples include MTS (which provides an interface for DLL), Sybase Jaguar, and IBM Component broker.

Active Application Server: This type of server supports and provides a rich environment for server-side logic expressed as objects, rules and components. These types of servers are most suitable for dealing with based e-commerce and decision processing.

3.12.3 Print Servers: Print servers provide shared access to printers. Most LAN operating systems provide print service. Print service can run on a file server or on one or more separate print server machines. Non-file server print servers can be dedicated to the task of print service, or they can be non-dedicated workstations.

The disadvantages of using workstations as print servers are similar to the disadvantages of using file servers as workstations. The workstation may run a little slower when print services are being used, a user could shut down the server without warning, or an application could lock up the server. The consequences of a lock-up or shut-down on a print server, however, are usually less severe than the consequences of locking up a file server. The time involved in dealing with these problems, however. can be costly.

3.12.4 Transaction Servers: MTS or Microsoft Transaction Server is an integral part of Windows NT, and is installed by default as part of the operating system in NT5. It is a **service** in much the same way as Internet Information Server or the File and Print services that we now take for granted. In other words, it is part of the system that is available in the background whenever one of our applications requires it.

Control and configuration of MTS is via either a snap-in to the Microsoft Management Console, or through the HTML administration pages that are included with MTS. This is very similar to the interface provided for Internet Information Server 4, and gives an integrated management function that is useful when building and setting up distributed applications.

What Does Transaction Server Do? To understand what MTS is and what it does, we need to first make one very important point clear. This software should really have been named Microsoft **Component** Server, not Microsoft Transaction Server. MTS is all about managing the way applications use components, and not just about managing transactions. Yes, transactions are a big part of many applications we write and MTS can help to manage these—but MTS also provides a very useful service for applications that don't use transactions at all. To be able to define MTS accurately, we first need to understand what goes on inside it in the most basic way.

3.12.5 Types of Internet Servers

File server: A file server, one of the simplest servers, manages requests from clients for files stored on the server's local disk. A central file server permits groups and users to share and access data in multiple ways. Central file servers are backed up regularly and administrators may implement disk space quotas for each user or group of users.
For example: Using a certain software client, PC users are able to "mount" remote UNIX server file systems. As a result, the remote network file system appears to be a local hard drive on the user's PC.

Mail server: A mail server is the most efficient way to receive and store electronic mail messages for a community of users. A central mail server runs 24 hours a day. The mail server can also provide a global email directory for all community and school users, as well as email gateway and relay services for all other mail servers in the district. In such a scenario, user email boxes would be maintained on a separate email server located at each school

Example: "Eudora" is a powerful cross-platform email client that receives incoming mail messages from and sends outgoing mail messages to a mail server.

DNS server: Domain Name Service is an Internet-wide distributed database system that documents and distributes network-specific information, such as the associated IP address for a host name, and vice versa. The host that stores this database is a name server. The library routines that query the name server, interpret the response and return the information to the program that requested it are resolvers.

For example: To determine the location of a remote computer on the Internet, communications software applications (such as NCSA Telnet) use resolver library routines to query DNS for the remote computer's IP address.

Gopher server: Gopher is an Internet application that uses multiple Gopher servers to locate images, applications, and files stored on various servers on the Internet. Gopher offers menu choices to prompt users for information that interests them, and then establishes the necessary network connections to obtain the resource. For example, "Veronica" is a Gopher application that searches databases of the file contents of worldwide Gopher servers to help locate Gopher resources.

Web server: The World Wide Web (WWW) is a very popular Internet source of information. Web browsers present information to the user in hypertext format. When the user selects a word or phrase that a Web page's author has established as a hypertext link, the Web browser queries another Web server or file to move to another Web page related to the link. For example, "Netscape" is a Web browser which queries Web servers on the Internet. Which Web server Netscape queries depends upon which hypertext link the user selects.

FTP server: File Transfer Protocol (FTP) is an Internet-wide standard for distribution of files from one computer to another. The computer that stores files and makes them available to others is server. Client software is used to retrieve the files from the server. The two most common way to transfer files are with anonymous FTP, where anyone can retrieve files from or place files on a specific site, and logged file transfers, where an individual must login into the FTP server with an ID and password.

For example, Merit Network, Inc. makes network configuration files such as Domain Name Registration templates available for anonymous FTP on ftp.merit.edu

News server: Usenet News is a world wide discussion system consisting of thousands of newsgroups organized into hierarchies by subject. Users read and post articles to these newsgroups using client software. The "news" is held for distribution and access on the news server. Because newsgroups tend to generate large amounts of Internet traffic, you may wish to consider the method in which we intend to receive Usenet news.

There are two ways to accept Usenet News: as a "push" or "pull" feed. With a "push" feed, news articles are "pushed" onto our news server, whether or not our users read those articles. With a "pull" feed, our news server has all of the headers for the collection of Usenet News articles, but does not retrieve the article itself unless it is specifically requested by a user.

For example, the newsgroup "k12.ed.comp.literacy" contains a discussion of topics dealing with Computer Literacy in K12 schools.

Chat server: Some organizations choose to run a server that will allow multiple users to have "real-time" discussions, called "chats" on the Internet. Some chat groups are moderated; most however are unmoderated public discussions. Further, most chat servers allow the creation of "private" chat rooms where participants can "meet" for private discussions. we can participate in chats on other servers without running a chat server yourself.

The popularity of chat rooms has grown dramatically over the past few years on the Internet, however, the ability to talk in small groups on the Internet is not new. "Chat" is a graphical form of an Internet service called IRC, or Internet Relay Chat. IRC was a replacement for a UNIX command called "talk." Using talk, and even IRC can be cumbersome. Chat clients, on the other hand, are available for all platforms and are graphical in nature, opening up their utility to the majority of Internet users.

Example:

http://chat.redding.net/about.htm
http://www.chatspace.com/products/small.htm

Caching server: A caching server is employed when you want to restrict your number of accesses to the Internet. There are many reasons to consider doing this. Basically, a caching server sits between the client computer and the server that would normally fulfill a client's request. Once the client's request is sent, it is intercepted by the caching server. The caching server maintains a library of files that have been requested in the recent past by users on the network. If the caching server has the requested information in its cache, the server returns the information without going out to the Internet.

Storing often-used information locally is a good way to reduce overall traffic to and from the Internet. A caching server does not restrict information flow. Instead, it makes a copy of requested information, so that frequently requested items can be served locally, instead of from the original Internet source. Caching servers can also be connected in a hierarchy so if the local cache does not have the information, it can pass the request to nearby caching servers that might also contain the desired files.

Proxy server: A proxy server is designed to restrict access to information on the Internet. If, for example, we do not want your users to have access to pornographic materials, a proxy server can be configured to refuse to pass the request along to the intended Internet server.

A proxy server operates on a list of rules given to it by a System Administrator. Some proxy software uses list of specific forbidden sites, while other proxy software examines the content of a page before it is served to the requester. If certain keywords are found in the requested page, access to it is denied by the proxy server.

Technologically, there's no substantial difference between a caching server and a proxy server. The difference comes in the desired outcome of such a server's use.

If we wish to reduce the overall amount of traffic exchanged between our network and the Internet, a caching server may be our best bet. On the other hand, if we wish to restrict or prohibit the flow of certain types of information to our network, a proxy server will allow us to do that. There are several different packages that will allow a System Administrator to set up a caching or proxy server. Additionally, we can buy any of a number of turn-key solutions to provide these services.

3.13 DIFFERENT TIER ARCHITECTURES

The Tier : A tier is a distinct part of hardware or software.

The most common tier systems are:

3.13.1 Single Tier: A single computer that contains a *database* and a *front end* to access the database. Generally, this type of system is used in small businesses. There is one computer which stores all of the company's data on a single database. The interface used to interact with the database may be part of the database or another program which ties into the database itself.

Advantages: A single-tier system requires only one stand-alone computer. It also requires only one installation of proprietary software which makes it the most cost-effective system available.

Disadvantages:

Can be used by only one user at a time. A single tier system is impractical for an organization which requires two pr more users to interact with the organizational data stores at the same time.

3.13.2 Two Tier systems: A two-tier system consists of a client an a server. The database is stored on the server, and the interface used to access the database is installed on the client.

The user system interface is usually located in the user's desktop environment and the database management services are usually in a server that is more powerful machine that services many clients. Processing management is split between the user system interface environment and the database management server environment, The database management server provides stored procedures and triggers.

Purpose and Origin: Two –tier architectures were developed in the 1980s from the file server software architecture design.

The two-tier architecture is intended to improve usability by supporting a forms-based, user-friendly interface.

The two-tier architecture improves scalability by accommodating upto approx 100 users and improves flexibility by allowing data to be shared, usually within a heterogeneous environment.

The two-tier architecture requires minimal operator intervention, and is frequently used in non-complex, non-time critical information processing systems.

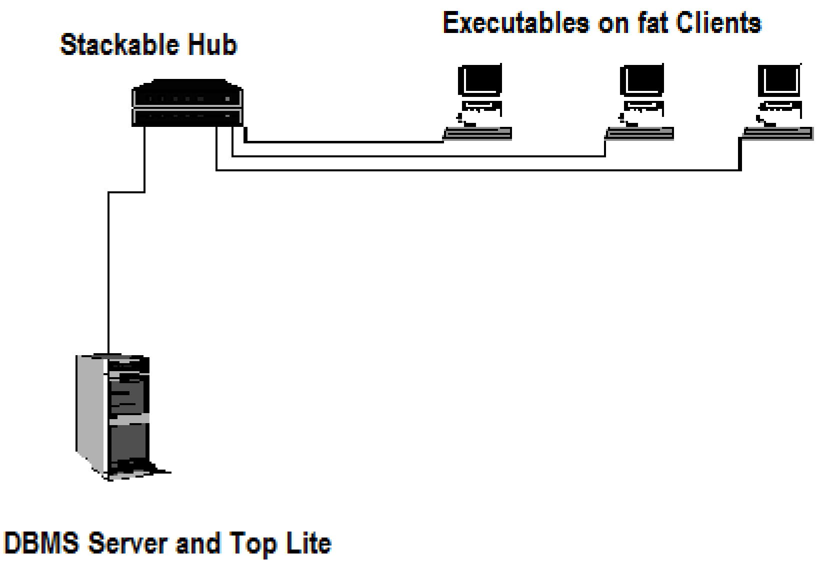


Fig 3.13.2.1 Two-Tier Architecture

Technical Details:

Two-tier architecture : A two tier application or architecture is a client server application where the processing load can fall either on the server or on the client. When the processing load falls on the client then the server simply acts as a controller between the data and the client. Such a client is called as a **fat client** and imposes a lot of memory and bandwidth on the clients machine. Thus in this type of architecture the business logic and the presentation layer is located on the client machine and the data layer is on the server machine. If the number of clients connecting to the sever are many then the server will be overloaded and this will make processing each client request very slow the data and presents it in a readable format to the student.

Two-tier architecture consists of three components distributed in two layers: Client(Requester of Services) and Server (Provider of Services). The three components are

1. User system interface (such as session, text input, dialog, and display management services)
2. Processing Management (such as process development, process enactment, process monitoring, and process resource services)
3. Database /Management (such as data and file services)

The two tier design allocates the user system interface exclusively to the client. It places database management of the server and splits the processing management between client and server, creating two layers.

The 2-tier architecture is extensively used in non-time critical information processing where management and operations of the systems are not complex. This design is used frequently in Decision Support system where the transaction load is light, 2-tier software architectures require minimal operator intervention.

Advantages:

Since processing was shared between the client and server, more users could interact with system.

Disadvantages:

- Performance deteriorates if number of users is greater than 100.
- Restricted flexibility and choice of DBMS, since data language used in server is proprietary to each vendor.
- Limited functionality in moving program functionality across servers.

3.13.3 Three Tier

The three-tier architecture emerged in 1990s to overcome the limitations of the two-tier architecture. The third tier architecture (middle tier server) is between the user interface (client) and the data management (server) components. This middle tier provides process management where business logic and rules are executed and can accommodate hundreds of users (as compared to only 100 users with the tow-tier architecture) by providing functions such as queuing, application execution, and database staging. The three tier architecture is used when an effective distributed client/server design is needed that provides (when compared to the two-tier) increased performance, flexibility, maintainability, reusability ad scalability, while holding the complexity of distributed processing from the user.

A three tier distributed client/server architecture (as shown in Fig 28) includes a user system interface top tier where user services (such as session, text input, dialog, and display management) reside.

The third tier provides database management functionality and is dedicated to data and file services that can be optimized without using any proprietary database management.

Why 3-tier?

Unfortunately the 2-tier model shows striking weaknesses, that make the development and maintenance of such applications much more expensive.

The complete development accumulates on the PC. The PC processes and presents information which leads to monolithic applications that are expensive to maintain.

In a 2-tier architecture, business-logic is implemented on the PC. Even the business-logic never makes direct use of the windowing-system, programmers have to be trained for the complex API under Windows.

Windows 3.X and Mac-systems have tough resource restrictions. For this reason applications programmers also have to be well trained in systems technology, so that they can optimize scarce resources.

The 2-tier-model implies a complicated software-distribution-procedure: as all of the application logic is executed on the PC, all those machines (maybe thousands) have to be updated in case of a new release. This can be very expensive, complicated, prone to error and time consuming. Distribution procedures include the distribution over networks (perhaps of large files) or the production of an adequate media like floppies or CDs. Once it arrives at the user's desk, the software first has to be installed and tested for correct execution. Due to the distributed character of such an update procedure, system management cannot guarantee that all clients work on the correct copy of the program.

3- and n-tier architectures endeavor to solve these problems. This goal is achieved primarily by moving the application logic from the client back to the server.

The fig 3.13.3.1 shows a simplified form of reference-architecture, though in principal, all possibilities are illustrated.

Client-tier: It is responsible for the presentation of data, receiving user events and controlling the user interface. The actual business logic (e.g. calculating added value tax) has been moved to an application-server. Today, Java-applets offer an alternative to traditionally written PC-applications. See our Internet-page for further information.

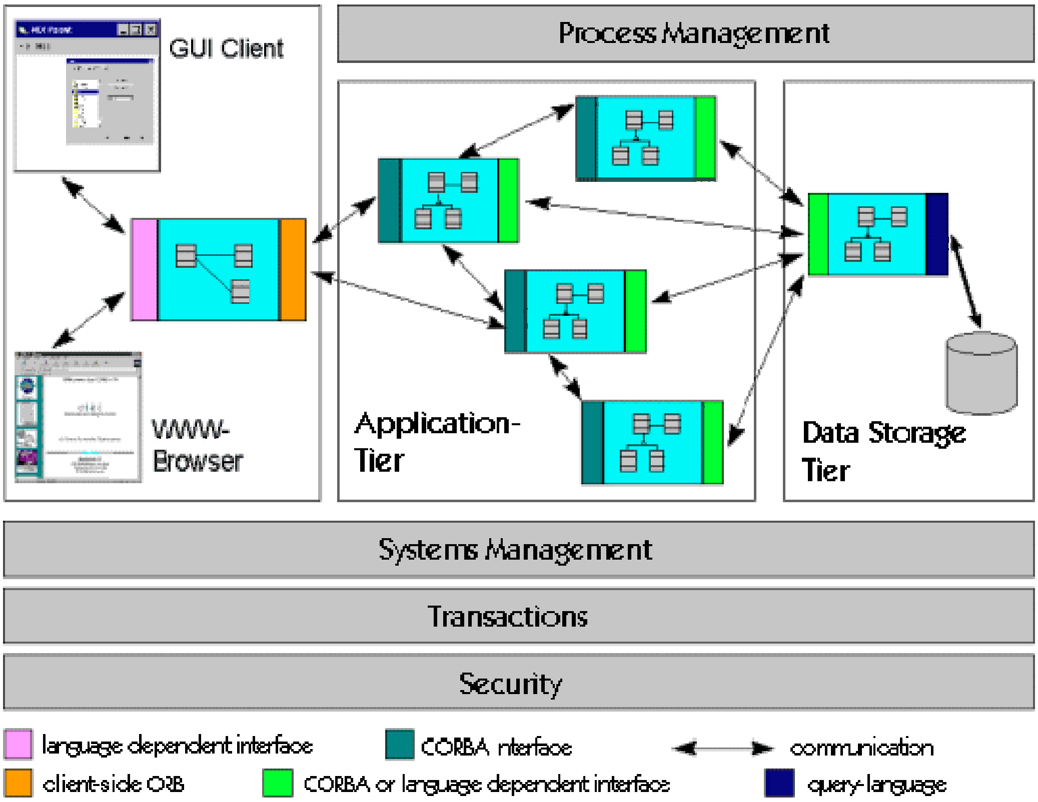


Fig 3.13.3.1 Reference Architecture

Application-server-tier: This tier is new, i.e. it isn't present in 2-tier architecture in this explicit form. Business-objects that implement the business rules "live" here, and are available to the client-tier. This level now forms the central key to solving 2-tier problems. This tier protects the data from direct access by the clients.

The object oriented analysis "OOA", on which many books have been written, aims in this tier: to record and abstract business processes in business-objects. This way it is possible to map out the applications-server-tier directly from the CASE-tools that support OOA.

Furthermore, the term "component" is also to be found here. Today the term predominantly describes visual components on the client-side. In the non-visual area of the system, components on the server-side can be defined as configurable objects, which can be put together to form new application processes.

Data-server-tier: This tier is responsible for data storage. Besides the widespread relational database systems, existing legacy systems databases are often reused here.

It is important to note that boundaries between tiers are logical. It is quite easily possible to run all three tiers on one and the same (physical) machine. The main importance is that the system is neatly structured, and that there is a well planned definition of the software boundaries between the different tiers.

The advantages of 3-tier architecture: As previously mentioned 3-tier architecture solves a number of problems that are inherent to 2-tier architectures. Naturally it also causes new problems, but these are outweighed by the advantages.

Clear separation of user-interface-control and data presentation from application-logic*:* Through this separation more clients are able to have access to a wide variety of server applications. The two main advantages for client-applications are clear: quicker development through the reuse of pre-built business-logic components and a shorter test phase, because the server-components have already been tested.

Dynamic load balancing*:* If bottlenecks in terms of performance occur, the server process can be moved to other servers at runtime.

Change management*:* Of course it's easy - and faster - to exchange a component on the server than to furnish numerous PCs with new program versions. To come back to our VAT example: it is quite easy to run the new version of a tax-object in such a way that the clients automatically work with the version from the exact date that it has to be run. It is, however, compulsory that interfaces remain stable and that old client versions are still compatible. In addition such components require a high standard of quality control. This is because low quality components can, at worst, endanger the functions of a whole set of client applications. At best, they will still irritate the systems operator.

3.13.4 Multi-tier

Multi-tier architecture (often referred to as n-tier architecture) is a client-server architecture in which an application is executed by more than one distinct software agent. For example, an application that uses middleware to service data requests between a user and a database employs multi-tier architecture. The most widespread use of "multi-tier architecture" refers to three-tier architecture

Multi-tier is shown below in fig 3.13.4.1

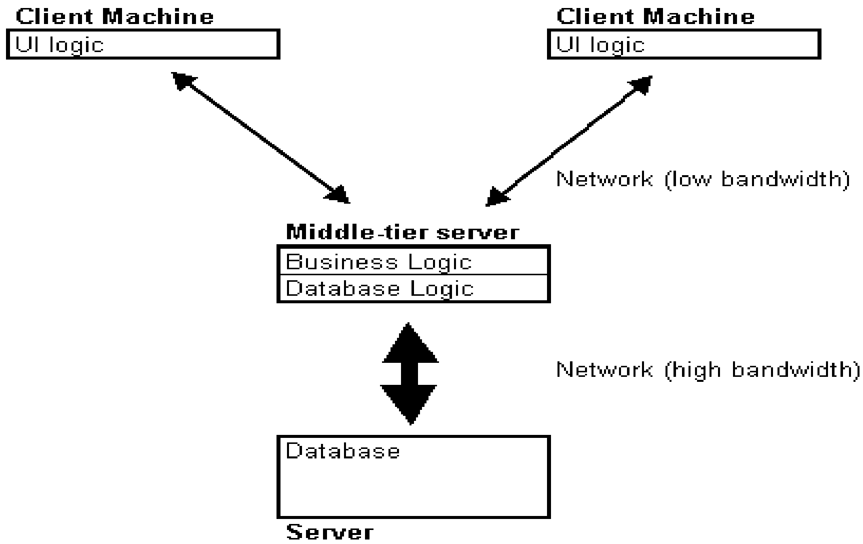


Fig 3.13.4.1 Multitier Architecture

The client program has only UI code. The UI code talks, via a network, to the "middle tier" on which the business and database logic sits. In turn the middle tier talks, via a network, to the database. In practice the middle tier can be placed, if necessary, on the same machine as the database.

In either architecture the data "traffic" is highest between database logic and database server (illustrated by a thicker arrow) This means that the network infrastructure that connects the database logic with the database server needs to be very high bandwidth; i.e. expensive. With a traditional client/server architecture it is easy to create a scenario where no existing network technology would be enough to cope.

The advantages of a multi-tier architecture are:

- Forced separation of UI and business logic.
- Low bandwidth network.
- Business logic sits on a small number (maybe just one) of centralized machines.
- Enforced separation of UI and business logic.

3.14 WHAT IS A DATA CENTRE ?

A data center is a centralized repository for the storage, management and dissemination of data and information. Data centers can be defined as highly secure, fault-resistant facilities, hosting customer equipment that connects to telecommunications networks. Often referred to as an Internet hotel/ server farm, data farm, data warehouse, corporate data center, Internet service provide(ISP) or wireless application service provider (WASP), the purpose of a data center is to provide space and bandwidth connectivity for servers in a reliable, secure and scaleable environment. These data centers are also referred to as public data centers because they are open to customers. Captive, or enterprise data centers, are usually reserved for the sole and exclusive use of the parent company, but essentially serve the same purpose. These facilities can accommodate thousands of servers, switches, routers and racks, storage arrays and other associated telecom equipment.

A data center also provides certain facilities, like housing websites, providing data serving and other services for companies. This kind of data center may contain a network operations center (NOC), which is a restricted access area containing automated systems that constantly monitor server activity, Web traffic, network performance and report even slight irregularities to engineers, so that they can spot potential problems before they happen. They primary 'goal' of a data center is to deploy the requisite state-of-the-art redundant infrastructure and systems so as to maximize availability and prevent or mitigate any potential downtime for customers.

3.14.1 Types and Tiers : According to the varied computing needs of the businesses they serve, data centers fall into following two main categories:

(i) Private Data Centre: A private data center (also called enterprise data centers) is managed by the organization's own IT department, and it provides the applications, storage, web-hosting, and e-business functions needed to maintain full operations. If an organization prefers to outsource these IT functions, then it turns to a public data center.

(ii) Public data centers: A public data center (also called internet data centers) provide services ranging from equipment colocation to managed web-hosting. Clients typically access their data and applications via the internet.

Typically, **data centers can be classified in tiers**, with tier 1 being the most basic and inexpensive, and tier 4 being the most robust and costly. The more 'mission critical' an application is, the more redundancy, robustness and security are required for the data center. A **tier 1 data center** does not necessarily need to have redundant power and cooling infrastructures. It only needs a lock for security and can tolerate upto 28.8 hours of downtime per year.

In contrast, a **tier 4 data center** must have redundant systems for power and cooling, with multiple distribution paths that are active and fault tolerant. Further, access should be controlled with biometric reader and single person entryways; gaseous fire suppression is required; the cabling infrastructure should have a redundant backbone; and the facility must permit no more than 0.4 hours of downtime per year.

Tier 1 or 2 is usually sufficient for enterprise data centers that primarily serve users within a corporation. Financial data centers are typically tier 3 or 4 because they are critical to our economic stability and, therefore must meet the higher standards set by the government. Public data centers that provide disaster recovery/backup services are also built to higher standards.

3.14.2 Which sectors use them? : Any large volume of data that needs to be centralized, monitored and managed centrally needs a data center. Of course, a data center is not mandatory for all organizations that have embraced IT; it depends on the size and criticality of data. Data centers are extremely capital-intensive facilities. Commissioning costs run into millions of dollars, and operational costs involved in maintaining levels of redundant connectivity, hardware and human resources, can be stratospheric. The percentage of enterprises for which it makes business sense to commission and operate an enterprise data center is, consequently, extremely small. The majority of small, medium and large enterprises host their online and Web-enabled applications with established public data centers, in order to leverage the existing infrastructure services and round-the –clock support and monitoring infrastructure that is already in place. Certain sectors, like defence and banks, go in for their own infrastructure.

3.14.3 What can they do? : Some of the value added services that a data center provides are:

(i) Database monitoring:

- This is done via a database agent, which enables the high availability of the database through comprehensive automated management.

(ii) Web monitoring:

- This is to assess and monitor website performance, availability, integrity and the responsiveness from a site visitor's perspective.
- It also reports on HTTP, FTP service status, monitors URL availability and round-trip response times, and verifies Web content accuracy and changes.

(iii) Backup and restore:

- It provides centralized multi-system management capabilities.
- It is also a comprehensive integrated management solution for enterprise data storage using specialized backup agents for the operating system, database, open files and application.

(iv) Intrusion detection system (IDS): ID stands for Intrusion Detection, which is the art of detecting inappropriate, incorrect, or anomalous activity. ID systems that operate on a host to detect malicious activity on that host are called host-based ID systems, and ID systems that operate on network data flows are called network-based ID systems. Sometimes, a distinction is made between misuse and intrusion detection. The term intrusion is used to describe attacks from the outside; whereas, misuse is used to describe an attack that originates from the internal network.

- The IDS is scalable so that the system grows with the organization, from smaller networks to enterprise installation.
- It provides automated network-based security assessment and policy compliance evaluation.

(v) Storage on demand:

- It provides the back-end infrastructure as well as the expertise, best practices and proven processes so as to give a robust, easily management and cost-effective storage strategy.
- It provides data storage infrastructure that supports your ability to access information at any given moments – one that gives the security, reliability and availability needed to meet company demands.

3.14.4 Features of Data Centers

(i) Size : Data centers are characterized foremost by the size of their operations. A financially viable data center could contain from a hundred to several thousand servers. This would require a minimum area of around 5,000 to 30,000 square meters. Apart from this, the physical structure containing a data center should be able to withstand the sheer weight of the servers to be installed inside. Thus, there is a need for high quality construction.

(ii) Data Security : Another issue critical for data centers is the need to ensure maximum data security and 100 per cent availability. Data centers have to be protected against intruders by controlling access to the facility and by video surveillance. They should be able to withstand natural disasters and calamities, like fire and power failures. Recovery sites must be well maintained as it is here that everything in the data center is replicated for failure recovery.

(iii) Availability of Data : The goal of a data center is to maximize the availability of data, and to minimize potential downtime. To do this, redundancy has to be built in to all the mission critical infrastructure of the data center, such as connectivity, electrical supply, security and surveillance, air conditioning and fire suppression.

(iv) Electrical and power systems: A data center should provide the highest power availability with uninterrupted power systems (UPS)

(v) Security: Physical security and systems security are critical to operations. Thus, it should provide both types of security measures to ensure the security of equipment and data placed at the data center.

(a) Physical security: It can be achieved through

- ♦ Security guards
- ♦ Proximity card and PIN for door access
- ♦ Biometrics access and PIN for door access
- ♦ 24 x 365 CCTV surveillance and recording

(b) Data security: Data security within a data center should be addressed at multiple levels.

- Perimeter security: This is to manage both internal and external threats. This consists of firewalls, intrusion detection and content inspections; host security; anti-virus and access control and administrative tools.
- Access management: This is for both applications and operating systems that host these critical applications.

System monitoring and support

The data center should provide system monitoring and support, so that you can be assured that the servers are being monitored round the clock.

- ♦ 24x7x365 hours network monitoring
- ♦ Proactive customer notification
- ♦ Notification to customers for pre-determined events

- Monitoring of power supply, precision air conditioning system, fire and smoke detection systems, water detection systems, generators and uninterruptible power supply (UPS) systems.

For a data center to be considered world-class, there can be no shortcuts in the commissioning of the facility. Connectivity, electrical supply and security are perhaps the three paramount requirements of any data center.

Storage : Data centers offer more than just network storage solutions. While SAN (Storage) are used primarily for the storage needs of large enterprises and service providers, data centers host websites and act as convergence points for service providers' networks as well. In public data centers, cumulative data storage runs into multiple terabytes. Due to differing customer requirements, data centers usually have hybrid storage and backup infrastructure. Primarily, data center storage can be differentiated into:

- Primary storage (SAN, NAS, DAS)
- Secondary storage (tape libraries)
- Tertiary storage (offline tape storage, such as DAT drives, and magneto-optical drives)

Most data centers today operate in hands-off mode, where no individual enters the data center unless there is a genuine need to do so. All the storage is operated and managed from remote consoles, which are located outside the data centers. The same holds true for all servers and tape libraries. This reduces dust and also accidental damage by people, like tripping over cables or accidentally touching the reset buttons on a server.

3.14.5 Constituents of a Data Centre

To keep equipment running reliably, even under the worst circumstances, the data center is built with following carefully engineered support infrastructures:

- Network connectivity with various levels of physical (optical fibre and copper) and service (both last mile and international bandwidth) provider redundancy
- Dual DG sets and dual UPS
- HVAC systems for temperature control
- Fire extinguishing systems
- Physical security systems: swipe card/ biometric entry systems, CCTV, guards and so on.
- Raised flooring
- Network equipment

- Network management software
- Multiple optical fiber connectivity
- Network security: segregating the public and private network, installing firewalls and intrusion detection systems (IDS)

3.14.6 Leveraging the best

In both enterprise/captive and public data centers, the systems and infrastructure need to be leveraged fully to maximize ROI. For companies that host their online applications with public data centers, in addition to the primary benefit of cost savings, perhaps the biggest advantage is the value-added services available. Enterprises usually prefer to select a service provider, which can function as a one-stop solution provider and give them an end-to-end outsourcing experience.

Data centers need to strike a careful balance between utilization and spare infrastructure capacity. They need to be able to provide additional infrastructure to their customers who wish to scale their existing contracts with little or no advance notice. Thus it is necessary that there be additional infrastructure at all times. This infrastructure could include bandwidth and connectivity, storage, server or security infrastructure (firewalls, etc.)

Ensuring that the mission critical data centers systems and infrastructure conforms to the highest technological standards, before investing in non-core, fringe accessories, can mitigate expenditures. In the past, data centers floated by some of the largest enterprises in the world have succumbed to mismanagement of finances. Another way to mitigate expenditures is to manage inventories efficiently. Bloated inventories lead to large amounts of sunken capital, and if this is not used in time, they can eventually become obsolete. Having a streamlined inventory can ensure that a data center has sufficient resources to meet the customer demand for scalability, without over-provisioning.

3.14.7 Challenges faced by the management

(i) ***Maintaining a skilled staff and the high infrastructure needed for daily data center operations:.*** A company needs to have staff which is expert at network management and has software / OS skills and hardware skills. The company has to employ a large number of such people, as they have to work on rotational shifts. The company would also used additional cover in case a person leaves

(ii) ***Maximizing uptime and performance*** : While establishing sufficient redundancy and maintaining watertight security, data centers have to maintain maximum uptime and system performance.

(iii) ***Technology selection*** *:* The other challenges that enterprise data centers face is technology selection, which is crucial to the operations of the facility keeping business objectives in mind. Another problem is compensating for obsolescence.

(iv*)* ***Resource balancing*** *:* The enterprise chief technical officer today needs to strike a working balance between reduced operational budgets, increased demands on existing infrastructure, maximizing availability, ensuring round-the-clock monitoring and management, and the periodic upgrades that today's technology demands. This is why even some of the largest enterprises in the world choose to host their mission-critical and sensitive data with established data centers, where security concerns can be met and the technology and resources are already in place.

3.14.8 Disaster recovery sites

Data centers need to be equipped with the appropriate disaster recovery systems that minimize downtime for its customers. This means that every data center needs to invest in solutions, such as power backup and remote management. Downtime can be eliminated by having proper disaster recovery (DR) plans for mission-critical types of organizations, so as to be prepared when disaster strikes. Some of the larger IT organizations, which cannot tolerate too much downtime, tend to set up their DR site as a hot site, where both the primary and DR sites are kept in real-time synchronization , all the time. The different types of plans are:

Cold site: An alternative facility that is devoid of any resources or equipment, except air conditioning and raised flooring. Equipment and resources must be installed in such a facility to duplicate the critical business functions of an organization. Cold sites have many variations depending on their communication facilities.

Warm site: An alternate processing site that is only partially equipped, as compared to a hot site, which is fully equipped. It can be shared (sharing servers equipment) or dedicated (own servers)

Hot site: An alternative facility that has the equipment and resources to recover business functions that are affected by a disaster. Hot sites may vary in the type of facilities offered (such as data processing, communications, or any other critical business functions needing duplication) The location and size of the hog site must be proportional to the equipment and resources needed.

3.14.9 Business Continuity Planning (BCP)

A **Business Continuity Plan (BCP)** is a documented description of action, resources, and procedures to be followed before, during and after an event, functions vital to continue business operations are recovered, operational in an acceptable time frame.

Disaster events: -

(i) There is a potential for significantly interrupt normal business processing,

(ii) Business is associated with natural disasters like earthquake, flood, tornadoes, thunderstorms, fire, etc.

(iii) It is not a fact that all the disruptions are disasters,

(iv) Disasters are disruptions causing the entire facility to be inoperative for a lengthy period of time (usually more than a day)

(v) Catastrophes are disruptions resulting from disruption of processing facility.

Components of BCP –

(i) Define requirements based on business needs,

(ii) Statements of critical resources needed,

(iii) Detailed planning on use of critical resources,

(iv) Defined responsibilities of trained personnel,

(v) Written documentations and procedures cove all operations,

(vi) Commitment to maintain plan to keep up with changes.

Life Cycle of BCP: The development of a BCP manual can have five main phases as shown in fig 3.14.9.1.

1. Analysis
2. Solution design
3. Implementation
4. Testing and organization acceptance
5. Maintenance

Fig 3.14.9.1 BCP Life Cycle

PHASE I – ANALYSIS: The analysis phase in the development of a BCP manual consists of an impact analysis, threat analysis, and impact scenarios with the resulting BCP plan requirement documentation.

➢ **Impact analysis (Business Impact Analysis, BIA)**

An impact analysis results in the differentiation between critical (urgent) and non-critical (non-urgent) organization functions/ activities. A function may be considered critical if the implications for stakeholders of damage to the organization resulting are regarded as unacceptable. Perceptions of the acceptability of disruption may be modified by the cost of establishing and maintaining appropriate business or technical recovery solutions. A function may also be considered critical if dictated by law.

For each critical (in scope) function, two values are then assigned:

- **Recovery Point Objective (RPO)**- the acceptable latency of data that will be recovered
- **Recovery Time Objective (RTO)** - the acceptable amount of time to restore the function

The Recovery Point Objective must ensure that the Maximum Tolerable Data Loss for each activity is not exceeded. The Recovery Time Objective must ensure that the Maximum Tolerable Period of Disruption (MTPD) for each activity is not exceeded.

The impact analysis results in the recovery requirements for each critical function. Recovery requirements consist of the following information:

- The business requirements for recovery of the critical function, and/or
- The technical requirements for recovery of the critical function

- **Threat analysis**

  Documenting potential threats is recommended to detail a specific disaster's unique recovery steps. Some common threats include disease ,earthquake, fire , flood, Cyber attack , bribery, hurricane , utility outage, terrorism .

  All threats in the examples above share a common impact: the potential of damage to organizational infrastructure - except one (disease). The impact of diseases can be regarded as purely human, and may be alleviated with technical and business solutions. Damage from flooding also has a unique characteristic. If an office environment is flooded with non-salinated and contamination-free water (e.g., in the event of a pipe burst), equipment can be thoroughly dried and may still be functional.

- **Definition of impact scenarios**

  After defining potential threats, documenting the impact scenarios that form the basis of the business recovery plan is recommended. In general, planning for the most wide-reaching disaster or disturbance is preferable to planning for a smaller scale problem, as almost all smaller scale problems are partial elements of larger disasters. A typical impact scenario like 'Building Loss' will most likely encompass all critical business functions, and the worst potential outcome from any potential threat. A business continuity plan may also document additional impact scenarios if an organization has more than one building. Other more specific impact scenarios - for example a scenario for the temporary or permanent loss of a specific floor in a building - may also be documented.

- **Recovery requirement documentation**

  After the completion of the analysis phase, the business and technical plan requirements are documented in order to commence the implementation phase. A good asset management program can be of great assistance here and allow for quick identification of available and re-allocateable resources. For an office-based, IT intensive business, the plan requirements may cover the following elements:

  - The numbers and types of desks, whether dedicated or shared, required outside of the primary business location in the secondary location. The individuals involved in the recovery effort along with their contact and technical details.
  - The applications and application data required from the secondary location desks for critical business functions.
  - The manual workaround solutions

- The maximum outage allowed for the applications
- The peripheral requirements like printers, copier, fax machine, calculators, paper, pens etc.

Other business environments, such as production, distribution, warehousing etc will need to cover these elements, but are likely to have additional issues to manage following a disruptive event.

PHASE II – SOLUTION DESIGN

The goal of the solution design phase is to identify the most cost effective disaster recovery solution that meets two main requirements from the impact analysis stage. For IT applications, this is commonly expressed as:

1. The minimum application and application data requirements
2. The time frame in which the minimum application and application data must be available

Disaster recovery plans may also be required outside the IT applications domain, for example in preservation of information in hard copy format, or restoration of embedded technology in process plant. This BCP phase overlaps with Disaster recovery planning methodology. The solution phase determines:

- ♦ the crisis management command structure
- ♦ the location of a secondary work site (where necessary)
- ♦ telecommunication architecture between primary and secondary work sites
- ♦ data replication methodology between primary and secondary work sites
- ♦ the application and software required at the secondary work site, and
- ♦ the type of physical data requirements at the secondary work site.

PHASE III –IMPLEMENTATION

The implementation phase, quite simply, is the execution of the design elements identified in the solution design phase. Work package testing may take place during the implementation of the solution, however; work package testing does not take the place of organizational testing.

PHASE IV –TESTING AND ORGANIZATIONAL ACCEPTANCE

The purpose of testing is to achieve organizational acceptance that the business continuity solution satisfies the organization's recovery requirements. Plans may fail to meet expectations due to insufficient or inaccurate recovery requirements, solution design flaws, or solution implementation errors. Testing may include:

- Crisis command team call-out testing
- Technical swing test from primary to secondary work locations
- Technical swing test from secondary to primary work locations
- Application test
- Business process test

At minimum, testing is generally conducted on a biannual or annual schedule. Problems identified in the initial testing phase may be rolled up into the maintenance phase and retested during the next test cycle.

PHASE V – MAINTENANCE

Maintenance of a BCP manual is broken down into three periodic activities. The first activity is the confirmation of information in the manual, roll out to ALL staff for awareness and specific training for individuals whose roles are identified as critical in response and recovery. The second activity is the testing and verification of technical solutions established for recovery operations. The third activity is the testing and verification of documented organization recovery procedures. A biannual or annual maintenance cycle is typical.

➢ **Information update and testing**

All organizations change over time, therefore a BCP manual must change to stay relevant to the organization. Once data accuracy is verified, normally a call tree test is conducted to evaluate the notification plan's efficiency as well as the accuracy of the contact data. Some types of changes that should be identified and updated in the manual include:

(i) Staffing changes

(ii) Staffing persona

(iii) Changes to important clients and their contact details

(iv) Changes to important vendors/suppliers and their contact details

(v) Departmental changes like new, closed or fundamentally changed departments.

(vi) Changes in company investment portfolio and mission statement

(vii) Changes in upstream/downstream supplier routes

➢ **Testing and verification of technical solutions**

As a part of ongoing maintenance, any specialized technical deployments must be checked for functionality. Some checks include:

(i) Virus definition distribution

(ii) Application security and service patch distribution

(iii) Hardware operability check

(iv) Application operability check

(v) Data verification

➢ **Testing and verification of organization recovery procedures**

As work processes change over time, the previously documented organizational recovery procedures may no longer be suitable. Some checks include:

(i) Are all work processes for critical functions documented?

(ii) Have the systems used in the execution of critical functions changed?

(iii) Are the documented work checklists meaningful and accurate for staff?

(iv) Do the documented work process recovery tasks and supporting disaster recovery infrastructure allow staff to recover within the predetermined recovery time objective

The above list is not exhaustive. There are a number of other considerations that could be included in your own plan / manual: - Risk Identification Matrix - Roles and Responsibilities (ensuring names are left out but titles are included, e.g. HR Manager) - Identification of top risks and mitigating strategies. - Considerations for resource reallocation e.g. skills matrix for larger organizations.

3.15 NETWORK SECURITY

3.15.1 Need for security: The basic objective for providing network security is two fold:

(i) to safeguard assets and (ii) to ensure and maintain the data integrity.

The boundary subsystem is an interface between the potential users of a system and the system itself controls in the boundary subsystem have the following purposes like

(i) to establish the system resources that the users desire to employ and (ii) to restrict the actions undertaken by the users who obtain the system resource to an authorized set.

There are two types of systems security. A physical security is implemented to protect the physical systems assets of an organization like the personnel, hardware, facilities, supplies and documentation. A logical security is intended to control (i) malicious and non-malicious threats to physical security and (ii) malicious threats to logical security itself.

3.15.2 Level of Security: The task of a Security Administration in an organization is to conduct a security program which is a series of ongoing, regular and periodic review of controls exercised to ensure safeguarding of assets and maintenance of data integrity. Security programs involve following eight steps –

(i) Preparing project plan for enforcing security,

(ii) Assets identification,

(iii) Assets valuation,

(iv) Threats identification,

(v) Threats probability of occurrence assessment,

(vi) Exposure analysis,

(vii) Controls adjustment,

(viii) Report generation outlining the levels of security to be provided for individual systems, end user, etc.

The project plan components are at first outlining the objectives of the review followed by in sequence determining the scope of the review and tasks to be accomplished, assigning tasks to the project team after organizing it, preparing resources budget which will be determined by the volume and complexity of the review and fixing a target / schedule for task completion.

Assets which need to be safeguarded can be identified and subdivided into Personnel, Hardware, Facilities, Documentation, Supplies, Data, Application Software and System Software.

Third step of valuation of Assets can pose a difficulty. The process of valuation can differ depending on who is asked to render the valuation, the way in which the asset can be lost and the period for which it is lost and how old is the asset.

Valuation of physical assets cannot be considered apart from the valuation of the logical assets. For example, the replacement value of the contents in a micro computer's hard disk may be several times more than the replacement value of the disk itself.

The fourth step in a security review is Threats Identification. The source of a threat can be external or internal and the nature of a threat can be accidental / non-deliberate or deliberate. The example of a non-deliberate external threat is an act of God, non-deliberate internal threat is pollution, deliberate external threat is hackers, and deliberate internal threat is employees. More exhaustively, the sources of threat are the Nature or acts of God like earthquake, flood, fire, extreme temperatures, and electromagnetic radiations followed by other sources like Hardware / Software Suppliers, Competitors, Contractors, Shareholders / Debenture holders, Unions, Governmental Regulations, Environmentalists, Criminals / Hackers, Management, Employees and Unreliable Systems.

The fifth step in a security review is assessment or the probability of occurrence of threats over a given time period. This exercise is not so difficult if prior period statistical data is available. If however, prior period data is not available, it has to be elicited from the associated stakeholders like end users (furnishing the data aspect) and the management (furnishing the control aspect)

The sixth step is the Exposures Analysis by first identifying the controls in the place, secondly assessing the reliability of the existing controls, thirdly evaluating the probability that a threat can be successful and lastly assessing the resulting loss if the threat is successful.

For each asset and each threat the expected loss can be estimated as the product of the probability of threat occurrence, probability of control failure and the resulting loss if the threat is successful.

The seventh step is the adjustment of controls which means whether over some time period any control can be designed, implemented and operated such that the cost of control is lower than the reduction in the expected losses. The reduction in the expected losses is the difference between expected losses with the (i) existing set of controls and (ii) improved set of controls.

The last step is report generation documenting, the findings of the review and specially recommending new assets safeguarding techniques that should be implemented and existing assets safeguarding mechanisms that should be eliminated / rectified, and also recommending the assignment of the levels of security to be pervaded for individual end users and systems.

3.15.3 IDS Components : The goal of intrusion detection is to monitor network assets to detect anomalous behavior and misuse. This concept has been around for nearly twenty years but only recently has it seen a dramatic rise in popularity and incorporation into the overall information security infrastructure. Below we have given a layman's description of the primary IDS components:

Network Intrusion Detection (NID) : Network intrusion detection deals with information passing on the wire between hosts. Typically referred to as "packet-sniffers," network intrusion detection devices intercept packets traveling along various communication mediums and protocols, usually TCP/IP. Once captured, the packets are analyzed in a number of different ways. Some NID devices will simply compare the packet to a signature database consisting of known attacks and malicious packet "fingerprints", while others will look for anomalous packet activity that might indicate malicious behavior. In either case, network intrusion detection should be regarded primarily as a perimeter defense.

Host-based Intrusion Detection (HID): Host-based intrusion detection systems are designed to monitor, detect, and respond to user and system activity and attacks on a given host. Some more robust tools also offer audit policy management and centralization, supply data forensics, statistical analysis and evidentiary support, and in certain instances provide some measure of access control. The difference between host-based and network-based intrusion detection is that NID deals with data transmitted from host to host while HID is concerned with what occurs on the hosts themselves.

Host-based intrusion detection is best suited to combat internal threats because of its ability to monitor and respond to specific user actions and file accesses on the host. The majority of computer threats come from within organizations, from many different sources; disgruntled employees and corporate spies are just two examples.

Hybrid Intrusion Detection : Hybrid intrusion detection systems offer management of and alert notification from both network and host-based intrusion detection devices. Hybrid solutions provide the logical complement to NID and HID - central intrusion detection management.

Network-Node Intrusion Detection (NNID) : Network-node intrusion detection was developed to work around the inherent flaws in traditional NID. Network-node pulls the packet-intercepting technology off of the wire and puts it on the host. With NNID, the "packet-sniffer" is positioned in such a way that it captures packets after they reach their final target, the destination host. The packet is then analyzed just as if it were traveling along the network through a conventional "packet-sniffer." This scheme came from a HID-centric assumption that each critical host would already be taking advantage of host-based technology. In this approach, network-node is simply another module that can attach to the HID agent. Network node's major disadvantage is that it only evaluates packets addressed to the host on which it resides. Traditional network intrusion detection, on the other hand, can monitor packets on an entire subnet. Even so, "packet-sniffers" are equally incapable of viewing a complete subnet when the network uses high-speed communications, encryption, or switches since they are essentially "without a sense of smell". The advantage to NNID is its ability to defend specific hosts against packet-based attacks in these complex environments where conventional NID is ineffective.

3.15.4 Threats and Vulnerabilities

The threats to the security of systems assets can be broadly divided into nine categories:

(i) Fire

(ii) Water

(iii) Energy variations like voltage fluctuations, circuit breakage, etc.

(iv) Structural damages

(v) Pollution

(vi) Intrusion like physical intrusion and eavesdropping which can be eliminated / minimized by physical access controls, prevention of electromagnetic emission and providing the facilities with their proper locations / sites

(vii) Viruses and Worms (being discussed in detail later on)

(viii) Misuse of software, data and services which can be avoided by preparing an employees' code of conduct and

(ix) Hackers, the expected loss from whose activities can be mitigated only by robust logical access controls.

A virus is itself a program that instructs the operating system to append it to other programs and thus propagates to other programs via files containing macros which are sent as attachments to electronic mail messages. A virus can be benign like it can cause minor disruptions by printing laughing message or can be malignant like it can delete files or corrupt other programs.

The controls to guard against the virus are threefold –

(i) Preventive controls like using only clean and licensed copies of software files, cutting the use of pubic domain software / shareware, downloading files or software only from a reliable websites, implementing read-only access to software. Checking new files / software with anti-virus software before installation, importing education and training programs to end users

(ii) Detective controls like regularly running antivirus software, undertaking file size comparison to observe whether the size of programs has changed, undertaking date / time comparisons to detect any unauthorized modifications.

(iii) Corrective controls like maintaining a clean backup, having a recovery plan from virus infections, regularly running antivirus software (which is useful for both detection and removal of virus)

Worms, unlike virus, exist as separate and independent programs and like virus, propagate their copies with benign or malignant intention using operating system as their medium of replication. They exploit security weakness / bug in the operating system to infiltrate other systems.

Exposures that arise from worms are more difficult to control than that arise from virus. These exposures should be addressed by all users of a network; other wise control weaknesses in a user's system can give rise to control weaknesses in another user's system.

Abuse of software, Data and Services can arise in the following ways:

(i) Generalized software and proprietary databases of the organization are often copied and taken away without an authority, by the employees who may keep it for their own purposes or for handing it over to competitors,

(ii) Organization fails to protect the privacy of the individuals who data are stored in it databases,

(iii) Employees use system services for their own personal gains and activities,

Hackers attempt to gain unauthorized entry in a system by circumventing the access control mechanism of the system. They can have a benign or a malignant intension for hacking like just by trespassing resort to read files without changing them or can wreak havoc through deletion of critical files, disruption / suspending operation, stealing sensitive data and / or programs. They can be avoided only through the robust logical access control and / or Cyber Laws of the Land.

Controls of last resorts are designed and practiced as a last mile approach keeping in view the disaster recovery of systems. For this purpose a backup and recovery plan is prepared in anticipation, which specifies how normal operations are to be restored. Besides, Insurance companies mitigate the losses associated with a disaster.

3.15.5 Techniques of Network security

Firewalls : Access controls are common form of controls encountered in the boundary subsystem by restricting the use of system resources to authorize users, limiting the actions authorized users can take with these resources and ensuring that the users obtain only authentic system resources.

Current systems are designed to allow users to share their resources. This is done by having a single system simulate the operations of several systems, where each of the simulated system works as virtual machine allowing more efficient use of resources by lowering the idle capacity of the real system. Here, a major design problem is to ensure that each virtual system operates as if it were totally unaware of the operations of the other virtual systems. Besides increased scope exists for unintentional or deliberate damage to system resources / user's actions. The route is resource sharing through virtual systems through need for isolation through need for access controls. Access controls associate with authentic users the resources, which the users are permitted to access and the action privileges, which the users have with reference to those resources. It acts as a part of the operating system. Now a days, special systems or firewalls are used to protect network from an un-trusted one. In that effect it has a routing ability.

Firewall is a device that forms a barrier between a secure and an open environment when the latter environment is usually considered hostile, for example the Internet. It acts as a system or combination of systems that enforces a boundary between more that one networks.

Self-Examination Questions

Multiple Choice Questions

1. Most appropriate definition of a computer network is
   (a) System allows making requests for information from the central computer.
   (b) An organized way of storing information about a set of similar things.
   (c) System that receives data and messages enabling two or more computers to communicate.
   (d) None of these.

2 A communication network which supports audio and video data transfer is known as
   (a) Data Network
   (b) Image Network
   (c) Multimedia Network
   (d) Voice Network

3. What is a NIC?
   (a) Netware Intranet Controller
   (b) No Internet Connection
   (c) Network Interference Control
   (d) Network Interface Card

4. What is a MAC?
   (a) A Computer made by Apple
   (b) Memory Address Corruption
   (c) Mediocre Apple Computer
   (d) Media Access Control
5. What do we call a collection of two or more computers that are located within a limited distance of each other and that are connected to each other directly or indirectly?
   (a) Internet
   (b) Intranet
   (c) Local Area Network
   (d) Wide Area Network
6. Generally modem speeds are measured in
   (a) bps
   (b) Kbps
   (c) Mbps
   (d) MIPS
7. WAN speeds are
   (a) Usually higher than LAN speeds
   (b) Measured in bytes per second
   (c) Depend on the transmission medium
   (d) None of these
8. MAN coverage is limited to
   (a) Peer-to-Peer
   (b) City
   (c) Country
   (d) Client Server

9. An NOS is

   (a) A proprietary operating system

   (b) A network operating system

   (c) Novell Operating System

   (d) Unix-like operating system

10. Protocol is

    (a) Software that facilitates connection to the internet

    (b) A list of rules for transferring data over a network

    (c) Software that allows file copy

    (d) A gateway calling program for internet bridging.

11. Which one of the following is NOT a network topology?

    (a) Star

    (b) Bus.

    (c) Linear

    (d) Ring

12. A hub is a

    (a) Router

    (b) Bridge

    (c) Repeater

    (d) All of the previous

13. An intranet mean

    (a) A LAN of variable size

    (b) A Wide Area Network connecting all branches of an organization

    (c) A network which supports limited application

    (d) A network connecting all computers of an organization and using the internet protocol

14. Internet is

    (a) A local computer network

    (b) A world wide network of computers

    (c) An interconnected network of computers

    (d) A world wide interconnected network of computers which use a common protocol to communicate with one another.

Answers:

1	c	**2**	c	**3**	d	**4**	d	**5**	c	**6**	b	**7**	b	**8**	b	**9**	b
10	b	**11**	c	**12**	c	**13**	d	**14**	d								

Short Term Questions

1. Make a list of the advantages and disadvantages of client-server and peer-to-peer networks.
2. Differentiate between the following:

    (a) LAN and WAN

    (b) Wired and Wireless Network.

    (c) Star and Ring topology

    (d) 1-tier and 2-tier system.

    (e) Internet and Intranet.

    (f) Gateway and Routers.

    (g) Hub and Switch
3. What are the advantages of fiber optic cables over coaxial cables when connecting network of computers?
4. What is meant by Data Communication?
5. What are the advantages of a network of computers over a number of stand-alone computers?
6. What are the two types of transmission technology available?
7. What are the possible ways of data exchange?

8. Explain the following terms:
   (a) MAC address
   (b) Bandwidth
   (c) NIC
   (d) Firewall
   (e) Client/server Networking
   (f) Peer-to-Peer Networking
   (g) Wireless LAN
   (h) MODEM
   (i) Data Center
   (j) Tier System
   (l) Protocols
9. What are the different types of Transmission media?
10. What are the different types of networking / internetworking devices?
11. What are major types of networks and explain?
12. What are the important topologies for networks?
13. How is network speed measured?

Long Term Questions

1. Explain Business Continuity Planning Life Cycle in detail.
2. Discuss various components of Local Area Network.
3. Discuss OSI and TCP/IP in detail and also compare them.
4. Discuss various network threats and vulnerabilities.
5. Discuss Client –Server Technology. What are the attributes of 3-tier architecture.
6. Explain different transmission modes.

CHAPTER 4

INTERNET AND OTHER TECHNOLOGIES

4.1 INTRODUCTION

With the introduction of the concept of "Information Superhighway", a revolutionary way was found to access a wealth of information and to interaction with the people around the globe from a home or office computer. Since that time, there has been exponential growth in the number of people obtaining connections to the global network, The backbone of this network is something called the Internet, a collection of interconnected networks all using the Internet Protocol Suite (TCP/IP). The Internet, an umbrella term covering countless networks and services that comprise a super-network, is a global network of computer networks that was initiated in the 1960's by a team of scientists under a U.S. government research contract.

The Internet eventually became a link for academic institutions to share research results and then evolved into an instrument for mixed academic, commercial, and personal uses; but even the most visionary original development team member could not have anticipated the phenomenal growth and current state of the Internet.

Information and access to information has become the basis for personal, economic, and political advancement. The Internet now provides access to Electronic Commerce (EC) transactions to millions of consumers and businesses. The role of the Internet in Electronic Commerce (EC) and its significant impact on the continued growth and acceptability of Electronic Commerce (EC) as a routine means of conducting business is of great importance and which will be covered throughout this chapter.

This vast network, by its very nature, however, has significant security and control weaknesses that must be addressed. As with many technological advances (for example, many consumers had serious reservations about using the "new" automated teller machines), controls lag behind the technology, and universal acceptance will be unattainable until effective controls have been implemented.

Internet usage can be as secure as a company requires. It is important to put in place the appropriate tools and procedures to protect information assets. It is also important, however, not to overreact and incur unnecessary costs and difficulties. For individual Internet connections used for normal business purposes, security is often not a problem.

4.1.1 History and Background : The history of the Internet is closely tied to the U.S. Department of Defense. The military was a leader in the use of computer technology in the 1960's and saw the need to create a network that could survive a single network computer's malfunction. In the 1970's, the Advanced Research Projects Agency (ARPA) developed a network that has evolved into today's Internet. The network was named ARPANET and had many objectives that are still relevant today.

ARPANET Objectives

- The network would continue to function even if one or many of the computers or connections in the network failed.
- The network had to be useable by vastly different hardware and software platforms.
- The network had to be able to automatically reroute traffic around non-functioning parts of the network.
- The network had to be a network of networks, rather than a network of computers (Hoffman, 1995)

It rapidly became evident that people wanted to share information between networks, and as a result, commercial networks were developed to meet consumer demand. The Internet became the umbrella name for this combination of networks in the late 1980's. Since the mid 1990's, the growth of the Internet and the associated number of individuals connected to it has been phenomenal. There are approximately 1,463,632,361 users of internet presently and the number is increasing at an extraordinary rate. This increase can be attributed to several trends including the expansion in the number of personal computers at businesses and in homes.

The worldwide internet users by world regions is shown in Fig. 4.1.1.1.

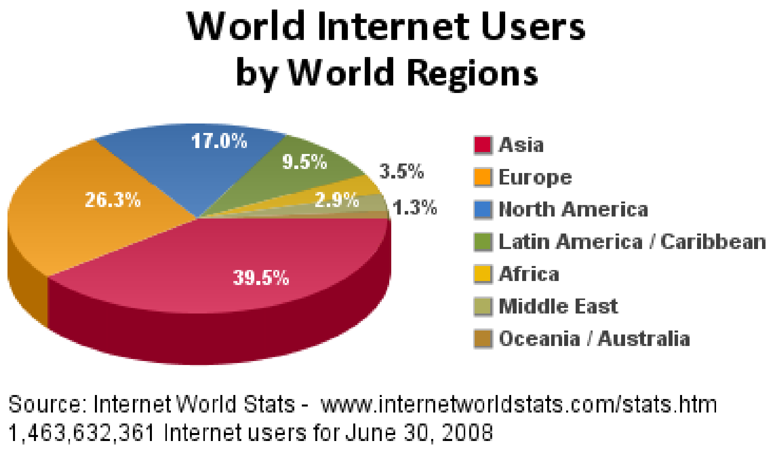


Fig 4.1.1.1 Worldwide Internet Users by World Regions

The Internet is difficult to define. Essentially, the Internet is a network of computers that offers access to information and people. In some ways, it's like an information service, because it offers e-mail, bulletin boards, and information-retrieval services that can access file directories and databases around the world. However, the Internet is different from an information service, primarily because there's no central computer system - there is just a web of connections between thousands of independent systems connected to each other through telephone lines. It is estimated that there are more than 50 million such computers all over the world and they are growing at a rate of 10 per cent per month. Using the telephone network worldwide, these computers can communicate with each other. These connections can use the regular **dial up telephone lines** or **dedicated higher capacity lines** to connect a user to the nearest *Internet Service Provider* (ISP). ISP makes Internet access available on a local telephone call and helps user avoid direct long distance or international calls to connect to computers in other parts of the world.

However, since the Internet has grown to a phenomenal size, it has also become complex for users. To help the growing number of users, who are not computer professionals, various developments have occurred. First is the setting up of Online Services like CompuService, America Online, etc. These online services operate on one powerful computer, connected to the Internet. Users from any part of the world connect to this computer and avail various facilities there, which include access to information from data-base, software libraries, news, bulletin boards for various interest groups, online chat facilities, E-mail etc.

A revolutionary development on the Internet is the World Wide Web (WWW).

4.1.2 World Wide Web : The World Wide Web (WWW) is most often called the Web. The Web is a network of computers all over the world. All computers in the Web can communicate with each other. All the computers use a communication standard called Hypertext Transfer protocol. WWW is a component of the Internet that provides access to large amounts of information located on many different servers. It also provides access to many of the services available on the Internet.

The fundamental unit of the Web is the **Web page**. The Web page is a text document that contains links to other Web pages, graphic and audio files, and other Internet services such as file transfer protocol (FTP) and E-mail.

Web pages reside on servers that run special software that allow users to access Web pages and to activate links to other Web pages and to Internet services. Tens of thousands of Web servers are connected to the Internet. A user can directly access any Web page on one of these servers and then follow the links to other pages. This process creates a Web of links around the world and, thus, the name World Wide Web.

Computers reading the Web pages are called a Web Client. Web clients view the pages with a program called a Web Browser. The first such browser capable of displaying graphics within a Web page was Mosaic. Some of the popular browsers are Internet Explorer, Netscape Navigator, Mozilla Firefox, Opera. A browser fetches a Web page from a server by a request. This request is a standard HTTP request containing a page address. A page address looks like: http://www.name.com.

Web pages are created by using *hypertext Markup Language* (HTML). HTML lets the creator of a Web page specify how text will be displayed and how to link to other Web pages, files, and Internet services. These links are formally known as **hypertext links**, because they are activated when a user clicks on specific text or images within a Web page.

The World Wide Web (WWW) is "indexed" through the use of search engines. These search engines comn though the Web documents, idenfiying text that is the basis for keyword searching. Each search engine works in a different way. Some engines scans for information in the title or header of the document whereas others look at the bold "heading" on the page for their information.

Fig. 4.1.2.1 depicts a typical search engine.

Fig 4.1.2.1 A typical Search Engine

The fact that search engines gather information differently means that each will probably yield different results. Therefore, it's wise to try more than one search engine when doing Web searching. Some other popular search engines include:

- Google (http://google.com/)
- Lycos (http://lycos,com/)
- Hot Bot (http://hotbot.com/)
- Yahoo (http://www.yahoo.com/
- Savy Search (http://www.cs.colostate.edu/~dreiling/smartform.html)
- Alta Vista (http://www.altavista.digital.com)
- All for One (http://www.all4one.com)

To illustrate the vast nature of information on the Web, the following general topics are included on the Yahoo search engine (http://www.yahoo.com/) :

- Arts and Humanities
- Business and Economy
- Computers and Internet

- Education
- Entertainment
- Government
- Health
- News and Media
- Recreation and Sports
- Reference
- Regional
- Science
- Social Science
- Society and Culture

When searching in Web, there is always information overload due to the volume of matches. With so much information available it is often difficult to word the search criteria appropriately to achieve the desired results.

The Web browser reads a specified Web page using the HTML commands within the Web page to display the desired information. Text positioning, fonts, colors, and size are specified through HTML. The browser software interprets the HTML commands and displays the information on the user's monitor. It is important to realize that different browsers can interpret an HTML command differently and thus display text differently. For example, a Web page may contain HTML code specifying that text be emphasized. One browser may emphasize text by bolding the text, but another browser may use Italics for emphasis.

4.1.3 Uniform Resource Locators (URLs) are used to address and access individual Web pages and Internet resources. The format of a URL is: **protocol/Internet address/Web page address.**

The protocol that the Web uses for HTML codes for Web page is **HyperText Transport Protocol** (HTTP) For example, consider the web page address: **http://pages.prodigy.com/kdallas/index.htm.**

Fig. 4.1.3.1 shows subsections of Uniform Resources Locator (URL).

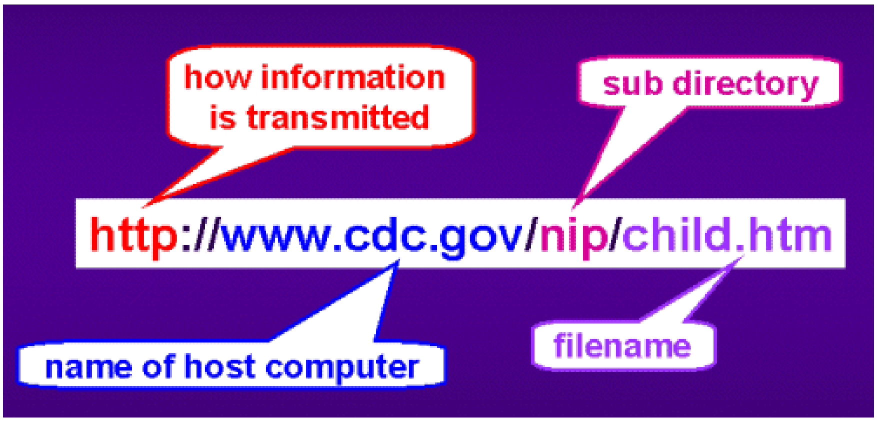


Fig 4.1.3.1 Subsections of Uniform Resource Locator (URL)

The **http://** specifies that HTTP will be used to process information to and from the Web server; pages.**prodigy.com** is the Web server's Internet address; and **kdallas/index.htm** is the address of the page on the server. Index.htm could have been omitted, because this is the default for the main page within a directory (i.e., kdallas in this example) Within HTML, there is the capability to display information in list or tables and to create forms for users to send information to someone else. In addition, HTML provides the capability to specify graphic files to be displayed. These and other features let a user create complex Web pages.

Surfing on the Internet: Many of the servers on the Internet provide information, specialising on a topic or subject. There is a large number of such servers on the Internet. When a user is looking for some information, it may be necessary for him/her to look for such information from more than one server. WWW links the computers on the Internet, like a spider web, facilitating users to go from one computer to another directly. When a user keeps hopping from one computer to another, it is called **"surfing"**.

The Internet facilitates "many to many" communication. Modern technology has, so far, made possible communication, "one to many" as in broadcasting; "one to one" as in telephony; "a few to a few" as in telephone conferencing; and "many to one" as in polling. In addition WWW works on "multi-media", and information can be accessed and transmitted in text, voice, sound and/or video. Graphics and interactive communication are two distinctive features of the Internet and WWW.

4.1.4 Applications of Internet - Internet's applications are many and depend on the innovation of the user. The common applications of the Internet can be classified into three primary types namely: Communication, Data retrieval and Data publishing as shown in Fig. 4.1.4.1

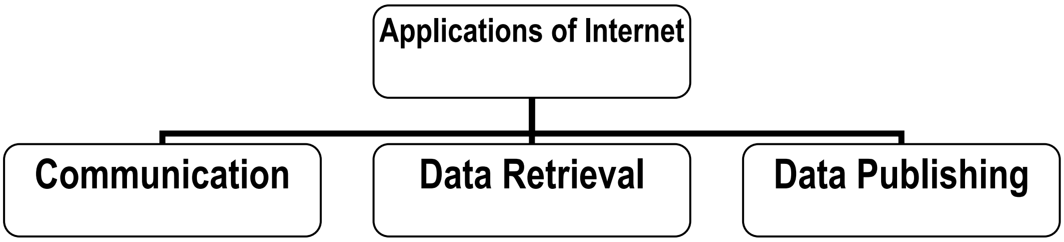


Fig 4.1.4.1 Applications of Internet (Hierarchical View)

(i) **Communication :** Communication on the Internet can be online or offline. When some users connect to a single server or an on-line service at the same time, they can communicate in an "online chat". This can be truly "many to many" as in a room full of people talking to each other on peer to peer basis. Alternatively, the users send e-mail to each other which can be read by the receiver whenever he/she finds the time. This is off-line communication, but "one to one" or "one to many". Similarly, it is possible for users to get together electronically with those sharing common interests in **"usenet"** groups. The users post messages to be read and answered by others at their convenience, in turn all of which can be read and replied to by others and so on.

(ii) **Data Retrieval :** For meaningful data retrieval, availability of data that has been compiled from various sources and put together in a usable form is an essential prerequisite. On the Internet, a large number of databases exist. These have been put together by commercially run data providers as well as individuals or groups with special interest in particular areas. To retrieve such data, any user needs to know the address/s of such Internet servers. Then depending on the depth of information being sought, different databases have to be searched and required information compiled. The work involved is similar to a search process in a large library; except that this Internet "library" is immense, dynamic, because of regular updating, and entirely electronic. While some skill is required for searching, the user will be able to access, search and check a large collection of servers. Conceivably, Internet will have the latest information available, because all data is transmitted electronically world over. For corporate users who are looking for latest information on products, markets and strategies, such sources are welcome.

(iii) **Data publishing :** Data publishing is a new opportunity that Internet has made possible. Information that needs to be made available to others can either be forwarded to specific addresses, posted in a Usenet site or kept on display in a special site. Internet discourages by social pressure, sending of unsolicited E-mail.

4.1.5 Business use of Internet : Though Internet has existed over many years, mostly research and education sectors have been the primary users all these years. Business has taken to Internet only recently. The Internet has developed references on what is acceptable and unacceptable practice. For example, the Internet is open and anyone can communicate with anyone anywhere on the Internet, but the prevalent custom prevents unsolicited E-mail and promotional communication on the Internet. Hence, business has to use Internet innovatively but within the norms and modes of this fast growing world community. Following are few of the business uses of Internet:-

Reach a worldwide audience : The Internet is a worldwide network allowing you to reach people even very expensive advertising could not.

Provide product information : Give customer direct access to information about your products. Some people prefer to learn about products on their own. The Internet has an unsurpassed ability to make information about your company's products or services available to potential customers. It also provides the information when the customer wants it (now).

Save on literature costs : Providing the information online reduces the need to print and mail product literature, thereby resulting in significant cost reductions.

Augment/replace phone banks : Often people staffing phone banks are serving merely as interfaces to computer databases. In an age of graphical, networked computing, this function is less necessary. Simple graphical interfaces can be designed to allow customers to find the information they want quickly and inexpensively.

Provide easy access to customer service representatives : Human interaction cannot be totally replaced by even the best graphical interface. When customers have a question, or would like to speak with a person, provide a list of contacts and phone numbers or allow them to send e-mail directly to a customer service representative, requesting that they be contacted.

Level your customer service load : How many customers are turned away unsatisfied when your customer service lines are busy? How often do you have slack times when customer support personnel are not handling calls but still cost your business money? E-mail provides "asynchronous communication" that can help level the load. Customers with problems that do not require immediate attention can send an e-mail message through your Web site which can be handled when support people are not busy. Telephone-tag is eliminated for your customers, and you.

Inexpensively create/augment your corporate image : It is easy and inexpensive to define your image on the Internet, whether you are a one-person-company or a large corporation. If your company information changes rapidly due to market forces, there is no easier way to change your image than electronically.

Recruit new employees : Many companies (now nearly all), provide current information about job openings and attract talented people from places they could not reach otherwise.

Provide useful information to attract customers : Ski shops often have a board listing local snow conditions. Search sites like " yahoo " and " Lycos " provide useful search services for the Web. Providing useful information to potential customers is a good way to get them to come to your site and return again and again (a property now called "stickiness").

Provide your service on-line : Many products and services can be delivered over the Internet. Online services will become an even brighter option for many businesses. Since the transaction is electronic, billing and inventory control can be automated, increasing accuracy and reducing your accounting and product storage costs.

Give customers access to searchable information : Computers on the Internet allow companies to post information in the form of static Web pages. But, with some of the latest software (or some clever programming) , these computers can also help your customers find the information you are providing quickly. Federal Express created an award winning Web site that allows customers to track their packages. In doing this, Fed- Ex is providing a useful customer service while also promoting their product (service).

Help customers understand why they need you : Another thing computers do well is provide artificial intelligence, expertise, or analysis. The Internet allows you to deliver custom software applications and extend your expertise virtually. Suppose you manufacture thermopane windows. A spreadsheet application could allow potential customers to determine how much money they would save in energy costs if they installed your windows. A financial services company could allow potential customers to analyze their investments in light of a financial service the company offers.

Let customers try a sample of your product or service : Many new Web tools are becoming available that will allow consumers to try out a sample of what you have to offer before they buy. Gain a competitive advantage by offering a "test drive" of your product or service.

Eliminate the middleman : Middlemen exist in some industries where there are barriers to direct contact between producers and consumers. The Internet is a vehicle for removing these barriers. This lowers prices for consumers and increases profits for producers.

On-line commerce : This has been much touted in the popular press. Some products and services are well suited for sales on-line. Rapid growth in this area will occur as secure credit card transactions become (are now) standardized. Efficiency of shipping and delivery methods for hard goods is important for typically impatient internet shoppers.

Consider an Intranet : Use the same Internet technology within your company to help workers communicate better and work more productively. Many companies are finding an Intranet to be a much more cost effective solution to their network information needs than proprietary software.

4.1.6 Internet Intrinsic Benefits

- Information on the business and services is placed in an assembled fashion in a common location.
- Access to this information is provided at reasonable costs (which are steadily declining, and with a significant reduction in duplication and distribution costs)
- A mechanism for immediate feedback from consumers or business partners is provided.
- The cost of information delivery to internal and external sources is reduced.
- Employee access to significant amounts of information is increased.
- An efficient means of updating and disseminating current information to customers and internal staff is provided.
- Customized information to consumers is delivered (for example, individual investment portfolios can be tracked).

These benefits make up just a small sample of the numerous intrinsic benefits of using the Internet as a business resource. Companies are primarily drawn to the Internet with the promise of access to new market segments and lower sales costs.

4.1.7 Types of Internet Connections : As technology grows, so does our need for bigger, better and faster. Over the years, the way content is presented via the Web has changed drastically. While technology changes at a rapid pace, so do Internet connections. It is important to note that Internet connection speeds also vary between Internet Service Providers (ISP).

There are various connection types on offer from the different Internet Service Providers (ISPs). The choice of taking an internet connection depends on how often and how you intend to use the internet.

The connection types can be broadly classified into the following types:-

Analog / Dial-up Connection : Also called dial-up access, it is both economical and slow. Using a modem connected to your PC, users connect to the Internet when the computer dials a phone number (which is provided by your Internet Service Provider (ISP)) and connects to the network. Dial-up is an analog connection because data is sent over an analog, public telephone network. The modem converts received analog data to digital and vice-versa. Because dial-up access uses normal telephone lines the quality of the connection is not always good and data rates are limited. Typical Dial-up connection speeds range from 2400 bps to 56 Kbps.

ISDN Connection : Integrated Services Digital Network (ISDN) is an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires. Typical Integrated Services Digital Network (ISDN) speeds range from 64 Kbps to 128 Kbps.

B-ISDN Connection : Broadband Integrated Services Digital Network (B-ISDN) is similar in function to Integrated Services Digital Network (ISDN) but it transfers data over fiber optic telephone lines, not normal telephone wires. Synchronous Optical Networking (SONET) is the physical transport backbone of Broadband Integrated Services Digital Network (B-ISDN). Broadband Integrated Services Digital Network (B-ISDN) has not been widely implemented.

DSL Connection : Digital Subscriber Line (DSL) is also called an always on connection because it uses existing 2-wire copper telephone line connected to the premise and will not tie up your phone as a dial-up connection does. There is no need to dial-in to your Intrenet Service Provider (ISP) as Digital Subscriber Line (DSL) is always on. The two main categories of Digital Subscriber Line (DSL) for home subscribers are called Asymmetric Digital Subscriber Line (ADSL) and Symmetric Digital Subscriber Line (SDSL).

ADSL Connection : Asymmetric Digital Subscriber Line (ADSL) is the most commonly deployed types of Digital Subscriber Line (DSL) in North America. Short for asymmetric digital subscriber line Asymmetric Digital Subscriber Line (ADSL) supports data rates of from 1.5 to 9 Mbps when receiving data (known as the downstream rate) and from 16 to 640 Kbps when sending data (known as the upstream rate). Asymmetric Digital Subscriber Line (ADSL) requires a special Asymmetric Digital Subscriber Line (ADSL) modem.

SDSL Connection : Symmetric Digital Subscriber Line (SDSL) is still more common in Europe. Symmetric Digital Subscriber Line (SDLS) is a technology that allows more data to be sent over existing copper telephone lines (Plain Old Telephone Services - POTS). Symmetric Digital Subscriber Line (SDSL) supports data rates up to 3 Mbps. Symmetric Digital Subscriber Line (SDSL) works by sending digital pulses in the high-frequency area of telephone wires and cannot operate simultaneously with voice connections over the same wires. Symmetric Digital Subscriber Line (SDSL) requires a special Symmetric Digital Subscriber Line (SDSL) modem. Symmetric Digital Subscriber Line (SDSL) is called symmetric because it supports the same data rates for upstream and downstream traffic.

VDSL Connection : Very High Digital Subscriber Line (VDSL) is a Digital Subscriber Line (DSL) technology that offers fast data rates over relatively short distances — the shorter the distance, the faster the connection rate. All types of Digital Subscriber Line (DSL) technologies are collectively referred to as xDSL. xDSL connection speeds range from 128 Kbps to 8 Mbps.

Cable Connection : Through the use of a cable modem you can have a broadband Internet connection that is designed to operate over cable TV lines. Cable Internet works by using TV channel space for data transmission, with certain channels used for downstream transmission, and other channels for upstream transmission. Because the coaxial cable used by cable TV provides much greater bandwidth than telephone lines, a cable modem can be used to achieve extremely fast access. Cable speeds range from 512 Kbps to 20 Mbps.

Wireless Internet Connections: Wireless Internet, or wireless broadband is one of the newest Internet connection types. Instead of using telephone or cable networks for your Internet connection, you use radio frequency bands. Wireless Internet provides an always-on connection which can be accessed from anywhere — as long as you geographically within a network coverage area. Wireless access is still considered to be relatively new, and it may be difficult to find a wireless service provider in some areas. It is typically more expensive and mainly available in metropolitan areas.

T-1 Lines Connection : T-1 lines are a popular leased line option for businesses connecting to the Internet and for Internet Service Providers (ISPs) connecting to the Internet backbone. It is a dedicated phone connection supporting data rates of 1.544Mbps. A T-1 line actually consists of 24 individual channels, each of which supports 64Kbits per second. Each 64Kbit/second channel can be configured to carry voice or data traffic. Most telephone companies allow you to buy just one or some of these individual channels. This is known as fractional T-1 access.

Bonded T-1 Connection : A bonded T-1 is two or more T-1 lines that have been joined (bonded) together to increase bandwidth. Where a single T-1 provides approximately 1.5Mbps, two bonded T1s provide 3Mbps or 46 channels for voice or data. Two bonded T-1s allow you to use the full bandwidth of 3Mbps where two individual T-1s can still only use a maximum of 1.5Mbps at one time. To be bonded the T-1 must run into the same router at the end, meaning they must run to the same ISP. T-1 Lines support speeds of 1.544 Mbps. Fractional T-1 speeds are 64 Kbps per channel (up to 1.544 Mbps), depending on number of leased channels. Typical Bonded T-1 (two bonded T-1 lines) speed is around 3 Mbps.

T-3 Lines Connection : T-3 lines are dedicated phone connections supporting data rates of about 43 to 45 Mbps. It too is a popular leased line option. A T-3 line actually consists of 672 individual channels, each of which supports 64 Kbps. T-3 lines are used mainly by Internet Service Providers (ISPs) connecting to the Internet backbone and for the backbone itself. Typical T-3 supports speeds ranging from 43 to 45 Mbps.

Satellite Connection : Internet over Satellite (IoS) allows a user to access the Internet via a satellite that orbits the earth. A satellite is placed at a static point above the earth's surface, in a fixed position. Because of the enormous distances signals must travel from the earth up to the satellite and back again, Internet over Satellite (IoS) is slightly slower than high-speed terrestrial connections over copper or fiber optic cables. Typical Internet over Satellite connection speeds (standard IP services) average around 492 up to 512 Kbps.

4.2 INTERNET COMPONENTS

4.2.1 Electronic Mail (e-mail)* : Electronic mail is an increasingly utilized technology, which has become the primary means of communication for many organizations and individuals. Electronic mail on the Internet provides quick, cost-effective transfer of messages to other E-mail users worldwide. This is probably one of the fastest and most convenient ways of communicating. The burden on the ever so popular Khakhi uniform clad Postman has been reduced considerably with the availability of the E-mail facility to Indians in most cities.

At present, all Internet subscribers in India get the E-mail facility free with each subscription. Thus, all Internet subscribers in India have unique and separate E-mail address. This E-mail account can be accessed by the subscriber from any part of the world!

In addition to the E-mail facility provided by Videsh Sanchar Nigam Limited (VSNL), there are a handful of private E-mail service providers in a few of the metros in India who provide exclusive E-mail facility. However, these connections do not allow access to the Internet.

As mentioned earlier, when one takes an Internet connection with any Internet Service Provider, he gets an exclusive E-mail address. With each E-mail address, the subscriber gets a certain amount of disk space on the Server on which he has been registered. This disk space serves as the post box of the respective subscriber. When somebody sends an E-mail message to the subscriber, the message lies in this post box. Even after the message has been accessed by the subscriber, it continues to lie in the post box till it is downloaded onto the local computer of the user or it is specifically deleted. As and when the post box starts getting filled to its full capacity, the service provider sends a warning to the subscriber to empty his post box.

The facility of E-mail has several features that are of immense help to us. One can send common circulars/letters to all those clients or other recipients who have E-mail facilities. This would result in saving a lot of stationery as well as postage charges. By creating Address Books in the computer, one does not have to remember the E-mail addresses of others. Further, a lot of time, energy and money can be saved by creating a Mailing List of all clients and using it to send common letters/notices/circulars. Another advantage of using E-mail is that as long as the correct E-mail address of the addressee has been keyed in by the sender, the chances of the addressee not receiving the message without the sender being aware of this are remote. Also, the transmission of messages to the server of the addressee is virtually instantaneous. Thus, E-mail beats the Postman and the Courier boy in the race by miles. E-mail transcends all time zones and barriers.

We can also send files created in any application such as, say, a Word Processor or a Spreadsheet, as attachments with the E-mail messages. Thus, for example, if we have created a Spreadsheet containing the computation of Total Income of a client, then we can write a letter to him in an E-mail and inform him that his computation is ready and also attach the Spreadsheet and send it to him for verification. Of course, care must be taken to ensure that the attachments are not very large files; otherwise, the recipient's mail box is likely to get jammed. Further, the recipients, to be able to open the file at his place, must also have the same application software in his computer. In certain cases, the recipient must also have the same version of the software that was used for preparing the attachment.

Email has changed the way we do business. Sure, people complain about the amount of Email they receive. But when all is said and done, using Email has impacted business in a positive way and has the edge over other methods of communication.

Here are five advantages of using Email at a glance:

Managing Email is Easy : You can manage all your correspondence on screen and so can your customers. Your proposal can be answered, revised, stored, and sent to others, all without reams of paper involved.

Email is Fast : Mail is delivered instantly...from your office to anywhere in the world. No other method of delivery can provide this service. Timely buying and selling decisions can be made in a heartbeat.

Email is Inexpensive : Compared to telephone calls, faxes, or overnight courier service, Email is less expensive. Transmission usually costs nothing, or at the most, very little.

Email is Easy to Filter : The subject line on an Email makes it easy to prioritize messages. The reader can identify critical correspondence quickly and dealt with it immediately. Unlike regular mail which needs to be opened and reviewed, or voice mail which requires you to either listen to or scan all your messages for those that require immediate attention.

Transmission is Secure and Reliable : The level of security in transmitting Email messages is very high, and the industry continues to strive to develop even tighter security levels. Email is private. Often telephone and fax messages are not. If the address information is correct, rarely does an Email go astray. Fax machines can be out of order or out of paper and this prevents an important message from being delivered in a timely manner.

Email is an Internet marketing tool that is fast, easy to use, inexpensive and effective. Email levels the playing field between the big corporations and small businesses. No longer is it just the big boys who have the resources to access the big advertising houses. Anyone can get their word out there using Email as the method of delivering the message.

The E-mail software supplied with Internet connection comprises of some important and useful features, which are as follows:

Composing messages : With the help of the Internet Browser, it is possible to compose messages in an attractive way with the help of various fonts. It is also possible to spell-check the message before finalizing it.

Replying to the mail received : It is possible to reply to any mail received by merely using the " Reply" facility available on the Internet Browser. This facility also allows one to send the same reply to all the recipients of the original message. This facility results in saving of a lot of time in terms of remembering addresses, typing the subject matter also.

Address Book : This is an electronic form of Address Book wherein the following features can be saved : Name, full name, E-mail address, name of organization to which the person belongs, the designation of such person etc.

When one has to send an E-mail, by merely typing the first name, for example, it would be possible to recall the E-mail address of the recipient. It is also possible to store addresses on the basis of categories. Thus, a group containing addresses of all clients could be created. Then, when a common letter or circular is to be sent to all clients, one has to merely type in the name of the category in place of the addresses. This would automatically send the letter to all persons listed in that category. This does away with the tedious task of retyping or reprinting the same letter again and again and putting the letters in envelopes, addressing and stamping the envelopes and finally, mailing the same.

Printing of messages : It is possible to print messages received as well as sent. Thus, if a person wants to keep a hard copy of any message, it would be possible for him to do so.

Offline Editing/Composing/Reading : One does not have to be connected to the Internet all the time to be able to read/edit/compose messages. This is a very important feature which many people do not make use of. Ideally, one should log onto the Internet, download all the messages onto one's own hard disk and then disconnect from the Internet. Once the user is offline, he should read all the messages that have been received. Even composing one's own messages, editing the same or replying to messages received ought to be done when one is off-line. This results in saving of Internet time as also helps in keeping telephone lines free. It is also possible to compose messages and save them as drafts so that at a later stage, the same can be edited or continued and then sent.

Forwarding of messages : It is possible to forward any message received from, say, Mr. A to Mrs. B without retyping the message.

Transfer of Data Files : An important use of the E-mail is the ability to send/receive data files to/from a client. For example, at the time of consolidation of accounts of a client, the data files containing final accounts of the branches of that client can be obtained *via* E-mail and after consolidation and finalization, the same can be sent back to the client's branches for closing entries etc. This would result in considerable saving of time, energy and money.

Greeting Cards : On the Internet, there are several sites which offer free greeting cards for thousands of occasions to anybody who wants to send greeting differently. To send an electronic greeting card, one has to simply visit a site offering this facility, select a card from amongst the several available, type in one's message, name and E-mail address of the recipient, name of the sender and with a simple click, send the card. The recipient is notified by E-mail that he has been sent a greeting card. He can then access the card by simply clicking on the web-site address of the site which has provided the facility of the greeting card. Most such cards also come with music. This makes the card extremely attractive, interesting and many times better than the traditional printed cards.

4.2.2 Webcasting or Push Technology : Another Web-based technology is **push technology—or Webcasting**—which allows users to passively receive broadcast information rather than actively search the Web for information. Push technology allows users to choose from a menu of sources, specifying what kind of information they want to receive. Once selected, the information is automatically forwarded to the user. Internet news services, which deliver the day's activities to the user's desktop, are an example of push technology. Users can also download software, select the frequency with which they will receive services, and subscribe to a variety of information sources. There is very little cost to the user for push services because information is delivered with advertising, and users view their custom-tailored news off-line.

Push technology differs from the traditional uses of the Internet. The Internet is, for the most part, **a pull environment** where a user opens a browser application and searches for information. While there are millions of Web pages, these pages are not of much use unless the user finds them and "pulls" the required information. The Web pages, then, are essentially dormant until they are located and the user successfully navigates his or her way to the correct destination. As any current Web user knows, this navigation process can sometimes be frustrating and time consuming. Push technology eliminates this frustration.

Push technology is having a major impact on the Internet, probably the biggest impact since the emergence of the Web.

4.3 INTRANET

The Intranet is a type of information system that facilitates communication within the organization, among widely dispersed departments, divisions, and regional locations. Intranets connect people together with Internet technology, using Web Browsers, Web Servers and Data Warehouses in a single view. The business perspective and technical perspective of intranet is shown in Fig. 4.3.1 & 4.3.2 respectively.

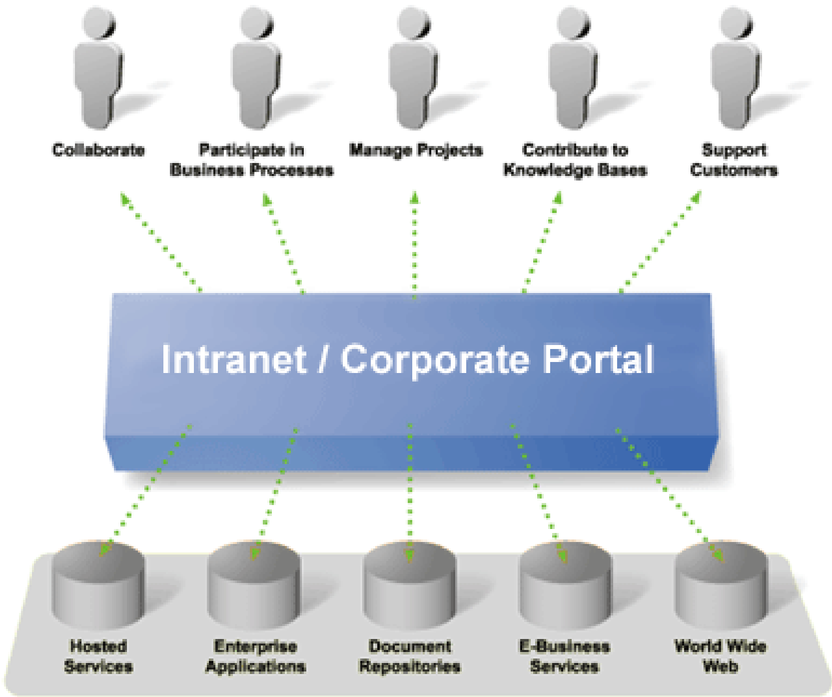


Fig 4.3.1 Intranet (Business Perspective)

With an Intranet, access to all information, applications and data can be made available through the same browser. The objective is to organize each individual's desktop with minimal cost, time and effort to be more productive, cost-efficient, timely and competitive. According to James Cimino, the challenge is to realize the following from focused Intranet work:

- Easily accessible information
- Reduced information searching time
- Sharing and reuse of tools and information
- Reduced set-up and update time
- Simplified reduced corporate licensing
- Reduced documentation costs
- Reduced support costs

- Reduced redundant page creation and maintenance
- Faster & cheaper creation
- One-time archive development costs
- Sharing of scare resources of skills.

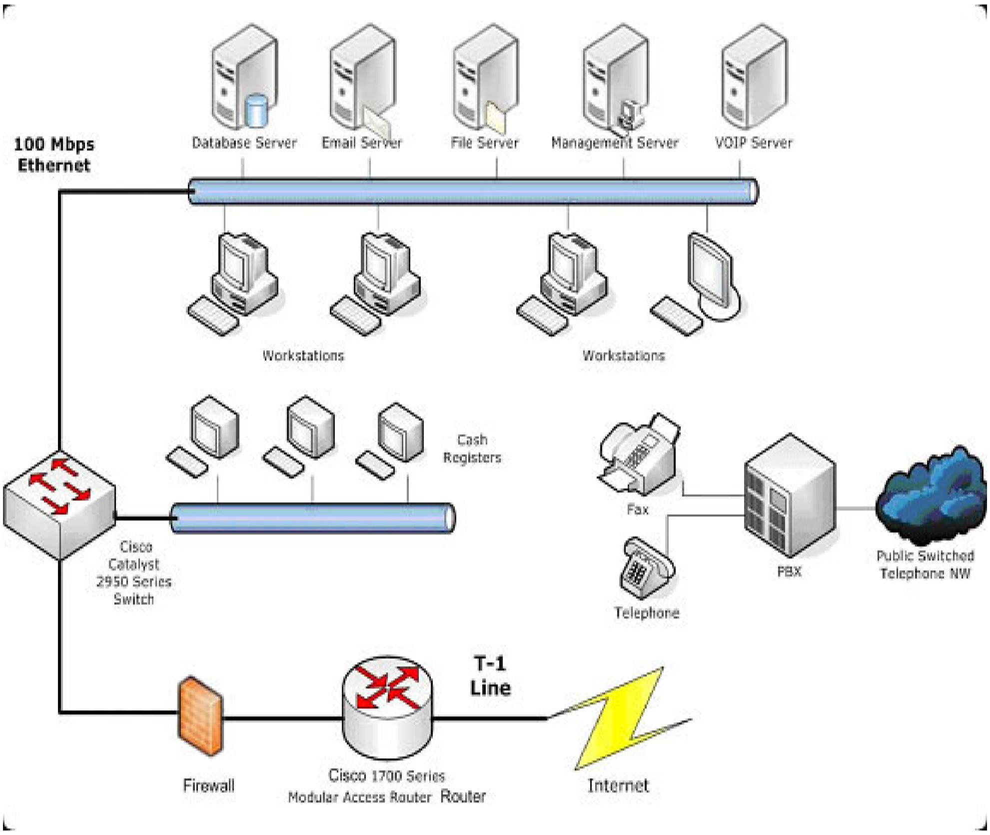


Fig 4.3.2 Intranet (Technical Perspective)

A properly planned Intranet implemented after a careful study of the business problems or issues can be a great help in the streamlining of a company. Some of the key benefits of using Intranet are:

Workforce Productivity : Intranets can help users to locate and view information faster and use applications relevant to their roles and responsibilities. With the help of a web browser interface, users can access data held in any database the organization wants to make available, anytime and - subject to security provisions - from anywhere within the company workstations, increasing employees' ability to perform their jobs faster, more accurately, and with confidence that they have the right information. It also helps to improve the services provided to the users.

Time : With intranets, organizations can make more information available to employees on a "pull" basis (i.e., employees can link to relevant information at a time which suits them) rather than being deluged indiscriminately by emails.

Communication : Intranets can serve as powerful tools for communication within an organization, vertically and horizontally. From a communications standpoint, intranets are useful to communicate strategic initiatives that have a global reach throughout the organization. The type of information that can easily be conveyed is the purpose of the initiative and what the initiative is aiming to achieve, who is driving the initiative, results achieved to date, and who to speak to for more information. By providing this information on the intranet, staff have the opportunity to keep up-to-date with the strategic focus of the organization.

Web publishing : It allows 'cumbersome' corporate knowledge to be maintained and easily accessed throughout the company using hypermedia and Web technologies. Examples include: employee manuals, benefits documents, company policies, business standards, newsfeeds, and even training, can be accessed using common Internet standards (Acrobat files, Flash files, CGI applications). Because each business unit can update the online copy of a document, the most recent version is always available to employees using the intranet.

Business Operations and Management : Intranets are also being used as a platform for developing and deploying applications to support business operations and decisions across the internetworked enterprise.

Cost-effective : Users can view information and data via web-browser rather than maintaining physical documents such as procedure manuals, internal phone list and requisition forms.

Promote Common Corporate Culture : Every user is viewing the same information within the Intranet.

Enhance Collaboration : With information easily accessible by all authorised users, teamwork is enabled.

Cross-platform Capability : Standards-compliant web browsers are available for Windows, Mac, and UNIX.

Planning and Creating an Intranet : Most organizations devote considerable resources into the planning and implementation of their intranet as it is of strategic importance to the organization's success. Some of the planning would include topics such as:

- The purpose and goals the intranet
- Persons or departments responsible for implementation and management

- Implementation schedules and phase-out of existing systems
- Defining and implementing security of the intranet
- How they'll ensure to keep it within legal boundaries and other constraints
- Level of interactivity (eg wikis, on-line forms) desired.
- Is the input of new data and updating of existing data to be centrally controlled or devolved?

These are in addition to the hardware and software decisions (like Content Management Systems), participation issues (like good taste, harassment, confidentiality), and features to be supported.

The actual implementation would include steps such as

1. User involvement to identify users' information needs.
2. Setting up web server(s) with the appropriate hardware and software.
3. Setting up web server access using a TCP/IP network.
4. Installing required user applications on computers.
5. Creation of document framework for the content to be hosted.
6. User involvement in testing and promoting use of intranet.

Intranet Applications : AT&T uses Intranet for its internal telephone directory, called POST, and Sandia National Laboratories has set up each of its departments with home pages. Tyson Foods, Federal Express, Levi Strauss, and Microsoft are other firms that have jumped on the Intranet bandwagon.

An Intranet usually has a system of access privileges controlled by passwords, restricting access to certain areas of the network. Payroll, sales projections, product development notes, and client memos are all examples of the kinds of information that a corporation would not want made accessible to every employee.

Often a company Intranet is a main means of infra-office communication. Updates to business policies and procedures can be posted, as can job openings, information on health insurance and other benefits, profiles of various employees, the company's organisational structure, as well as in-house training for employees.

Intranets also can be set up to provide an electronic directory service so employees can easily find someone's telephone number and location. Another possibility is a constantly updated company calendar so employees can check the time and location of all company events and meetings. If an employee wants to schedule a Sales Department meeting for a specific Friday at 3 p.m., it's good to know the Marketing Department already has a meeting set for 2 p.m.

An Intranet also may have a whiteboard, an electronic chat space where employees can "talk" to each other in real time by posting text messages.

Some employees even have their own home pages on their company's Intranet. The individual home pages are hooked into the company's Intranet electronic directory so other employees can access the pages easily. Personal home pages allow employees to get to know each other, and promote camaraderie among co-workers.

Use of an Intranet for access to GroupWare offers exceptionally high potential. **GroupWare** is the name given to software used in a group decision support system, in which several people jointly solve a problem. Such Internet service vendors as Netware and such GroupWare vendors as IBM/Lotus Notes are adding features to their products that are aimed at using the Net for collaborative problem solving.

Most major corporations already have at least one Intranet, and many larger companies have several. Even entry-level employees are expected to have enough familiarity with digital operations to be able to use such a network with minimal training.

Many universities and colleges have their own Intranets for students, faculty, and other designated users. For students, this is an excellent way to gain experience using Intranets. Standard University, for example, posts documents about campus life on its Intranet. Students can log onto the Intranet and read a variety of informational postings about campus events, programs, and activities.

4.4 EXTRANET

An Extranet is an extension of an Intranet that makes the latter accessible to outside companies or individuals with or without an Intranet. It is also defined as a collaborative Internet connection with other companies and business partners. Parts of an Intranet are made available to customers or business partners for specific applications. The Extranet is thus an extended Intranet, which isolates business communication from the Internet through secure solutions. Extranets provide the privacy and security of an Intranet while retaining the global reach of the Internet as shown in Fig. 4.4.1.

The key characteristics of an Extranet is that it extends the Intranet from one location to another across the Internet by securing data flows using cryptography and authorization procedures, to another Intranet of a business partner. This way, Intranets of business partners, material suppliers, financial services, distributors, customers, etc. are connected to the Extranets by an agreement between the collaborating parties. The emphasis is on allowing access to authorized groups through strictly controlled mechanisms. This has led to the true proliferation of e-commerce.

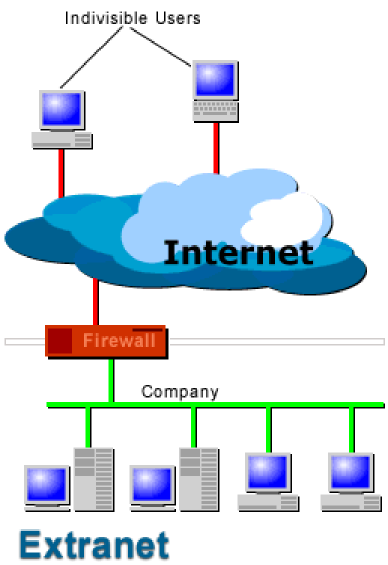


Fig 4.4.1 An Extranet

It is the combination of Intranets with Extranets that has established the virtual corporation paradigm. This business paradigm is turning out to be critical for e-commerce, allowing corporations to take advantage of any market opportunity anywhere, anytime and offering customized services and products.

Fig. 4.4.2 shows a representation of the relationship between the internet, intranet and extranet.

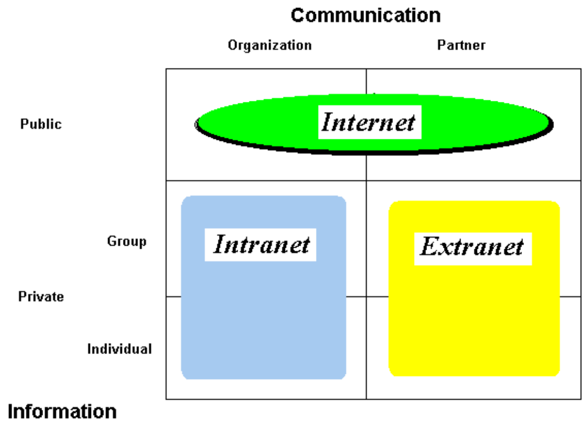


Fig 4.4.2 The diagram shows a representation of the relationship between the Internet, Intranets and Extranets.

The Intranet is a public facility. An organization uses the Internet to communicate public information about itself to members of the organization and to others outside the organization. Intranets and Extranets are private versions of the Internet. An organization uses an intranet to share information between the members of the organization. Organizations use Extranets to exchange information with and provide services to their business partners (customers, suppliers, etc.)

An extranet requires security and privacy. These require firewall server management, the issuance and use of digital certificates or similar means of user authentication, encryption of messages, and the use of virtual private networks (VPN) that tunnel through the public network.

Companies can use an extranet to do the following tasks:

- Exchange large volumes of data using Electronic Data Interchange (EDI) or XML.
- Share product catalogs exclusively with wholesalers or those "in the trade".
- Collaborate with other companies on joint development efforts.
- Jointly develop and use training programs with other companies.
- Provide or access services provided by one company to a group of other companies, such as an online banking application managed by one company on behalf of affiliated banks.
- Share news of common interest exclusively with partner companies.

With competitive advantage as the ultimate prize, two fundamental drivers are propelling large enterprises to the extranet: market consolidation and service externalization. Markets are consolidating as the pace of merger, investment, and acquisition intensifies. Yet within companies, core services are also increasingly being externalized, delivered by a network of external parties that includes outsourcers, demand and supply chain partners, consultants, and contractors. This dynamic environment presents clear business needs, which can be summarized as the Five Rules of the Extranet which are as follows:.

Be as flexible as the business : An extranet must be driven by the demands of the market, not the limitations of technology. It must be extremely flexible and allow companies to immediately deploy extranet services that best fit the business need, be it intimate supply chain partners using a wide range of applications or mass e-commerce extranets driven by Web-based applications.

Deploy in "Internet time" : To deploy an extranet, companies shouldn't have to roll out a new infrastructure or go through a major re-architecting of their applications. To remain market-driven, enterprises must be able to deploy their extranet quickly, and leverage their existing infrastructure to do so.

Protect the interests of the data owner : Extranet services need to be deployed in a fast and flexible way, but with the complete assurance that only the correct users can access the right services. An extranet must ensure that what's supposed to be private, stays private.

Serve the partner as a customer : An extranet presents a very important and delicate balance: providing customer service to key partners (who might also be customers) in a competitive environment with mission-critical resources at risk. The final solution must be an extranet without compromise. Partners should never be required to change their security policies, networks, applications, and firewalls for the "good" of the extranet community.

Drive information to the decision-maker : An extranet must provide a central means to measure progress, performance, and popularity. Business units deploying applications need to understand which extranet content and applications are most successful.

4.5 INTERNET PROTOCOL SUITE

The **Internet protocol suite** is the set of communications protocols that implement the protocol stack on which the Internet and most commercial networks run.

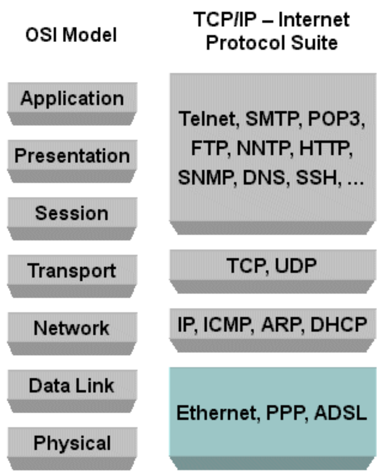


Fig 4.5.1 Diagram showing OSI Model & TCP / IP – Internet Protocol Suite

It is sometimes called the **TCP/IP** protocol suite, after the two most important protocols in it: the Transmission Control Protocol (TCP) and the Internet Protocol (IP), which were also the first two defined. Fig. 4.5.1 shows OSI Model & TCP/IP Model.

The Internet protocol suite — like many protocol suites — can be viewed as a set of layers, each layer solves a set of problems involving the transmission of data, and provides a well-defined service to the upper layer protocols based on using services from some lower layers. Upper layers are logically closer to the user and deal with more abstract data, relying on lower layer protocols to translate data into forms that can eventually be physically transmitted.

The **OSI model** describes a fixed, seven layer stack for networking protocols. Comparisons between the OSI model and TCP/IP can give further insight into the significance of the components of the IP suite, but can also cause confusion, as TCP/IP consists of only 4 layers.

Layer	TCP / IP Protocols
Application	DNS, TLS/SSL, TFTP, FTP, HTTP, IMAP, IRC, NNTP, POP3, SIP, SMTP, SNMP, SSH, TELNET, BitTorrent, RTP, rlogin, ...
Transport	TCP, UDP, DCCP, SCTP, IL, RUDP, ...

Network	IP (IPv4, IPv6), ICMP, IGMP, ARP, RARP, ...
Link	Ethernet, Wi-Fi, Token ring, PPP, SLIP, FDDI, ATM, DTM, Frame Relay, SMDS

4.6 ELECTRONIC COMMERCE

Electronic commerce and its related technologies are unquestionably the current leading-edge business and finance delivery systems for the 21st Century. The explosion in the application of technologies and the delivery of these technologies into the hands of consumers has made the vision, the dream, the fantasy, of conducting business electronically, anywhere in the global community, a reality. Electronic Commerce (EC) is no longer just a concept; it is a market force to be reckoned with. As more and more organizations launch Internet/World Wide Web (WWW) home pages and intranets to disseminate company/product information, and expand their customer base, countless yet unnamed companies are just beginning to investigate this alternative. These companies are realizing that business via the Internet is inevitability that they will not be able to ignore. The lure of reaching additional customers, expanding market shares, providing value-added services, advancing technological presence, and increasing corporate profits is just too valuable to disregard, and will eventually attract companies to electronic commerce like moths to a flame.

Many businesses will rush headlong into this cyber marketplace in an attempt to stake their claim to these potential riches, unaware of the risks which await them as they venture forth into this “new frontier.” Unfortunately, if not properly controlled, the organization’s leap to electronic commerce will result in the same fate as the moth’s fatal attraction to the flame. The move to “cyber-business” requires the commitment of the entire corporation. Accounting and audit professionals along with security, telecommunications, legal, and marketing personnel must all become involved with the planning, securing and control of this electronic business.

4.6.1 Defining Electronic Commerce : Electronic commerce is quickly entering our daily vocabulary, becoming common terminology. But, what exactly is electronic commerce, and why is EC quickly becoming a phenomenon to be reckoned with?

Depending upon the industry, and upon the company’s grasp of technology and the implementation of that technology into the fabric of daily processing activities, EC has varied definitions. A fairly broad definition of EC is given below:

Electronic commerce is the process of doing business electronically. It involves the automation of a variety of business-to-business and business-to-consumer transactions through reliable and secure connections.

It would be unfair to give the impression that this is an all-inclusive definition for such an evolving, maturing business strategy. To demonstrate, a limited examination of EC-related literature revealed the following definitions of EC:

- Electronic Commerce is a composite of technologies, processes and business strategies that foster the instant exchange of information within and between organizations. EC strengthens relationships with buyers, makes it easier to attract new customers, improves (and in some cases reinvents) customer responsiveness, and opens new markets on a global scale. (Greg Martin, Interchange Software Group of Sterling Commerce)
- Electronic Commerce is the application of various communications technologies to provide the automated exchange of business information with internal and external customers, suppliers and financial institutions. Examples of these technologies include Electronic Data Interchange (EDI), bar coding, scanning, E-mail and fax, to name a few. The bottom line is that Electronic Commerce requires a paradigm shift in the way corporations do business today. (Electronic Commerce Forum)
- Electronic Commerce, simply put, is the automation of the business process between buyers and sellers. (IBM Corporation)
- Electronic business transactions, without paper documents, using computer and telecommunication networks. These networks can be either private or public, or a combination of the two. Traditionally, the definition of electronic commerce has focused on Electronic Data Interchange (EDI) as the primary means of conducting business electronically between entities having a pre-established contractual relationship. More recently, however, the definition of electronic commerce has broadened to encompass business conducted over the Internet (specifically the Web) and includes entities not previously known to each other. This is due to the Web's surge in popularity and the acceptance of the Internet as a viable transport mechanism for business information. The use of a public network-based infrastructure like the Internet can reduce costs and "level the playing field" for small and large businesses. This allows companies of all sizes to extend their reach to a broad customer base. (The American Institute of Certified Public Accountants).

Thus, it should be apparent that currently there is no single, globally accepted definition of EC, and there may never be EC could be considered a methodology which, depending on an organization's needs, can involve different technologies and value-added services. These technologies and services can include, but are not be limited to: electronic data interchange (EDI), e-mail, electronic funds transfer (EFT), electronic benefits transfer (EBT), electronic forms, digital cash (DC), interoperable database access, bulletin boards (BBs), electronic catalogs, intranets, cable services, World Wide Web (WWW)/Internet services, electronic banking (EB), Web broadcasting, push technologies, Web site management tools, Extranets, Internet Telephony, Bar-coding - 2D, Imaging, Internet - Electronic Forms, Internet - Publishing, , Voice Recognition, security services such as firewalls, encryption, and gateway managers and many more.

Thus, EC is not a single technology, but rather a sophisticated combination of technologies and consumer-based services integrated to form a new paradigm in business transaction processing. The future of EC is bright and viable—the application, however, has not yet reached full integration into the business mainstream. Several significant hurdles remain, which must be cleared before electronic commerce will become a mainstay business strategy.

Electronic Commerce impacts a broad number of business activities such as:

- marketing, sales and sales promotion
- pre-sales, subcontracts, supply
- financing and insurance
- commercial transactions: ordering, delivery, payment
- product service and maintenance
- co-operative product development
- distributed co-operative working
- use of public and private services
- business-to-administrations (concessions, permissions, tax, customs, etc)
- transport and logistics
- public procurement
- automatic trading of digital goods
- accounting

4.6.2 Working of E-Commerce: Following is a step by step online transaction processing in an e-commerce environment:

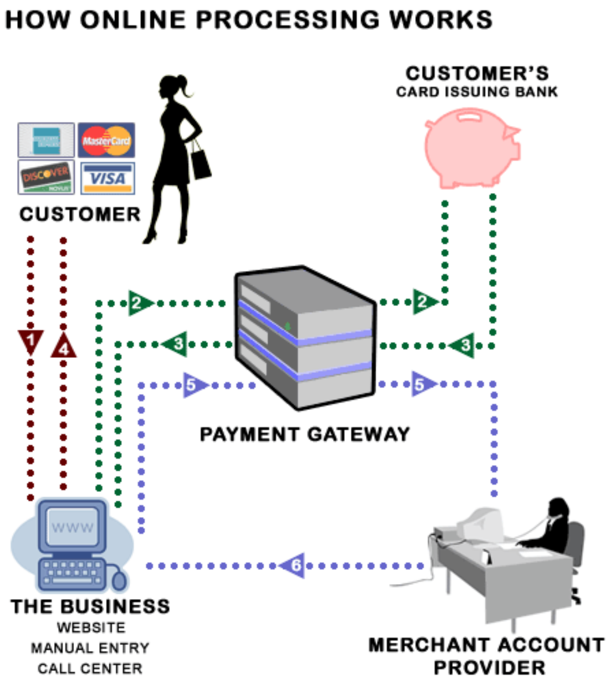


Fig 4.6.2.1 E-Commerce Transaction

Order Placed : Customer places order through secure connection on website, or merchant manually keys in transaction.

Authorization Request : Payment Gateway receives the transaction through the secure internet connection, encrypts it, and submits an authorization to the credit card issuing bank.

Authorization Response : Credit card issuing bank either approves or declines the request and sends a response back through the payment gateway to the website.

Order Fulfilled : Once approved the merchant processes and ships the customer's order.

Settlement Request : The Payment Gateway sends a settlement request to the merchant account provider each day that transactions are processed.

Settlement Deposited : The merchant account provider deposits the amount for each settlement into the merchant's bank account. Usually takes 24 - 48 hours.

Fig. 4.6.2.1 also shows how online processing works.

4.6.3 Benefits of Electronic Commerce Application and Implementation : EC presents many benefits to individual organizations, consumers, and society as a whole.

1. Reduced costs to buyers from increased competition in procurement as more suppliers are able to compete in an electronically open marketplace.
2. Reduced errors, time, and overhead costs in information processing by eliminating requirements for re-entering data.
3. Reduced costs to suppliers by electronically accessing on-line databases of bid opportunities, on-line abilities to submit bids, and on-line review of rewards.
4. Reduced time to complete business transactions, particularly from delivery to payment.
5. Creation of new markets through the ability to easily and cheaply reach potential customers.
6. Easier entry into new markets, especially geographically remote markets, for companies of all sizes and locations.
7. Better quality of goods as specifications are standardized and competition is increased and improved variety of goods through expanded markets and the ability to produce customized goods.
8. Faster time to market as business processes are linked, enabling seamless processing and eliminating time delays.
9. Optimization of resource selection as businesses form cooperative teams to increase the chances of economic successes, and to provide the customer products and capabilities more exactly meeting his or her requirements.
10. Reduced inventories and reduction of risk of obsolete inventories as the demand for goods and services is electronically linked through just-in-time inventory and integrated manufacturing techniques.
11. Ability to undertake major global programs in which the cost and personnel needed to manage a non-automated system would be unreasonable or prohibitive.
12. Reduced overhead costs through uniformity, automation, and large-scale integration of management processes.
13. Reduced use of ecologically damaging materials through electronic coordination of activities and the movement of information rather than physical objects)

14. Reduced advertising costs.
15. Reduced delivery cost, notably for goods that can also be delivered electronically.
16. Reduced design and manufacturing cost.
17. Improved market intelligence and strategic planning.
18. More opportunity for niche marketing.
19. Equal access to markets (i.e. for small-to-medium enterprises (SMEs) vis-a-vis larger corporations)
20. Access to new markets.
21. Customer involvement in product and service innovation (Caniglia 1996, Timmers, 1996)

Clearly, the benefits of corporate-wide implementation of EC are many, and this list is by no means complete. With the benefits, however, also come the risks. An organization should be cautious not to leap blindly into EC, but rather first develop an EC strategy, and then organize a corporate-wide team to implement that strategy. Key users throughout the organization should be represented on this implementation team.

4.6.4 The Internet's Role in Electronic Commerce : Why is the Internet considered a viable alternative to traditional commerce methods? The answer lies in the sheer number of potential consumers or business partners in an existing and extremely cost-effective network. Where else can tens of millions of potential consumers be reached at virtually no network cost? Now virtually may be stretching it a bit, since there are some costs involved, however, those costs are largely fixed costs. Today the Internet provides an inexpensive and information-rich, shared, multimedia network interconnecting more than 100 million users and 50 million servers, in more than 150 countries.

When comparing the enormous costs of a private network and the associated limits in terms of access to consumers, electronic commerce (on the Internet) appears to be a godsend. In fact, it has been claimed that doing Electronic Data Interchange (EDI) (discussed in subsequent section) over the Internet is less expensive than using private networks by as much as 90%.

At least six reasons exist for the Internet's dramatic impact on the scope of business networking applications and for the Internet's emergence as the foundation for the world's new information infrastructure:

1. **Universality**—Any business using the Internet can interact with any other business using the Internet. This is by no means true of earlier networking technologies that allowed businesses to ship goods to only those companies connected to the same network.

2. **Reach**—The Internet is everywhere: large cities and small towns throughout the modern and developing world.

3. **Performance**—Unlike many other public networks, the Internet can handle visual images, audio clips, and other large electronic objects. It provides its users with a high-function window to the world, in addition to handling everyday networking tasks such as electronic mail.

4. **Reliability--**The design concepts for the Internet came out of U.S. Department of Defense. Hence, Internet technology is highly robust and reliable, in spite of significant differences in the extent to which various Internet service providers actually implement and ensure this reliability.

5. **Cost**—Compared with alternative networking technologies, Internet costs are surprisingly low.

6. **Momentum**—Tens of millions of individuals are already connected to the Internet and business use is increasing at a dramatic rate.

4.6.5 Electronic Commerce (EC) and Internet successes - Two successful areas in Web based electronic commerce have been through the sales of books and electronic stock transactions. Many companies have entered these two Electronic Commerce (EC) arenas, including Amazon.com and E*TRADE.

Amazon.com (http://www.amazon.com) "Earth's Biggest Bookstore" "opened its doors" on the World Wide Web in July 1995. It quickly became not only the leading online retailer of books, but also one of the most widely used and cited commerce sites on the World Wide Web. Amazon.com has 35 million customers and lists millions of unique items in categories such as electronics, kitchen and house wares, books, music, DVDs, videos, photography equipment, toys, software, computer and video games, tools and hardware, outdoor living and wireless products.

Amazon.com operates four international Web sites: www.amazon.fr, www.amazon.co.uk, www.amazon.de and www.amazon.co.jp. It also operates the Internet Movie Database (www.imdb.com), the Web's comprehensive and authoritative source of information on more than 250,000 movies and entertainment titles and 1 million cast and crew members dating from the birth of film in 1891 to the present.

Another example of a success story in Electronic Commerce (EC) on the Web is E*TRADE Group, Inc. (http://www.etrade.com/html/alliance/yahoo/team.shtml) which is a leading provider of online investing services. Since 1992, they have been offering secure, online stock and options trading to independent investors. In 1997, they added mutual fund trading capabilities to their Web site. E*Trade grew from virtually nothing to over $50 million in revenue in just a few years. With $3.7 billion in assets under management, E*Trade has become a financial force.

Advertising has become an increasingly popular revenue producer for Web sites. Companies are eager to place advertisements on heavily visited sites, such as search engines. Often these advertisements are "banners" that flash across the computer screen with the hope that the consumer will click on the banner and enter the advertiser's site. The advertising is also becoming increasingly targeted. For example, a consumer that searches on financial related matters will have targeted advertisements, such as electronic trading or mutual fund companies.

EC on the Internet is at the crossroads of explosion, and many businesses and consumers want to exploit the technology but have reservations about the security and reliability of transactions. Auditors and security personnel, as a result, will play a crucial role in helping organizations design and review security and control standards to make EC on the Internet safe and secure.

4.7 TYPES OF E-COMMERCE

There are four general classes of e-commerce applications:

(a) Business-to-Business (B2B)

(b) Business-to-Consumer (B2C)

(c) Consumer-to-Business (C2B)

(d) Consumer-to-Consumer (C2C)

4.7.1 Business-to-Business (B2B) : It is a short form of business-to-Business, the exchange of services, information and/or products from one business to another, as opposed to between a business and a consumer.

Business-to-Business electronic commerce (B2B) typically takes the form of automated processes between trading partners and is performed in much higher volumes than business-to-consumer

(B2C) applications. For example, a company that makes cattle feed would sell it to a cattle farm, another company, rather than directly to consumers. An example of a B2C transaction would be a consumer buying grain-fed cattle at a grocery store. B2B can also encompass marketing activities between businesses, and not just the final transactions that result from marketing. Business-to-Business (B2B) also is used to identify sales transactions between businesses. For example a company selling Xerox copies would likely be a B2B sales organization as opposed to a Business-to-Consumer (B2C) sales organization. Some of the examples of Business-to-Business (C2B) ecommerce websites are commodityindia.com, e2commerce.net, castingsworld.com, chemround.com.

***B2B standards*:** UN/EDIFACT is one of the most well-known and established B2B standards. ANSI ASC X12 is also a popular standard in the States. Rosetta Net is an XML based, emerging B2B standard in the heavy technology industry.

4.7.2 Business-to-Customer (B2C) : It is a short form of Business-to-Consumer, the exchange of services, information and/or products from a business to a consumer, as opposed to between one business and another. Business-to-consumer electronic commerce (B2C) is a form of electronic commerce in which products or services are sold from a firm to a consumer.

Two Classifications of B2C E-Commerce are –

(a) ***Direct Sellers :*** Companies that provide products or services directly to customers are called direct sellers. There are two types of direct sellers: E-tailers and Manufacturers.

(i) **E-tailers :** Upon receiving an order, the E-tailer ships products directly to the consumer or to a wholesaler or manufacturer for delivery.

(ii) **Manufacturers :** The manufacturer sells directly to consumers via the Internet. The goal is to remove intermediaries, through a process called dis-intermediation, and to establish direct customer relationships. Dis-intermediation is not a new idea as catalog companies have been utilizing this method for years.

(b) ***Online Intermediaries :*** Online intermediaries are companies that facilitate transactions between buyers and sellers and receive a percentage. There are two types of online intermediaries: brokers and infomediaries.

(i) **Brokers:** A broker is a company that facilitates transactions between buyers and sellers. There are various t*ypes of Brokers*:

- Buy/Sell Fulfillment – A corporation that helps consumers place buys and sell orders.
- Virtual Mall – A company that helps consumers buys from a variety of stores.
- Metamediary – A firm that offers customers access to a variety of stores and provides them with transaction services, such as financial services.
- Bounty – An intermediary that offers a fee to locate a person, place, or idea.
- Search Agent – A company that helps consumers compare different stores.
- Shopping Facilitator – A company that helps consumers uses online shops easier and potentially in a user customized interface, by providing currency conversion, language translation, and payment and delivery solutions.

(ii) Infomediaries:

- Advertising-Based Models : In an advertising-based system, businesses' sites have ad inventory, which they sell to interested parties. There are two guiding philosophies for this practice: high-traffic or niche. Advertisers take a high-traffic approach when attempting to reach a larger audience. These advertisers are willing to pay a premium for a site that can deliver high numbers, for example advertisements on any web site. When advertisers are trying to reach a smaller group of buyers, they take a niche approach. These buyers are well-defined, clearly identified, and desirable. The niche approach focuses on quality, not quantity. For example, an advertisement may be mainly viewed by business people and executives.
- Community-Based Models : In a community-based system, companies allow users worldwide to interact with each other on the basis of similar areas of interest. These firms make money by accumulating loyal users and targeting them with advertising.
- Fee-Based Models : In a fee-based system, a firm charges a subscription fee to view its content. There are varying degrees of content restriction and subscription types ranging from flat-fees to pay-as-you-go.

The Business-to-Consumer (B2C) model can save time and money by doing business electronically but customers must be provided with safe and secure as well as easy-to-use and convenient options when it comes to paying for merchandise. This minimizes internal costs created by inefficient and ineffective supply chains and creates reduces end prices for your customers. This could be beneficial especially if you are in the business of commodity-like products where you must be innovative and accommodating to gain and retain customers.

Payment Options for B2C E-commerce businesses**:** The following are types of online payment options that could be used in B2C E-commerce:

Financial cyber mediary: an internet based company that facilitates payment between two individuals online usually by credit card.

Electronic Cheque: transferring money from your checking account to another over the internet.

Electronic bill presentment and payment (EBPP): a Computer system that generates electronic bills and sends them to customers over the internet.

Smart Card: Debit cards that contain information about how much money you have and deduct purchases from that total. These are provided by all banks.

B2C can be used no matter what product is being offered online. The following are the types of merchandise that can be sold easily online by a B2C E-commerce business: Convenience Goods: low priced products but that are bought frequently Specialty Goods: high priced merchandise that is ordered rarely and usually requires customization Commodity-like Goods: products that are the same where ever they are bought and are highly substituted. Digital Goods: products that are created and sent electronically. These are the best to provide given their low cost to keep in inventory and ship.

ADVANTAGES OF B2C E-COMMERCE

(i) Shopping can be faster and more convenient.

(ii) Offerings and prices can change instantaneously.

(iii) Call centers can be integrated with the website.

(iv) Broadband telecommunications will enhance the buying experience.

Challenges Faced by B2C E-Commerce: The two main challenges faced by b2c e-commerce are building traffic and sustaining customer loyalty. Due to the winner-take-all nature of the b2c structure, many smaller firms find it difficult to enter a market and remain competitive. In addition, online shoppers are very price-sensitive and are easily lured away, so acquiring and keeping new customers is difficult.

4.7.3 Consumer-to-Business (C2B) : Customer directly contact with business vendors by posting their project work with set budge online so that the needy companies review it and contact the customer directly with bid. The consumer reviews all the bids and selects the company for further processing. Some examples are guru.com, rentacoder.com, getacoder.com, freelancer.com.

4.7.4 Consumer-to-Consumer (C2C) : Consumer-to-Consumer electronic commerce (abbreviated C2C) is an internet-facilitated form of commerce that has existed for the span of history in the form of barter, flea markets, swap meets, yard sales and the like. Most of the highly successful Consumer-to-Consumer (C2C) examples using the Internet take advantage of some type of corporate intermediary and are thus not strictly good examples of Consumer-to-Consumer (C2C).

Companies using internal networks to offer their employees products and services online--not necessarily online on the Web--are engaging in B2E (Business-to-Employee) ecommerce. G2G (Government-to-Government), G2E (Government-to-Employee), G2B (Government-to-Business), B2G (Business-to-Government), G2C (Government-to-Citizen), C2G (Citizen-to-Government) are other forms of ecommerce that involve transactions with the government--from procurement to filing taxes to business registrations to renewing licenses.

4.8 CRM

Customer Relationship Management (CRM) includes the methodologies, technology and capabilities that help an enterprise manage customer relationships. The general purpose of CRM is to enable organizations to manage their customers in a better way through the introduction of reliable systems, processes and procedures. Fig. 4.8.1 shows an overview of customer relationship management (CRM). The complete approach of customer relationship management (CRM) is shown in 4.8.4.

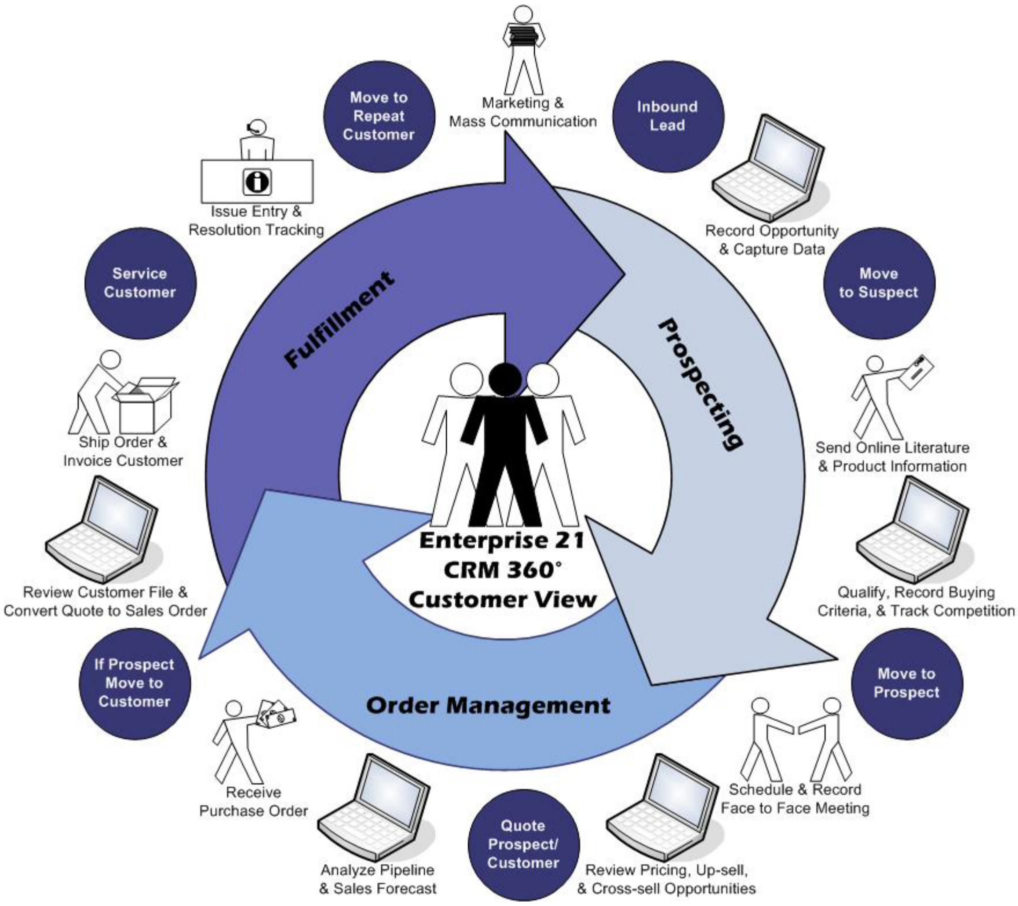


Fig 4.8.1 Customer Relationship Management

Implementing CRM: Customer Relationship Management is a corporate level strategy which focuses on creating and maintaining lasting relationships with its customers. Although there are several commercial CRM software packages on the market which support CRM strategy, it is not a technology itself. Rather, a holistic change in an organization's philosophy which places emphasis on the customer.

A successful CRM strategy cannot be implemented by simply installing and integrating a software package and will not happen over night. Changes must occur at all levels including policies and processes, front of house customer service, employee training, marketing, systems and information management; all aspects of the business must be reshaped to be customer driven. A CRM framework is shown in Fig.4.8.2.

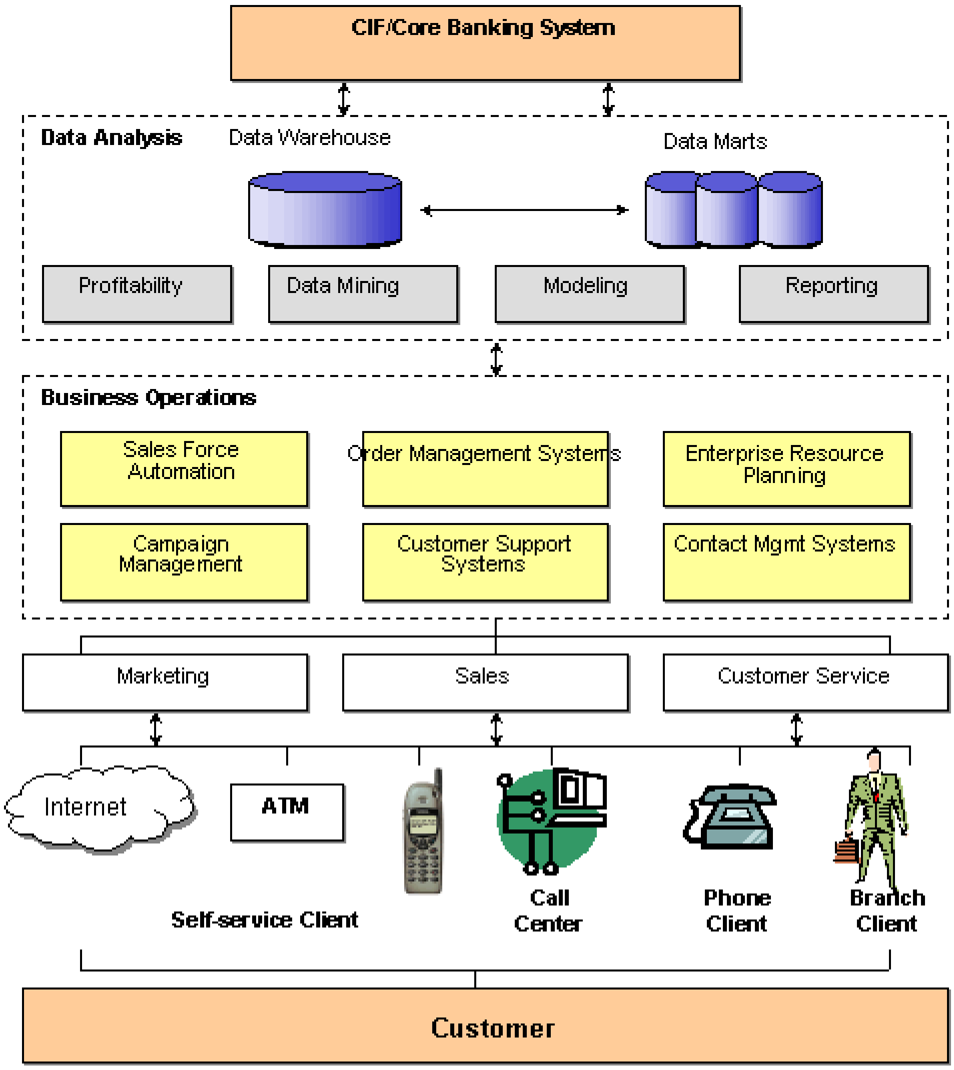


Fig 4.8.2 CRM Framework

To be effective, the CRM process needs to be integrated end-to-end across marketing, sales, and customer service. A good CRM program needs to:

(i) Identify customer success factors

(ii) Create a customer-based culture

(iii) Adopt customer-based measures

(iv) Develop an end-to-end process to serve customers

(v) Recommend what questions to ask to help a customer solve a problem

(vi) Recommend what to tell a customer with a complaint about a purchase

(vii) Track all aspects of selling to customers and prospects as well as customer support.

When setting up a CRM segment for a company it might first want to identify what profile aspects it feels are relevant to its business, such as what information it needs to serve its customers, the customer's past financial history, the effects of the CRM segment and what information is not useful. Being able to eliminate unwanted information can be a large aspect of implementing CRM systems.

When designing a CRM's structure, a company may want to consider keeping more extensive information on their primary customers and keeping less extensive details on the low-margin clients

Architecture of CRM: There are three parts of application architecture of CRM as shown in Fig. 4.8.3 :-

(i) Operational - automation is provided to the basic business processes like marketing, sales, service.

(ii) Analytical - support to analyze customer behavior, implements business intelligence alike technology.

(iii) Collaborative - ensures the contact with customers like phone, email, fax, web, sms, post, in person.

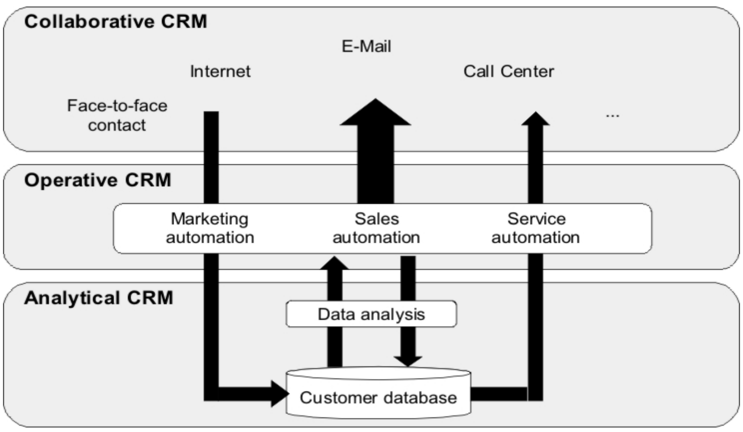


Fig 4.8.3 Key Elements of CRM Architecture

(i) Operational CRM: Operational CRM means supporting the front office business processes, which include customer contact like sales, marketing and service. Tasks resulting from these processes are forwarded to employees responsible for them, as well as the information necessary for carrying out the tasks and interfaces to back-end applications are being provided and activities with customers are being documented for further reference.

It provides the following benefits –

- Delivers personalized and efficient marketing, sales, and service through multi-channel collaboration.
- Enables a reverse view of the customer while the organization is interacting with them.
- Sales people and service engineers can access complete history of all customer interaction with your company, regardless of the touch point.

The operational part of CRM typically involves three general areas of business –

- **Sales force automation (SFA)** : SFA automates some of the company's critical sales and sales force management functions, for example, lead/account management, contact management, quote management, forecasting, sales administration, keeping track of customer preferences, buying habits, and demographics, as well as performance management. SFA tools are designed to improve field sales productivity. Key infrastructure requirements of SFA are mobile synchronization and integrated product configuration.
- **Customer service and support (CSS)** : CSS automates some service requests, complaints, product returns, and information requests. Traditional internal help desk and traditional inbound call-center support for customer inquiries are now evolved into the "customer interaction center" (CIC), using multiple channels (Web, phone/fax, face-to-face, kiosk, etc) Key infrastructure requirements of CSS include computer telephony integration (CTI) which provides high volume processing capability, and reliability.
- **Enterprise marketing automation (EMA)** : EMA provides information about the business environment, including competitors, industry trends, and macro environmental variables. It is the execution side of campaign and lead management. The intent of EMA applications is to improve marketing campaign efficiencies. Functions include demographic analysis, variable segmentation, and predictive

modeling occur on the analytical (Business Intelligence) side. Integrated CRM software is often also known as front office solutions. This is because they deal directly with the customer. Many call centers use CRM software to store all of their customer's details. When a customer calls, the system can be used to retrieve and store information relevant to the customer. By serving the customer quickly and efficiently, and also keeping all information of a customer in one place, a company aims to make cost savings, and also encourage new customers. CRM solutions can also be used to allow customers to perform their own service via a variety of communication channels. For example, you might be able to check your bank balance via your WAP phone without ever having to talk to a person, saving money for the company, and saving your time.

Fig 4.8.4 CRM (A Complete Approach)

(ii) Analytical CRM : In analytical CRM, data gathered within operational CRM and/or other sources are analyzed to segment customers or to identify potential to enhance client relationship. Customer analysis typically can lead to targeted campaigns to increase share of customer's wallet. Examples of Campaigns directed towards customers are:

(i) Acquisition: Cross-sell, up-sell

(ii) Retention: Retaining customers who leave due to maturity or attrition.

(iii) Information: Providing timely and regular information to customers.

(iv) Modification: Altering details of the transactional nature of the customers' relationship.

Analysis typically covers but is not limited to decision support:

(i) Dashboards, reporting, metrics, performance etc.

(ii) Predictive modeling of customer attributes

(iii) Strategy and research.

(iv) Analysis of Customer data may relate to one or more of the following analyses:

(v) Campaign management and analysis

(vi) Contact channel optimization

(vii) Contact Optimization

(viii) Customer Acquisition / Reactivation / Retention

(ix) Customer Segmentation

(x) Customer Satisfaction Measurement / Increase

(xi) Sales Coverage Optimization

(xii) Fraud Detection and analysis

(xiii) Financial Forecasts

(xiv) Pricing Optimization

(xv) Product Development

(xvi) Program Evaluation

(xvii) Risk Assessment and Management

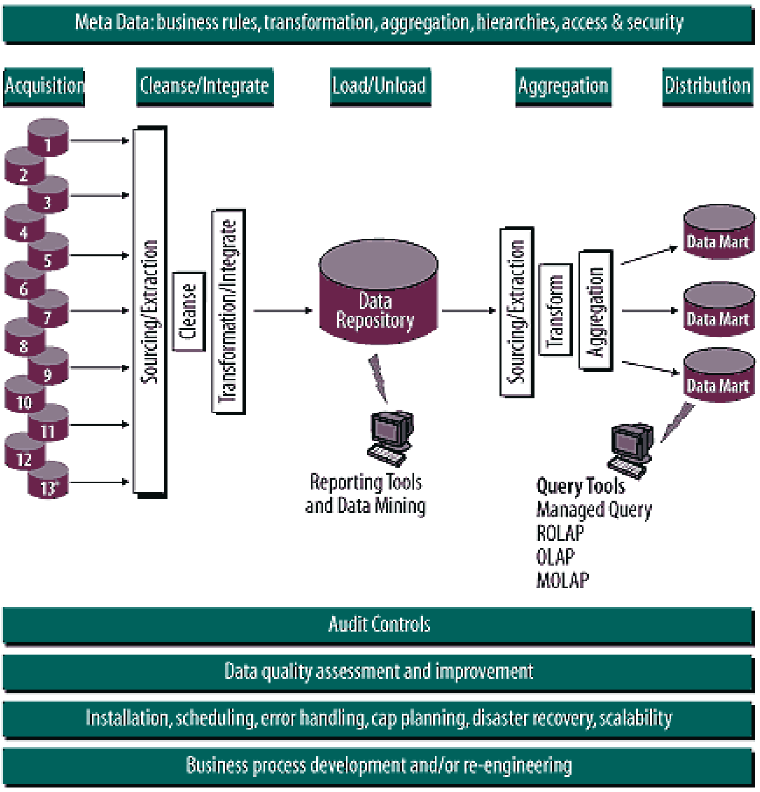


Fig 4.8.5 Analytical CRM Architecture

Data collection and analysis is viewed as a continuing and iterative process. Ideally, business decisions are refined over time, based on feedback from earlier analysis and decisions. Therefore, most successful analytical CRM projects take advantage of a data warehouse to provide suitable data.

Business Intelligence is a related discipline offering some more functionality as separate application software. Analytical CRM architecture is shown in Fig. 4.8.5.

(iii) Collaborative CRM : Collaborative CRM facilitates interactions with customers through all channels like personal, letter, fax, phone, web, E-mail and supports co-ordination of employee teams and channels. It is a solution that brings people, processes and data together so companies can better serve and retain their customers. The data/activities can be structured, unstructured, conversational, and/or transactional in nature.

Collaborative CRM provides the following benefits –

(i) Enables efficient productive customer interactions across all communications channels

(ii) Enables web collaboration to reduce customer service costs

(iii) Integrates call centers enabling multi-channel personal customer interaction

(iv) Integrates view of the customer while interaction at the transaction level

Purposes of Customer Relationship Management – CRM, in its broadest sense, means managing all interactions and business with customers. This includes, but is not limited to, improving customer service. A good CRM program will allow a business to acquire customers, service the customer, increase the value of the customer to the company, retain good customers, and determine which customers can be retained or given a higher level of service. A good CRM program can improve customer service by facilitating communication in several ways –

(i) Provide product information, product use information, and technical assistance on web sites that are accessible round the clock.

(ii) Identify how each individual customer defines quality, and then design a service strategy for each customer based on these individual requirements and expectations.

(iii) Provide a fast mechanism for managing and scheduling follow-up sales calls to assess post-purchase cognitive dissonance, repurchase probabilities, repurchase times, and repurchase frequencies.

(iv) Provide a mechanism to track all points of contact between a customer and the company, and do it in an integrated way so that all sources and types of contact are included, and all users of the system see the same view of the customer (reduces confusion)

(v) Help to identify potential problems quickly, before they occur.

(vi) Provide a user-friendly mechanism for registering customer complaints (complaints that are not registered with the company cannot be resolved, and are a major source of customer dissatisfaction)

(vii) Provide a fast mechanism for handling problems and complaints (complaints that are resolved quickly can increase customer satisfaction)

(viii) Provide a fast mechanism for correcting service deficiencies (correct the problem before other customers experience the same dissatisfaction)

(ix) Use internet cookies to track customer interests and personalize product offerings accordingly.

(x) Use the Internet to engage in collaborative customization or real-time customization.

(xi) Provide a fast mechanism for managing and scheduling maintenance, repair, and on-going support (improve efficiency and effectiveness)

(xii) The CRM can be integrated into other cross-functional systems and thereby provide accounting and production information to customers when they want it.

Improving customer relationships : CRM programs also are able to improve customer relationships. Proponents say this is so because –

CRM technology can track customer interests, needs, and buying habits as they progress through their life cycles, and tailor the marketing effort accordingly. These way customers get exactly what they want as they change.

The technology can track customer product use as the product progresses through its life cycle, and tailor the service strategy accordingly. These way customers get what they need as the product ages.

In industrial markets, the technology can be used to micro-segment the buying centre and help coordinate the conflicting and changing purchase criteria of its members.

When any of the technology-driven improvements in customer service (mentioned above) contribute to long-term customer satisfaction, they can ensure repeat purchases, improve customer relationships, increase customer loyalty, decrease customer turnover, decrease marketing costs (associated with customer acquisition and customer “training”), increase sales revenue, and thereby increase profit margins.

Repeat purchase, however, comes from customer satisfaction - which in turn comes from a deeper understanding of each customer, their individual business challenges and proposing solutions for those challenges rather than a "one size fits all" approach.

CRM software enables sales people to achieve this one on one approach to selling and can automate some elements of it via tailorable marketing communications. However, all of these elements are facilitated by or for humans to achieve - CRM is therefore a company-wide attitude as much as a software solution.

Technical functionality : A CRM solution is characterized by the following functionality:

Scalability: the ability to be used on a large scale, and to be reliably expanded to whatever scale is necessary.

Multiple communication channels: the ability to interface with users via many different devices (phone, WAP, internet, etc)

Workflow: the ability to trigger a process in the back office system, e. g. Email Response, etc.

Assignment: the ability to assign requests (Service Requests, Sales Opportunities) to a person or group.

Database: the centralized storage (in a data warehouse) of all information relevant to customer interaction

Customer privacy considerations: the data encryption and the destruction of records are needed to ensure that they are not stolen or abused.

Privacy and ethical concerns : CRM programs are not however considered universally good - some feel it invades customer privacy and enable coercive sales techniques due to the information companies now have on customers. However, CRM does not necessarily imply gathering new data, it can be used merely to make better use of data the corporation already has. But in most cases they are used to collect new data.

Some argue that the most basic privacy concern is the centralized database itself, and that CRM's built this way are inherently privacy-invasive.

CRM in Business : The use of internet sites and specifically E-mail, in particular, are often touted as less expensive communication methods in comparison to traditional ones such as telephone calls. These types of technologies service can be very helpful, but it is completely useless to a business that cannot reach its customers. Some major companies believe that the majority of their clients trust other means of communication, like telephone, more than they trust E-mail. Clients, however, are usually not the ones to blame because it is often the manner of connecting with consumers on a personal level making them feel as though they are cherished as customers. It is up to companies to focus on reaching every customer and developing a relationship.

It is possible for CRM software to run an entire business. From prospect and client contact tools to billing history and bulk email management. The CRM system allows a business to maintain all customer records in one centralized location that is accessible to an entire organization through password administration. Front office systems are set up to collect data from the customers for processing into the data warehouse. The data warehouse is a back office system used to fulfill and support customer orders. All customer information is stored in the data warehouse. Back office CRM makes it possible for a company to follow sales, orders, and cancellations. Special regressions of this data can be very beneficial for the marketing division of a firm/company.

CRM for nonprofit organizations *:* CRM is also important to non-profit organizations, which sometimes use the terms like constituent relationship management, contact relationship management or community relationship management to describe their information systems for managing donors, volunteers and other supporters.

4.9 SUPPLY CHAIN MANAGEMENT

Supply chain management (SCM) is the process of planning, implementing, and controlling the operations of the supply chain with the purpose to satisfy customer requirements as efficiently as possible. Supply chain management spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point-of-origin to point-of-consumption. An overview of Supply Chain Management is shown in Fig. 4.9.1 and in Fig. 4.9.2.

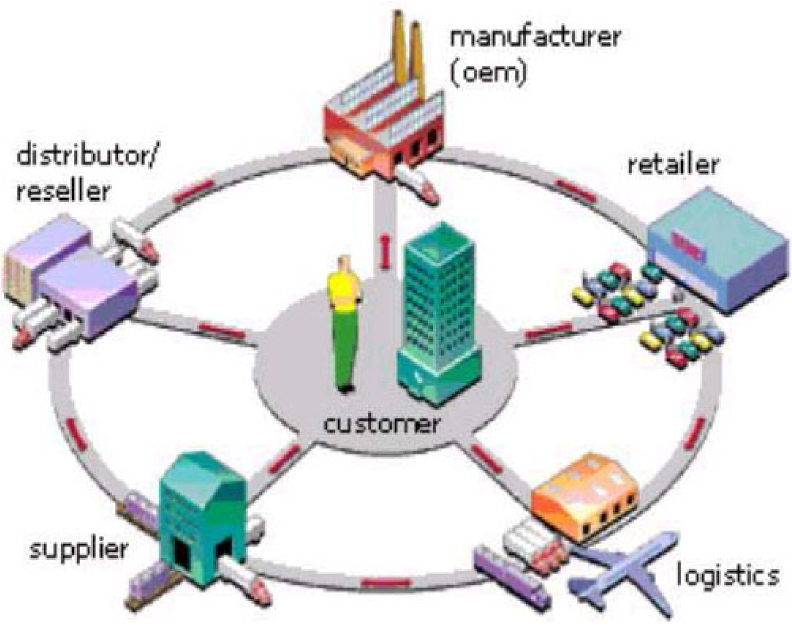


Fig 4.9.1 Supply Chain Management

According to the Council of Supply Chain Management Professionals (CSCMP), a professional association that developed a definition in 2004, Supply Chain Management *encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, Supply Chain Management integrates supply and demand management within and across companies*.

Supply chain event management (abbreviated as SCEM) is a consideration of all possible occurring events and factors that can cause a disruption in a supply chain. With SCEM possible scenarios can be created and solutions can be planned.

Some experts distinguish supply chain management and logistics management, while others consider the terms to be interchangeable. From the point of view of an enterprise, the scope of supply chain management is usually bounded on the supply side by supplier's suppliers and on the customer side by customer's customers.

Opportunities enabled by Supply Chain Management – The following strategic and competitive areas can be used to their full advantage if a supply chain management system is properly implemented.

Fulfillment: Ensuring the right quantity of parts for production or products for sale arrive at the right time and is enabled through efficient communication, ensuring that orders are placed with the appropriate amount of time available to be filled. The supply chain management system also allows a company to constantly see what is on stock and making sure that the right quantities are ordered to replace stock.

Logistics: *Keeping the cost of transporting materials as low as possible consistent with safe and reliable delivery*. Here the supply chain management system enables a company to have constant contact with its distribution team, which could consist of trucks, trains, or any other mode of transportation. The system can allow the company to track where the required materials are at all times. As well, it may be cost effective to share transportation costs with a partner company if shipments are not large enough to fill a whole truck and this again, allows the company to make this decision.

Production: Ensuring production lines function smoothly because high-quality parts are available when needed. Production can run smoothly as a result of fulfillment and logistics being implemented correctly. If the correct quantity is not ordered and delivered at the requested time, production will be halted, but having an effective supply chain management system in place will ensure that production can always run smoothly without delays due to ordering and transportation.

Revenue & profit: *Ensuring no sales are lost because shelves are empty*. Managing the supply chain improves a company's flexibility to respond to unforeseen changes in demand and supply. Because of this, a company has the ability to produce goods at lower prices and distribute them to consumers quicker then companies without supply chain management thus increasing the overall profit.

Costs: Keeping the cost of purchased parts and products at acceptable levels. Supply chain management reduces costs by "... increasing inventory turnover on the shop floor and in the warehouse" controlling the quality of goods thus reducing internal and external failure costs and working with suppliers to produce the most cost efficient means of manufacturing a product.

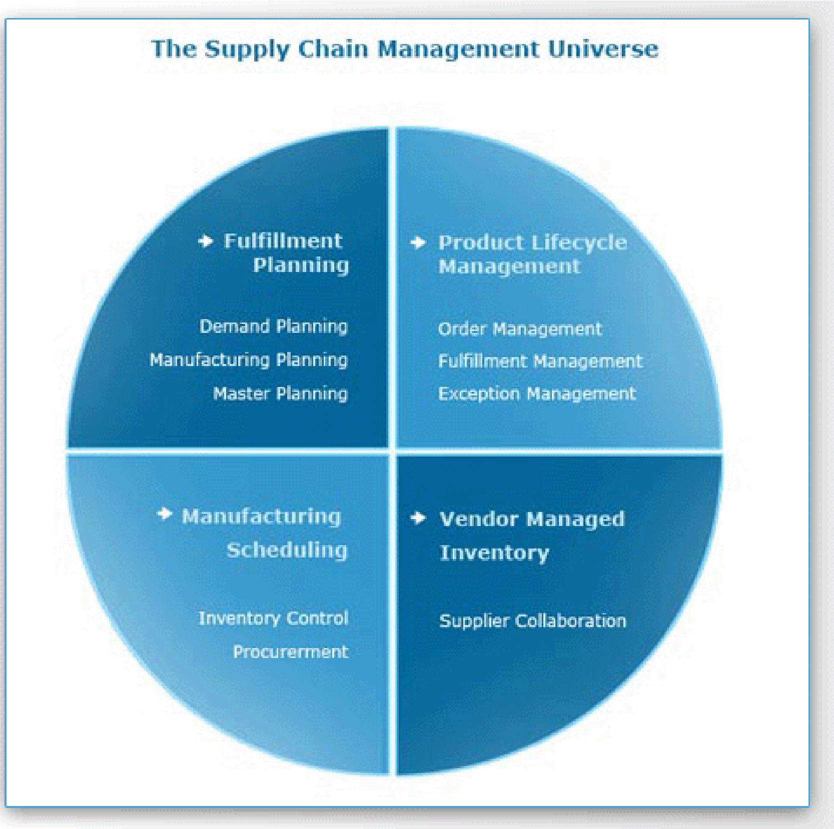


Fig 4.9.2 Supply Chain Management (Overview)

Cooperation: Among supply chain partners ensures 'mutual success'. Collaborative planning, forecasting and replenishment (CPFR) is a *longer-term commitment, joint work on quality, and support by the buyer of the supplier's managerial, technological, and capacity development*. This relationship allows a company to have access to current, reliable information, obtain lower inventory levels, cut lead times, enhance product quality, improve forecasting accuracy and ultimately improve customer service and overall profits. The suppliers also benefit from the cooperative relationship through increased buyer input from suggestions on improving the quality and costs and though shared savings. Consumers can benefit as well through higher quality goods provided at a lower cost.

Supply chain management problems: Supply chain management must address the following problems –

(i) Distribution Network Configuration: Number and location of suppliers, production facilities, distribution centers, warehouses and customers.

(ii) Distribution Strategy: Centralized versus decentralized, direct shipment, cross docking, pull or push strategies, third party logistics.

(iii) Information: Integrate systems and processes through the supply chain to share valuable information, including demand signals, forecasts, inventory and transportation.

(iv) Inventory Management: Quantity and location of inventory including raw materials, work-in-process and finished goods.

Activities/Functions: Supply chain management is a cross-functional approach to managing the movement of raw materials into an organization and the movement of finished goods out of the organization toward the end-consumer. As corporations strive to focus on core competencies and become more flexible, they have reduced their ownership of raw materials sources and distribution channels. These functions are increasingly being outsourced to other corporations that can perform the activities better or more cost effectively. The effect has been to increase the number of companies involved in satisfying consumer demand, while reducing management control of daily logistics operations. Less control and more supply chain partners led to the creation of supply chain management concepts. The purpose of supply chain management is to improve trust and collaboration among supply chain partners, thus improving inventory visibility and improving inventory velocity.

Several models have been proposed for understanding the activities required to manage material movements across organizational and functional boundaries. SCOR is a supply chain management model promoted by the Supply-Chain Council. Another model is the SCM Model proposed by the Global Supply Chain Forum (GSCF) Supply chain activities can be grouped into strategic, tactical, and operational levels of activities.

Strategic:

(i) Strategic network optimization, including the number, location, and size of warehouses, distribution centers and facilities.

(ii) Strategic partnership with suppliers, distributors, and customers, creating communication channels for critical information and operational improvements such as cross docking, direct shipping, and third-party logistics.

(iii) Product design coordination, so that new and existing products can be optimally integrated into the supply chain.

(iv) Information Technology infrastructure, to support supply chain operations.

(v) Where to make and what to make or buy decisions

Tactical:

(i) Sourcing contracts and other purchasing decisions.

(ii) Production decisions, including contracting, locations, scheduling, and planning process definition.

(iii) Inventory decisions, including quantity, location, and quality of inventory.

(iv) Transportation strategy, including frequency, routes, and contracting.

(v) Benchmarking of all operations against competitors and implementation of best practices throughout the enterprise.

(vi) Milestone Payments

Operational:

(i) Daily production and distribution planning, including all nodes in the supply chain.

(ii) Production scheduling for each manufacturing facility in the supply chain (minute by minute)

(iii) Demand planning and forecasting, coordinating the demand forecast of all customers and sharing the forecast with all suppliers.

(iv) Sourcing planning, including current inventory and forecast demand, in collaboration with all suppliers.

(v) Inbound operations, including transportation from suppliers and receiving inventory.

(vi) Production operations, including the consumption of materials and flow of finished goods.

(vii) Outbound operations, including all fulfillment activities and transportation to customers.

(viii) Order promising, accounting for all constraints in the supply chain, including all suppliers, manufacturing facilities, distribution centers, and other customers.

(ix) Performance tracking of all activities

The Bullwhip Effect: The Bullwhip Effect or Whiplash Effect is an observed phenomenon in forecast-driven distribution channels. Because customer demand is rarely perfectly stable, businesses must forecast demand in order to properly position inventory and other resources. Forecasts are based on statistics, and they are rarely perfectly accurate. Because forecast errors are a given, companies often carry an inventory buffer called *safety stock*. Moving up the supply chain from end-consumer to raw materials supplier, each supply chain participant has greater observed variation in demand and thus greater need for safety stock. In periods of rising demand, down-stream participants will increase their orders. In periods of falling demand, orders will fall or stop in order to reduce inventory. The effect is that variations are amplified the farther you get from the end-consumer. The bullwhip effect is shown in Fig. 4.9.3.

For example, with three companies having no other clients or suppliers, we have the following:

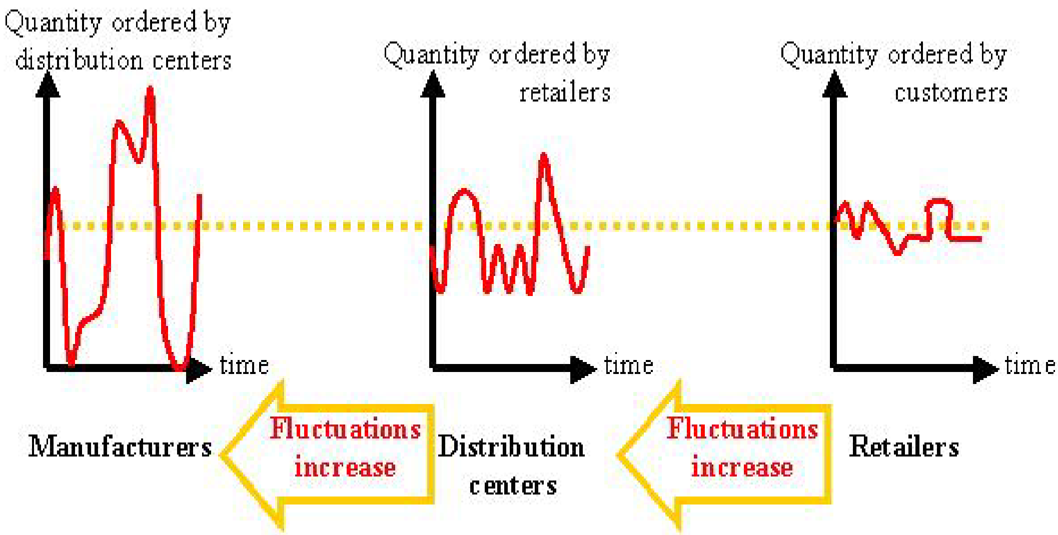


Fig 4.9.3 The Bullwhip Effect

Supply chain experts have recognized that the Bullwhip Effect is a problem in forecast-driven supply chains. The alternative is to establish a demand-driven supply chain which reacts to actual customer orders. The result is near-perfect visibility of customer demand and inventory movement throughout the supply chain. Better information leads to better inventory positioning and lower costs throughout the supply chain. Barriers to implementing a demand-driven supply chain include investments in information technology and creating a corporate culture of flexibility and focus on customer demand.

Factors contributing to the Bullwhip Effect:

(i) Forecast Errors

(ii) Lead Time Variability

(iii) Batch Ordering

(iv) Price Fluctuations

(v) Product Promotions

(vi) Inflated Orders

(vii) Methods intended to reduce uncertainty, variability, and lead time:

(viii) Vendor Managed Inventory (VMI)

(ix) Just In Time replenishment (JIT)

(x) Strategic partnership (SP)

4.10 ELECTRONIC DATA INTERCHANGE (EDI)

The term electronic data interchange has many definitions. American National Standards Institute (ANSI) has defined it as :

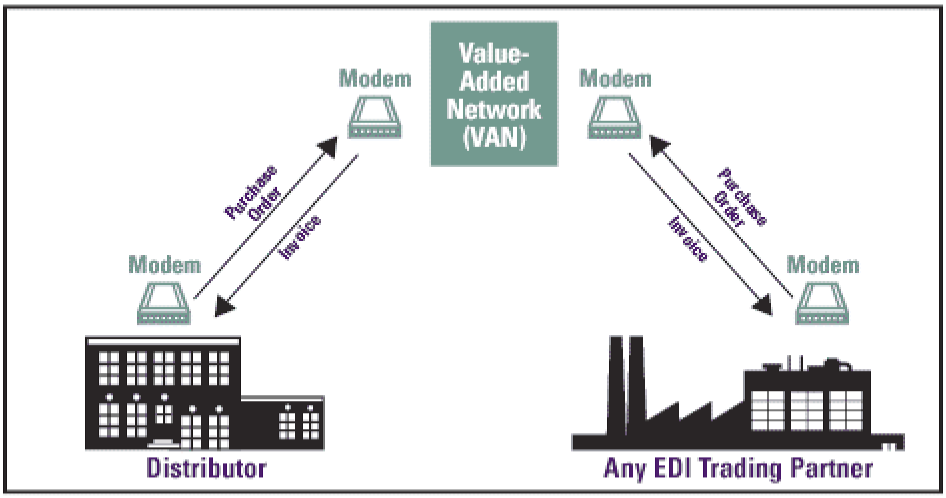
Electronic Data Interchange (EDI) is the transmission, in a standard syntax, of unambiguous information of business or strategic significance between computers of independent organisations. The users of EDI do not have to change their internal data bases. However, users must translate this information to or from their own computer system formats, but this translation software has to be prepared only once.

In simple terms, EDI is computer-to-computer communication using a standard data format to exchange business information electronically between independent organisations. Fig. 4.10.1 shows working of Electronic Data Interchange (EDI).

EDI no longer merely aids in transmitting documents, but dynamically moves data between companies' computer systems. The computer-to-computer transfer can be direct, between two companies using an agreed upon data protocol, or it can be performed by a third-party service vendor. Users can transmit business documents such as purchase orders, price quotes, shipping notices, and even payment orders electronically to customers and suppliers. Design documents, electronic funds transfers, and database transactions can all come under the EDI umbrella. The format for data transmission between trading partners via common carrier, is governed by a predetermined and institutionally agreed upon set standards.

Among the companies and industries that might reap significant benefits by converting to EDI are those companies that handle a large volume of repetitive standard transactions, or operate on very tight margins. Additionally, companies that face strong competition (which requires significant productivity improvements), operates in a time-sensitive environment, or has already received requests to convert to EDI from trading partners, can also benefit. EDI improves the operations dealing with high volumes of transactions by providing electronic information exchange between trading partners. This electronic connection reduces data entry errors (EDI will not prevent input errors from occurring, however) by eliminating repetitive tasks and lowers administrative overhead costs associated with paper-based processing methods.

Traditional EDI (Reference A)



EDI Today (Reference B)

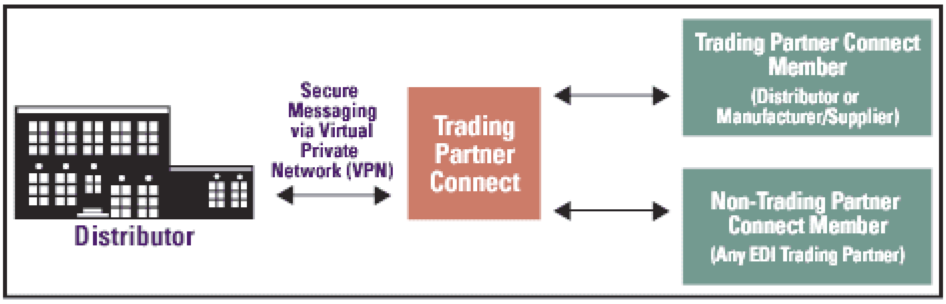


Fig 4.10.1 Electronic Data Interchange

In the traditional paper-based flow of information, manual data entry is performed at each step in the process. In addition, manual reconciliation—comparison of purchase order, receiving notice, and invoice—is also required, thereby contributing to the higher cost of transaction processing and the continued involvement of the end user in the overall process. These two manual processes are eliminated with the substitution of electronic methods such as EDI.

Some problems with paper-based information systems that EDI can address are:

(*i*) *Labour costs* - In a paper based system, manual processing is required for data keying, document storage and retrieval, document matching, envelope stuffing etc.

(*ii*) *Errors* - Since the same information is keyed in a number of times, paper-based systems are error-prone.

(*iii*) *Inventory* -Due to the fact that delays and uncertainties are commonplace in paper processing, inventories may be higher than they need to be.

(*iv*) *Uncertainty* - Uncertainty exists in three areas. Firstly, transportation and keying delays mean that timing is uncertain. Secondly, the sender does not know whether the matter dispatched was received at all. Thirdly, in the payment area, it is difficult to tell when the bank will disburse the cheque.

The results of EDI implementation can be dramatic. Time delays are greatly reduced. Mail and processing delays are eliminated. Uncertainty with regard to timings is discarded in some cases and lessened in others. This enables a firm to forecast cash flows more accurately.

A content acknowledgement provides the buyer fast feedback on whether the order will be honored or whether the buyer must look elsewhere. This lessens the need for safety stock. One-time keying means that labour costs can be reduced and payments can be processed through the settlement system the day after initiation.

4.10.1 Advantages of EDI

(*i*) *Issue and receive orders faster* - Since most purchasing transactions are routine, they can be handled automatically, utilizing the staff for more demanding and less routine tasks.

(*ii*) *Make sales more easily* - Quotes, estimates, order entry and invoicing will proceed more smoothly and efficiently. Orders received electronically ensure that information is available immediately, so that an organization can respond faster and be more competitive.

(*iii*) *Get paid sooner* - Invoices received electronically can be reconciled automatically, which means they are earmarked for payment in one's trading partner's accounting department sooner. And, in turn, your own purchasing department is in a position to negotiate for better terms including faster payment.

(*iv*) *Minimize capital tied up in inventory* - For manufacturing organizations with a just-in-time strategy, the right balance is crucial but every organization stands to benefit from reducing order lead times.

(*v*) *Reduce letters and memos* - Letters and memos do not follow rigid rules for formatting. They can be handled by an electronic mail system.

(*vi*) *Decrease enquiries* - Customers or suppliers can make direct on-line enquiries on product availability, or other non-sensitive information instead of consuming the staff's precious time.

(*vii*) *Make bulk updates of catalogues and parts listings* - One can provide updates of data files, such as catalogues to customers or part listings to franchisees.

Any organization that sends or receives large volumes of paper transactions, needs to reduce inventory costs, distribute products using repetitive procedures, wants to handle documents more expeditiously, deals with many trading partners, has to manage long delays in the purchasing cycle and conducts business (buying and selling) with mostly the same companies can make optimum use of the EDI.

EDI is vastly implemented in the trucking, marine shipping and air cargo industries in developed countries. Implementation need not be expensive. All that a small firm needs to have is a personal computer, a modem and telephone line and the necessary software.

EDI is considered by many to be the leading application of eCommerce technology, may be because it has been around so long, or maybe because EDI has the look and feel of what eCommerce is eventually suppose to be. It is important to note however, that EDI is simply only one element in the broad eCommerce environment. eCommerce is much more than simply EDI. eCommerce has been defined as a means of conducting business electronically via online transactions between merchants and consumers. Electronic Data Interchange (EDI), however, is the computer application-to-computer application transmission of business documents in a pre-determined, standard format. While electronic commerce is targeted for global trading and is suited to anyone interested in online commerce, EDI on the other hand, is best suited for a selected group of trading partners.

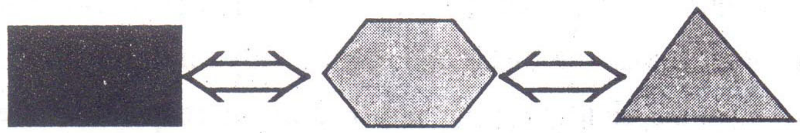
4.10.2 EDI users and types of activities : Companies of all types and sizes can utilize EDI. The initial impetus for EDI was provided by the transportation industry in the United States, in 1970s. The transportation industry characterized by its paper intensive multi-part bills of landing, way bills, invoices, customs forms, intense competition and pressure to reduce delivery times, was a logical breeding ground for this application of information technology.

The concept gained further momentum with its general acceptance by the American grocery industry in the late 1970s and the automotive industry in the early 1980s, Canadian counterparts in both these sectors followed suit in 1984.

In India, Videsh Sanchar Nigam Limited has recently launched another value added service - the EDI. The service will be used to clear import/export transactions more efficiently.

Internet-based EDI can be interactive and is relatively inexpensive, thus paving the way for Small-Medium-Enterprises (SMEs) to use electronic commerce. These Business-to-Business transactions include the use of EDI and electronic mail for purchasing goods and services, buying information and consulting services. Additionally, Internet-based EDI trading techniques aim to improve interchange of information between trading partners, suppliers and customers by bringing down the boundaries that restrict how they interact and do business with each other. However, by doing so the risks involved in the process of conducting commercial transactions are increased. Thus it lacks the security and reliability arising from the issues of a *"complete trustworthy relationship"* among the trading partners. The security of electronic commerce is not only critical but is also absolutely inevitable if organizations are to maintain and increase their profitability .

4.10.3 How EDI Works : EDI is the electronic exchange of business documents such as invoices, purchase orders, and shipping notices in a standard, machine-processable data format. EDI automates the transfer of data between dissimilar computer systems. This is a 3-step process. General Working of Electronic Data Interchange is shown in Fig. 4.10.3.1. Looking at an outgoing scenario:



1.	2.	3.
Your Application	EDI Translator	Trading Partner

Fig 4.10.3.1 General Working of EDI

Data from your application is translated into a standard format.

Then, it is transmitted over communication lines to your trading partner.

Finally, it is re-translated by your trading partner's application.

(The process works in reverse when your trading partner wishes to send an EDI transaction to you.)

Communications : To make EDI work, one needs communications software, translation software, and access to standards. Communications software moves data from one point to another, flags the start and end of an EDI transmission, and determines how acknowledgements are transmitted and reconciled. Translation software helps the user to build a map and shows him how the data fields from his application corresponds to the elements of an EDI standard. Later, it uses this map to convert data back and forth between the application format and the EDI format.

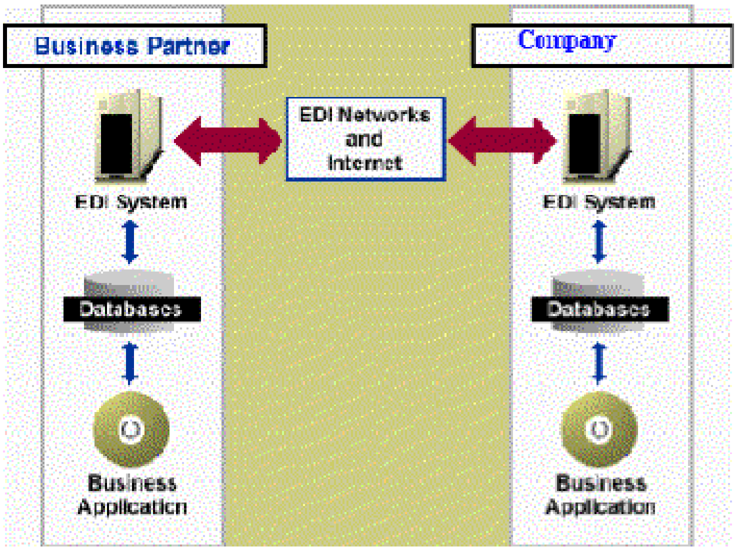


Fig 4.10.3.2 Working of EDI

Mapping : To build a map, the user first selects the EDI standard that is appropriate for the kind of EDI data he wants to transmit. For example, there are specific standards for invoices, purchase orders, advance shipping notices, and so on. Usually, the trading partner will tell the user what standard to use (or the user may be dictating this to his trading partner, depending on who initiated the request to conduct business via EDI) Next, he edits out parts of the standard that don't apply to his particular application or utilization. Again, the user and his trading partner normally exchange this information.

Next, he imports a file that defines the fields in his application. An application file can be a flat file or a file extracted from a database. An EDI translator displays a selected EDI standard on one side of the screen, and his application file on the other.

Finally, he marks the map to show where the data required by the EDI standard is located in his application. Once the map is built, the translator will refer to it during EDI processing every time a transaction of that type is sent or received.

Profiles : The last step is to write a partner profile that tells the system where to send each transaction and how to handle errors or exceptions. Whereas the user needs a unique map for every kind of document he exchanges with a partner, he should only have to define partner information once.

Coordinating : In summary, to make EDI work, you need to:

Select communications software.

Select a standard for each document you want to exchange with your trading partner.

Import an application file that defines the fields and records in your application.

Define a map that shows how the fields in your application correspond to elements in the standard.

Define partner profiles that tell the system how transactions will be addressed, what they will contain, and how to respond to errors.

Finally, the system should be tested with sample documents. Fig. 4.10.3.2 shows working of Electronic Data Interchange (EDI).

EDI as we know it today is a 25 year-old collection of standards used by organizations to communicate (transmit) invoices, purchase orders, electronic funds transfer, shipping orders, and non-financial records. However, the standards, which define EDI, are showing their age as the World Wide Web (WWW) and the Internet continue to grow in importance as a primary business-transaction delivery system. Redefined software will allow not only data, but also processes and transactions, to flow over the Web. For example, imagine a supply chain in which the retailer's system uses the Web to query the warehouse system of its distributor to determine the status and availability of certain products. The distributor can, in turn, query the manufacturer about specific delivery schedules for certain products. The Web will allow these activities to occur interactively or even automatically.

Traditional EDI will inevitably give way to Web-based EDI and eventually a broader eCommerce strategy for conducting business will dominate organizational sales strategies. Organizations driven to reduce inventories, improve delivery times, and improve customer satisfaction will spearhead this metamorphosis.

4.11 ELECTRONIC FUND TRANSFER (EFT)

EFT stands for "Electronic Funds Transfer" and represents the way the business can receive direct deposit of all payments from the financial institution to the company bank account. Once the user *signs up*, money comes to him directly and sooner than ever before. EFT is Fast, Safe, and means that the money will be confirmed in user's bank account quicker than if he had to wait for the mail, deposit the cheque, and wait for the funds to become available. Fig. 4.11.1 shows working of Electronic Fund Transfer (EFT).

The payment mechanism moves money between accounts in a fast, paperless way. These are some examples of EFT systems in operation:

Automated Teller Machines (ATMs): Consumers can do their banking without the assistance of a teller, as John Jones did to get cash, or to make deposits, pay bills, or transfer funds from one account to another electronically. These machines are used with a debit or EFT card and a code, which is often called a personal identification number or "PIN."

Point-of-Sale (POS) Transactions: Some debit or EFT cards (sometimes referred to as check cards) can be used when shopping to allow the transfer of funds from the consumer's account to the merchant's. To pay for a purchase, the consumer presents an EFT card instead of a check or cash. Money is taken out of the consumer's account and put into the merchant's account electronically.

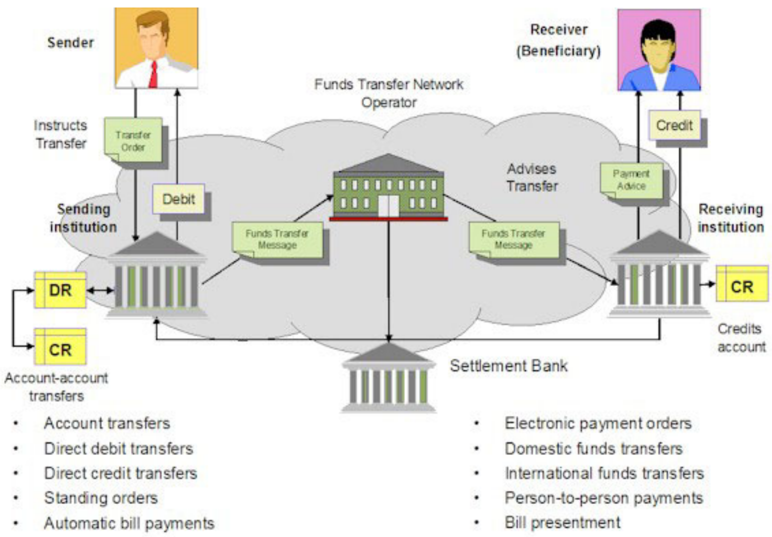


Fig 4.11.1 Working of Electronic Fund Transfer

Preauthorized Transfers: This is a method of automatically depositing to or withdrawing funds from an individual's account, when the account holder authorizes the bank or a third party (such as an employer) to do so. For example, consumers can authorize direct electronic deposit of wages, social security, or dividend payments to their accounts. Or they can authorize financial institutions to make regular, ongoing payments of insurance, mortgage, utility, or other bills.

Telephone Transfers: Consumers can transfer funds from one account to another— from savings to checking, for example—or can order payment of specific bills by phone.

4.12 TYPES OF ELECTRONIC PAYMENTS

The methods that have been developed for making payments on the Internet are essentially electronic versions of the traditional payment systems we use everyday-cash, checks, and credit cards. The fundamental difference between the electronic payment systems and traditional one is that everything is digital, and is designed to be handled electronically form the get-go-there's no crinkle of dollar bills, no clink of coins in your pocket, or signing a check with a pen. In a manner of speaking, everything about the payment has been virtualized into strings of bits. This virtualization will make many of the electronic payment options appear similar to each other – often the differences are due more to the companies and consortia developing the software than to the logic involved.

While many of the payment systems that are currently implemented now, uses personal computers, One day you'll be able to use a personal digital assistant (PDA) for handling payment. Trials are already underway with smart cards for making transaction over the net possible.

4.12.1 Credit Cards : In a credit card transaction, the consumer presents preliminary proof of his ability to pay by presenting his credit card number to the merchant. The merchant can verify this with the bank, and create a purchase slip for the consumer to endorse. The merchant then uses this purchase slip to a collect funds form the bank, and, on the next billing cycle, the consumer receives a statement form the bank with a record of the transaction.

A general life cycle of electronic payment through credit card is shown in Fig. 4.12.1.1. How credit card is handled is shown in Fig. 4.12.1.2 & Fig. 4.12.1.3.

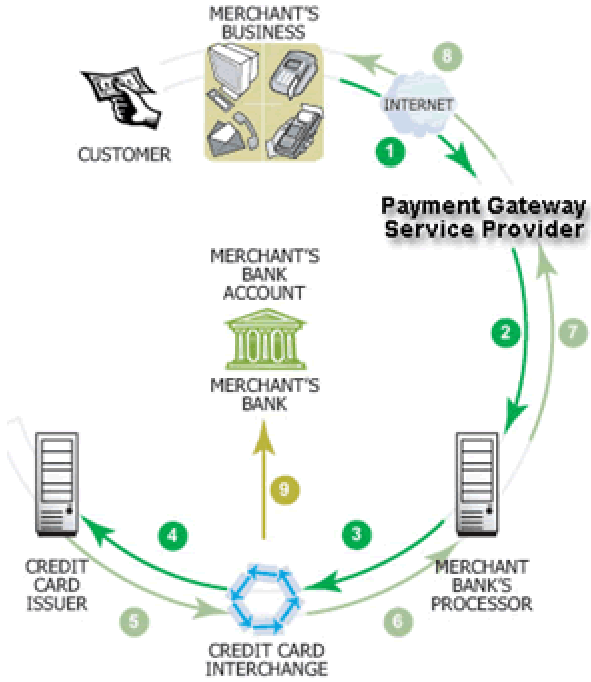


Fig 4.12.1.1 General Life Cycle of Electronic Payment Through Credit Card

Using a credit card to make a purchase over the Internet follows the same scenario. But on the Internet added steps must be taken to provide for secure transactions and authentication of both buyer and seller. This has led to a variety of system for using credit cards over the Internet. Two of the features distinguishing these systems are the level of security they provide for transactions, and the software required on both the customer and business sides of the transaction. *The picture shows Handling credit card and ordering data with HTML forms and CGI script (non secure and secured with SSL)*

Credit cards can be handled on line in two different ways:

(a) Sending unencrypted credit card numbers over the Internet

(b) Encrypting credit card details before any transactions are transmitted.

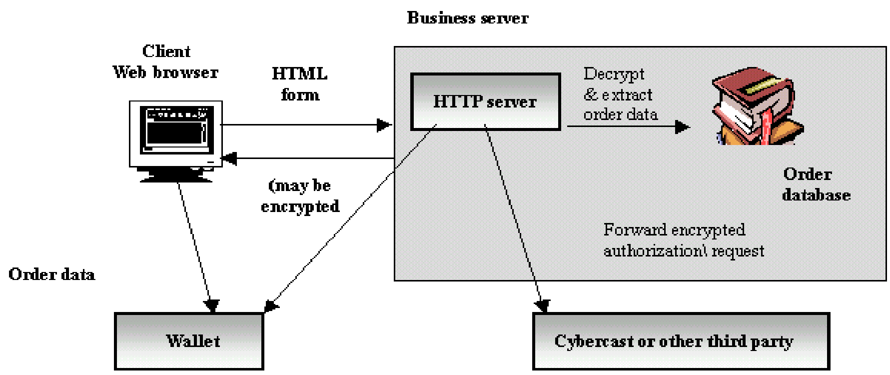


Fig 4.12.1.2 Ways of Handling Credit Cards

Encrypting credit card transactions can also be subdivided according to what is encrypted. If the entire transmission between buyer and merchant is encrypted, the merchant has to decrypt at least the order details to a complete a purchase. Then to further assure the customer that only authorized parties see his credit card information and protect against merchant fraud, a trusted third party can be used to separately

Handling credit card and order data with a wallet as helper application and third party for credit card processing decrypt the credit card information for authorization of the purchase.

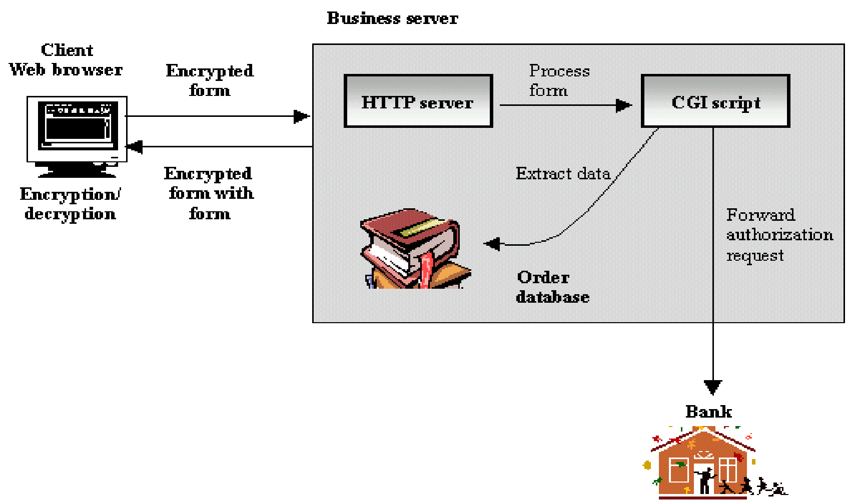


Fig 4.12.1.3 Handling credit Card

A customer browsing the Web might enter a credit card number in an order form, and click a submit button to transmit the information to the merchant's web server. The data would be raw, and there are no security guarantees for this type of transaction, someone could be monitoring network traffic and could intercept the transmission, or an unscrupulous merchant (or someone posing as a merchant could use the unencrypted number for illegal charges)

On the business end, processing the incoming credit card information only requires a Web server with a CGI script to process the form filled out by the customer. But if you want to secure the communication between buyer and seller against snooping, a good choice is a Web browser-server combination that supports the Secure Sockets Layer (SSL) protocol.

The use of servers and browsers that support the SSL protocol only protects data against network monitors and spies. It does not guarantee that the data is protected form spying eyes on the merchant's end. To protect against merchant fraud (using a credit card for other unauthorized purchases, for example), use systems from either CyberCash, Verifone, of First Virtual. CyberCash and Verifone both use a helper application called a wallet for the Web browser, and pass the encrypted credit card number through the merchant to its own processor/server for authentication and approval of the sale. First Virtual issues a VirtualPIN to the customer who then uses it in place of the credit card number. After receiving the sales information from the merchant, First Virtual converts the VirtualPin to the credit card account number to clear the purchase.

Here's a case where the electronic versions of a traditional payment system offer an added advantage-using encrypted credit card information with a trusted third party, such as Cybercash or First Virtal, instead of allowing the merchant to handle credit card processing, offers more protection against merchant fraud than is commonly seen in the every-day world.

4.12.2 Transaction Using Third Party Verification : The market for handling credit card purchases on the Internet has yet to converge on a single way of doing things, or a single standard that allows the software from different vendors to work together. This lack of interoperability will likely slow down both consumer and business acceptance of using credit cards for making purchases on the Internet.

There are, however, two significant standards in the works that will make the interoperability of electronic wallet and credit card transactions simpler, both for consumers and businesses. Fig. 4.12.2.1 shows transaction using third party.

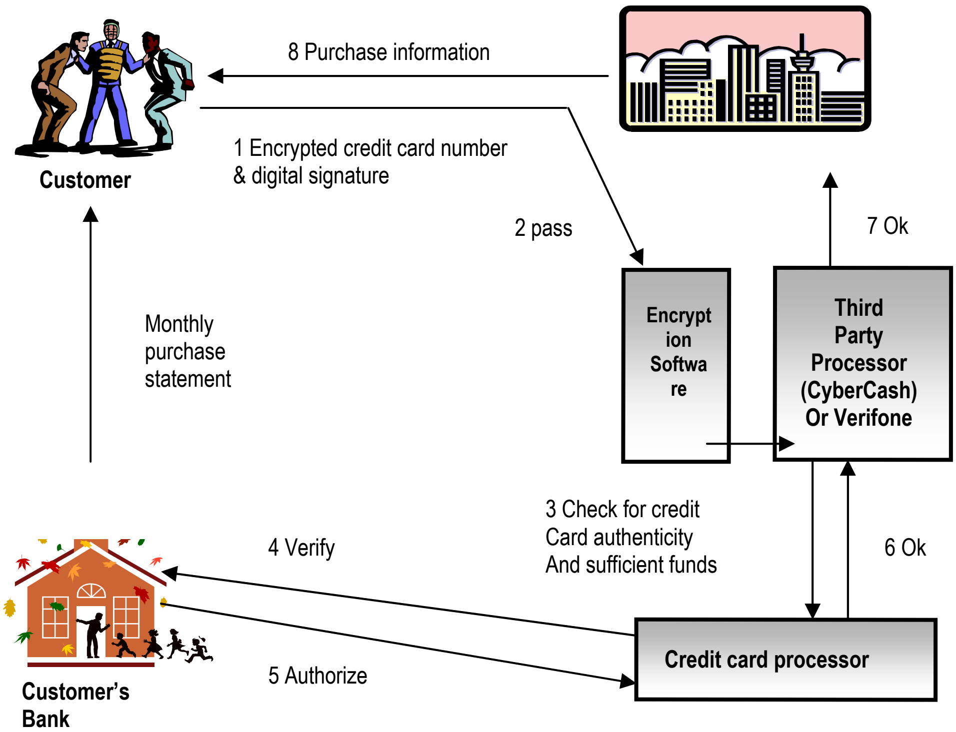


FIG 4.12.2.1 Transaction using third party

4.12.3 Secured Electronic Transaction (SET) : First, there's the Secured Electronic Transaction protocol (SET) developed by a consortium led by MasterCard and Visa. SET is actually a combination of a protocol designed for use by other applications (Such as Web browsers) and a standard (Recommended procedures) for handling credit card transactions over the Internet. Designed for cardholders, merchants, banks, and other card processors, SET uses digital certificates to ensure the identities of all parties involved in a purchase. SET also encrypts credit card and purchase information before transmission on the Internet.

4.12.4 Joint Electronic Transaction : The second standard is the Joint Electronic Payments Initiative, led by the World Wide Web Consortium and Commerce Net. JEPI, as it's known, is an attempt to standardize payment negotiations. On the buyer's side (the client side), it serves as an interface that enables a Web browser, and wallets, to use a variety of payment protocols. On the merchant's side (the serve side), it acts between the network and transport layers to pass off the incoming transactions to the proper transport protocol (e-mail vs. HTTP, for instance) and proper payment protocol (such as SET) Because it's likely that multiple protocols will be around for payment, transport, and wallets, JEPI makes it easier for the buyer to use a single application, and single interface, in a variety of commercial situations. It also makes it easier for the merchant to support the variety of payment system that customers will want to use.

4.12.5 Electronic Cheques : Credit card payments will undoubtedly be popular for commerce on the Internet. However, following two systems have been developed to let consumers use electronic cheques to pay Web merchants directly**.** Fig. 4.12.5.1 shows the electronic cheque model.

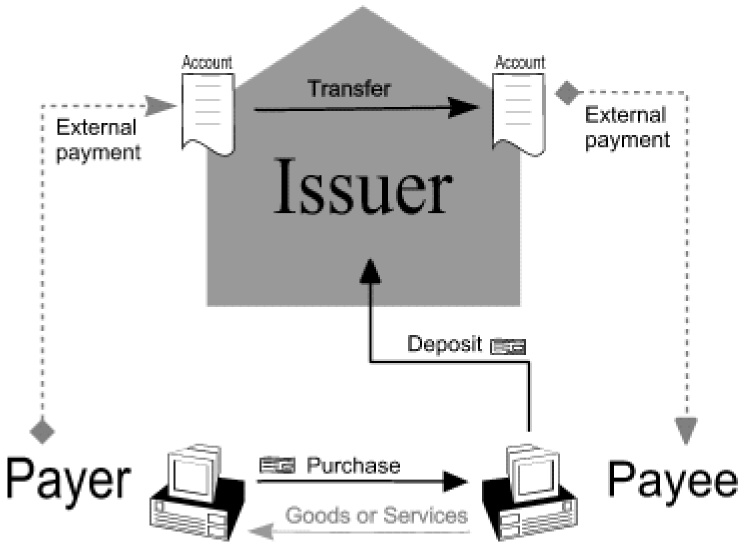


Fig 4.12.5.1 The Electronic Cheque Model

(a) By the Financial Services Technology Corporation (FSTC)

(b) *By CyberCash* : An electronic cheque has all the same features as a paper cheque. It functions as a message to the sender's bank to transfer funds, and, like a paper cheque, the message is given initially to the receiver who, in turn, endorsees the cheque and presents it to the bank to obtain funds. The electronic cheque can prove to be superior to the paper cheque in one significant aspect. As sender, you can protect yourself against fraud by encoding your account number with the bank's public key, thereby not revealing your account number to the merchant. As with the SET protocol, digital certificates can be used to authenticate the payer, the payer's bank, and bank account.

CyberCash's system for electronic checking is an extension of their **wallet** for credit cards, and it can be used in the same way to make payments with participating vendors. Unlike the Cyber Cash credit card system, through, CyberCash will not serve as an intermediate party for processing the cheque-that function will be handled directly by banks.

The FSTC is a consortium of banks and clearing houses that has designed an electronic cheque. Modeled on the traditional paper cheque, this new cheque is initiated electronically, and uses a digital signature for signing and endorsing.

To add to the flexibility of their payment system, the FSTC wants to offer users a choice of payment instruments that allow them to designate an electronic cheque as a certified cheque or an electronic charge card slip, for example. This means that the user can use a single mechanism, the electronic cheque, to complete payments that vary according to payee's requirements. For example, you could decide to pay your utility bills by standard electronic cheque, but you could designate that one of the electronic cheque be delivered as a certified cheque in order to make a down payment on a new house. The instructions accompanying your electronic cheque would be processed by the electronic payment handler (EPH) software installed at you bank, and distributed by the appropriate payment network. Fig. 4.12.5.2 shows working of electronic transaction.

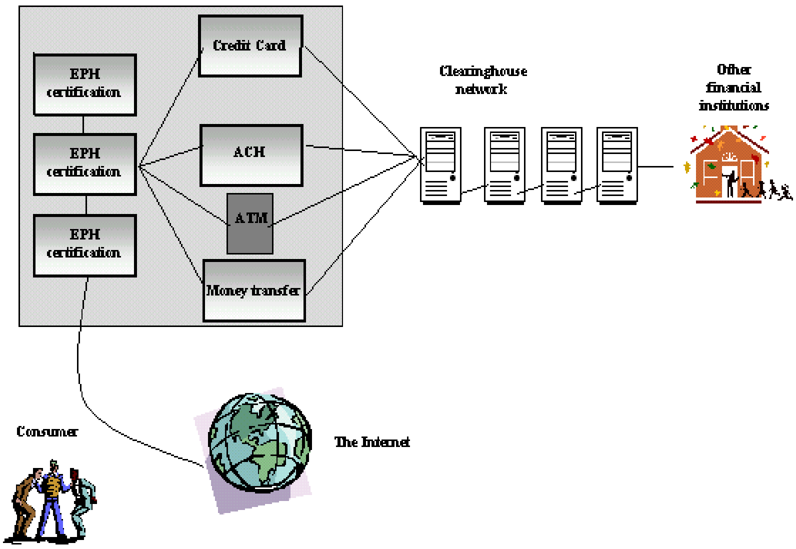


Fig 4.12.5.2 Working of electronic transaction

Extending electronic checks to existing payment systems

Electronic cheque can be delivered either by direct transmission over a network, or by electronic mail. In either case, existing banking channels can clear payments over their networks. This leads to a convenient integration of the existing banking infrastructure and the Internet. Because FSTC's plans for electronic checking include money transfers and transactions involving the National Automated Clearing House Association for transferring funds between banks, businesses could use the FSTC scheme to pay in voice from other businesses.

4.12.6 Smart Cards : Smart cards have an embedded microchip instead of magnetic strip. The chip contains all the information a magnetic strip contains but offers the possibility of manipulating the data and executing applications on the card. Fig.4.12.6.1 shows a smart card.

Three types of smart cards have established themselves.

- **Contact Cards –** Smart cards that need to insert into a reader in order to work, such as a smart card reader or automatic teller machines.
- **Contactless Cards** – Contactless smart cards don't need to be inserted into a reader. Just waving them near a reader is just sufficient for the card to exchange data. This type of cards is used for opening doors.
- **Combi Cards –** Combi cards contain both technologies and allow a wider range of applications.

Fig 4.12.6.1 Smart Cards

4.12.7 Electronic Purses : Electronic is yet another way to make payments over the net. It is very similar to a pre paid card. For Eg: Bank issues a stored value cards to its customers, the customer can then transfer value from their accounts to the cards at an ATM, a personal computer, or a specially equipped telephone. The electronic purse card can be used as a ATM card as well as a credit card.

While making purchases, customers pass their cards through a vendor's point of sale terminal. No credit check or signature is needed. Validation is done through a Personal Identification Number (PIN Number)

Once the transaction is complete, funds are deducted directly from the cards and transferred to the vendor's terminal. Merchants can transfer the value of accumulated transactions to their bank accounts by telephone as frequently as they choose. When the value on a card is spent, consumers can load additional funds from their accounts to the card.

4.13 RISKS AND SECURITY CONSIDERATIONS

The Internet's use by businesses for electronic commerce will continue to expand. Therefore, the focus for these businesses will be to develop methods of ensuring its safe and effective use. With no oversight body establishing security standards or ensuring the continued availability of Internet services, inherent risks are associated with using the Internet as a primary means of conducting business transactions, and those risks must be addressed and corrected.

Because computers are more accessible and their hackers more numerous, the computer security problem can no longer be ignored by the corporate executives who have, for years, been in a state of denial about the importance of computer security. The accounting firm Ernst & Young (1995) surveyed 1,290 information system executives and found that security continues to be a significant problem in corporate America. The survey results included the following staggering statistics:

- Nearly half of the 1,290 respondents have lost valuable information in the last two years.
- At least 20 respondents have lost information worth more than $1 million.
- Nearly 70 percent say security risks have worsened in the last five years.
- Nearly 80 percent have hired a full-time information-security director/ ("Security.. Survey,")

Fewer than a third of the respondents to the Ernst & Young survey said they are satisfied with Internet security and only about a quarter of them are willing to use the Internet for business purposes.

Another study conducted by Deloitte & Touche's *Leading Trends in Information Services* found that more than half of the 431 respondents to their survey pointed to security concerns as the major barrier to initiating electronic commerce on the Internet.

A number of additional concerns about initiating electronic commerce on the Internet must be addressed before these businesses are ready to take the "electronic plunge":

- Reliability—Will the service level that the company depends upon to conduct business always be available? America Online customers, for example, experienced a 19-hour outage in August of 1996.
- Scalability—How can the Internet and individual services be scaled to meet the needs and expectations of all businesses?
- Ease of use—Can methods be developed to promote easy access and use to all potential trading partners? Will small businesses be at a disadvantage due to a lack of technical sophistication and resources?
- Payment methods—What will be an appropriate, safe, and reliable payment method for electronic commerce?

Many other concerns about the vulnerability of the Internet include the risks inherent in electronic mail transactions, the threat of computer viruses, and the existence of unprofessional employees. Companies or consumers passing information through e-mail that can be intercepted bringing risk to both parties. Businesses connected to the Internet that also store important company information in the same location are subject to tampering, and their information may be accessed and possibly damaged. Financial information such as credit card numbers may be stolen and used by unauthorized parties to make illegal purchases, resulting in damage to customers and businesses alike. These fraudulent purchases, unfortunately, are charged to the customer and prove difficult for the businesses to collect.

Businesses also have general management concerns, many of which are exacerbated by the inherent security weaknesses in the Internet.

General Management Concerns

- *Loss of paper audit trail*: Paper is the prime source of a certifiable audit trail. Without paper certification, the issue of the reliability of electronic certification becomes a management concern.
- *Business continuity*: As increased dependence is placed on an electronic means of conducting business, the loss of EC systems has the potential to cripple an organization.
- *Exposure of data to third parties*: As data is shared and organizations become connected to the outside world, the possibility of data exposure to vendors, service providers, and trading partners is significantly increased.
- *Potential legal liability*: The inability to complete transactions or meet deadlines, or the risk of inadvertently exposing information of trading partners poses significant legal risks.
- *Record retention and retrievability*: Electronic information has the same legal and statutory requirements as paper information. Organizations are responsible for the safe storage, retention and retrieval of this information.
- *Segregation of duties:* In an electronic environment, the potential for a significant volume of fraudulent transactions is increased; therefore, duties for those involved in EC must be appropriately segregated and reviewed (Marcella & Chan, 1993)

In spite of the varied concerns, corporations understand that the Internet is clearly the most promising infrastructure for “anywhere, anytime” electronic communication between businesses, customers, and suppliers; and progress is being made as companies further realize and respond to these concerns. Several tools are now available to protect information and systems against compromise, intrusion, or misuse:

1. Firewalls are systems that control the flow of traffic between the Internet and the firm’s internal LANs and systems. They are usually packaged as turnkey hardware/software packages, and are set up to enforce the specific security policies that are desired. A firewall is a proven, effective means of protecting the firm’s internal resources from unwanted intrusion.

2. Encryption allows information to transit the Internet while being protected from interception by eavesdroppers. There are two basic approaches to encryption:

(i) Hardware encryption devices are available at a reasonable cost, and can support high- speed traffic. If the Internet is being used to exchange information among branch offices or development collaborators, for instance, use of such devices can ensure that all traffic between these offices is secure.

(ii) Software encryption is typically employed in conjunction with specific applications. Certain electronic mail packages, for example, provide encryption and decryption for message security.

The free flow of encryption technology is being stifled due to legal constraints that disallow the export of technology that may impact the national interest of a country. The resolution of these export restriction issues will have a major impact on the growth of electronic commerce from an international perspective.

3. **Message authentication** makes sure that a message is really from whom it purports to be and that it has not been tampered with. Regardless of a company's individual needs, clearly defined Internet security policies and procedures should always be part of any corporate Internet security strategy.

4. **Site Blocking** is a software-based approach that prohibits access to certain Web sites that are deemed inappropriate by management. For example, sites that contain explicit objectionable material can be blocked to prevent employee's from accessing these sites from company Internet servers. In addition to blocking sites, companies can also log activities and determine the amount of time spent on the Internet and identify the sites visited.

4.13.1 Legal issues : Electronic transactions are often used by businesses to issue instructions to and make commitments with external organizations, and many of these transactions are used to form legally binding contracts. For example, a contract is entered into when a buyer electronically issues a purchase order for goods at a set price and a seller electronically acknowledges the order. In legal terms, the electronic order is an "offer," and the electronic acknowledgment is an "acceptance," constituting a contract.

In his book *The Internet and Business: A Lawyer's Guide to the Emerging Legal Issues*, Benjamin Wright states that electronic contracts raise some important legal issues:

- Are electronic transactions enforceable in court?
- What terms and conditions are included within those transactions?
- Can they be proven in court?

- To what extent is a VAN liable if it loses an acceptance message and thereby prevents a contract from being formed?

E-commerce throws up several new challenges. The most important issue that is thrown up by such commerce is that of taxation. For taxation purposes, the first question that has to be addressed is where did the sale take place? Since there is no physical form of the place of business in case of E-commerce, it becomes difficult to determine the country/state/city from where the sale was concluded. Accordingly, jurisdictional disputes arise about the taxation of the same especially with respect to indirect taxes. Even the most advanced nations such as U.S.A, Japan, France and U.K. have not yet been able to satisfactorily solve this problem.

Similarly, another problem that arises is about the transaction escaping the tax net all together. Since there is no paper work involved and all the interaction between the buyer and the seller is done electronically, there is a possibility of the transaction being kept out of the books of account of either or both sides to the transaction. As auditors, Chartered Accountants would have to deal with this problem increasingly as E-commerce takes firm roots in India.

Another problem area of E-commerce is regarding fraud detection. E-commerce comes to us along with the in-built dangers of electronic crimes and frauds. Detection and Prevention of such frauds would be an area of great concern.

As electronic commerce grows and matures, the legal landscape of EC will change at a dynamic pace, presenting a myriad of new legal issues to be discussed and litigated. Organizations must be prepared to protect themselves from potential legal liabilities and ensure that their legal rights are protected.

Internet usage can be as secure as a company requires. It is important to put in place the appropriate tools and procedures to protect information assets. It is also important, however, not to overreact and incur unnecessary costs and difficulties. For individual Internet connections used for normal business purposes, security is often not a problem. The same is usually true of Web servers which are distinct from internal networks, and which are intended for public access. Nevertheless, for corporations with security concerns, effective security measures are available, and new methods are continually being developed to address these concerns.

Since EC and the Internet will be intertwined, it is imperative that organizations take a proactive role in monitoring electronic transactions and protecting assets. As with any major initiative or new technology, corporations must perform a risk assessment and analysis to determine the appropriate direction for the short and long-term viability of the organization. Auditors and security professionals will play a vital role in ensuring that the appropriate preliminary assessments are conducted, ultimately guaranteeing the safety and security of electronic transactions on the Internet.

4.14 MOBILE COMMERCE, or m-Commerce, is about the explosion of applications and services that are becoming accessible from Internet-enabled mobile devices. It involves new technologies, services and business models. It is quite different from traditional e-Commerce. Mobile phones or PDAs impose very different constraints than desktop computers. But they also open the door to a slew of new applications and services.

M-commerce (mobile commerce) is the buying and selling of goods and services through wireless handheld devices such as cellular telephone and personal digital assistants (PDAs) Known as next-generation e-commerce, m-commerce enables users to access the Internet without needing to find a place to plug in. The emerging technology behind m-commerce, which is based on the Wireless Application Protocol (WAP), has made strides in countries, where mobile devices equipped with Web-ready micro-browsers are much more common. Fig 4.14.1 shows an overview of mobile commerce and Fig. 4.14.2 shows working of mobile commerce.

Fig 4.14.1 Mobile Commerce (An Overview)

In order to exploit the m-commerce market potential, handset manufacturers such as Nokia, Ericsson, Motorola, and Qualcomm are working with carriers such as AT&T Wireless and Sprint to develop WAP-enabled smart phones, and ways to reach them. Using Bluetooth technology, smart phones offer fax, e-mail, and phone capabilities all in one, paving the way for m-commerce to be accepted by an increasingly mobile workforce.

As content delivery over wireless devices becomes faster, more secure, and scalable, there is wide speculation that m-commerce will surpass wireline e-commerce as the method of choice for digital commerce transactions. The industries affected by m-commerce include:

- Financial services, which includes mobile banking (when customers use their handheld devices to access their accounts and pay their bills) as well as brokerage services, in which stock quotes can be displayed and trading conducted from the same handheld device.
- Telecommunications, in which service changes, bill payment and account reviews can all be conducted from the same handheld device.
- Service/retail, as consumers are given the ability to place and pay for orders on-the-fly.
- Information services, which include the delivery of financial news, sports figures and traffic updates to a single mobile device.

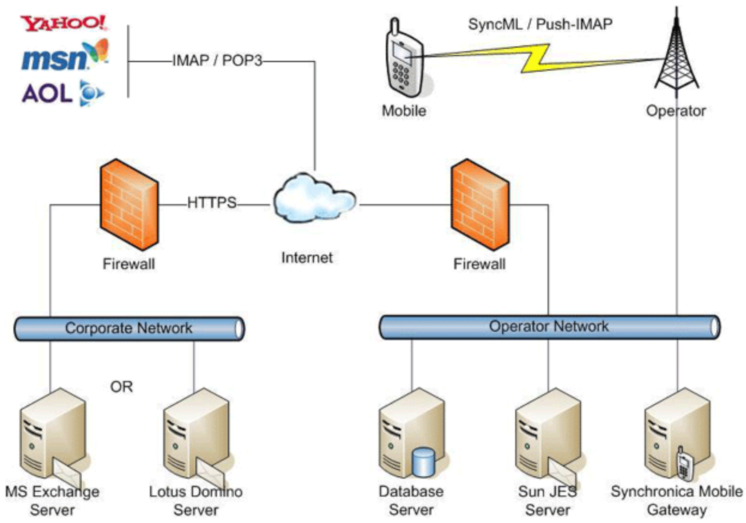


Fig 4.14.2 Working of Mobile Commerce

IBM and other companies are experimenting with speech recognition software as a way to ensure security for m-commerce transactions

4.15 BLUETOOTH

Bluetooth is a telecommunications industry specification that describes how mobile phones, computers, and personal digital assistants (PDAs) can be easily interconnected using a short-range wireless connection. Using this technology, users of cellular phones, pagers, and personal digital assistants can buy a three-in-one phone that can double as a portable phone at home or in the office, get quickly synchronized with information in a desktop or notebook computer, initiate the sending or receiving of a fax, initiate a print-out, and, in general, have all mobile and fixed computer devices be totally coordinated.

Bluetooth requires that a low-cost transceiver chip be included in each device. The tranceiver transmits and receives in a previously unused frequency band of 2.45 GHz that is available globally (with some variation of bandwidth in different countries) In addition to data, up to three voice channels are available. Each device has a unique 48-bit address from the IEEE 802 standard. Connections can be point-to-point or multipoint. The maximum range is 10 meters. Data can be exchanged at a rate of 1 megabit per second (up to 2 Mbps in the second generation of the technology) A frequency hop scheme allows devices to communicate even in areas with a great deal of electromagnetic interference. Built-in encryption and verification is provided. Fig. 4.15.1 shows bluetooth technology.

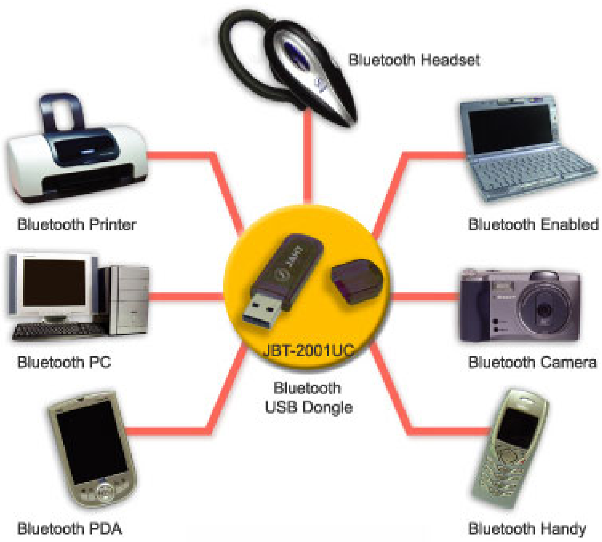


Fig 4.15.1 Bluetooth Technology

The technology got its unusual name in honor of Harald Bluetooth, king of Denmark in the mid-tenth century.

4.16 WIFI- WIRELESS FIDELITY

Wifi (also **WiFi**, **Wi-fi** or **wifi**) is a brand originally licensed by the Wi-Fi Alliance to describe the underlying technology of wireless local area networks (WLAN) based on the IEEE 802.11 specifications. Wi-Fi stands for ***Wi****reless* ***Fi****delity*.

Wi-Fi was intended to be used for mobile computing devices, such as laptops, in LANs, but is now often used for increasingly more applications, including Internet and VoIP phone access, gaming, and basic connectivity of consumer electronics such as televisions and DVD players. There are even more standards in development that will allow Wi-Fi to be used by cars in highways in support of an Intelligent Transportation System to increase safety, gather statistics, and enable mobile commerce IEEE 802.11p. Fig. 4.16.1 shows a basic wi fi network.

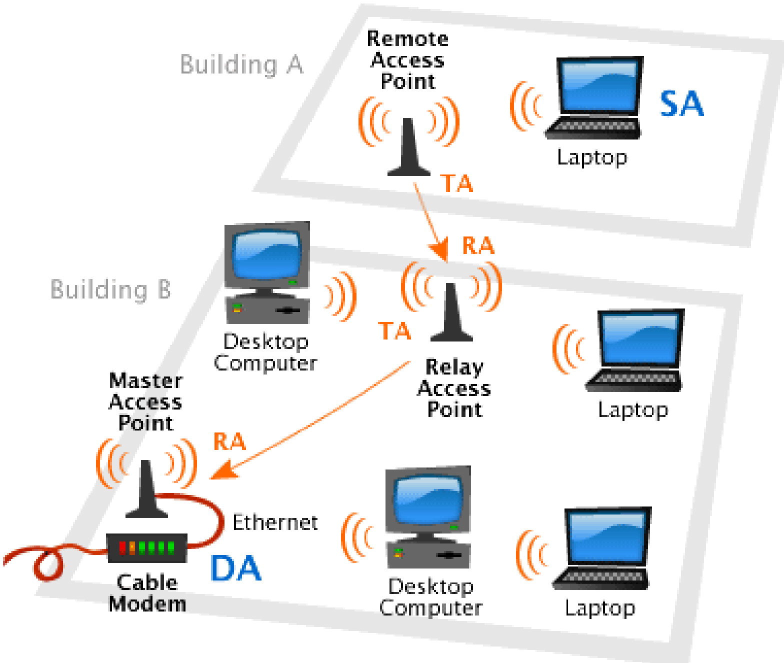


Fig 4.16.1 Basic Wi-Fi Network

A person with a Wi-Fi device, such as a computer, telephone, or personal digital assistant (PDA) can connect to the Internet when in proximity of an access point. The region covered by one or several access points is called a hotspot. Hotspots can range from a single room to many square miles of overlapping hotspots. Wi-Fi can also be used to create a Wireless mesh network. Both architectures are used in Wireless community network, municipal wireless networks, and metro-scale networks.

Wi-Fi also allows connectivity in peer-to-peer mode, which enables devices to connect directly with each other. This connectivity mode is useful in consumer electronics and gaming applications.

When the technology was first commercialized there were many problems because consumers could not be sure that products from different vendors would work together. The Wi-Fi Alliance began as a community to solve this issue so as to address the needs of the end user and allow the technology to mature. The Alliance created another brand "Wi-Fi CERTIFIED" to denote products are interoperable with other products displaying the "Wi-Fi CERTIFIED" brand. Fig. 4.16.2 shows deployment of wi fi based architecture.

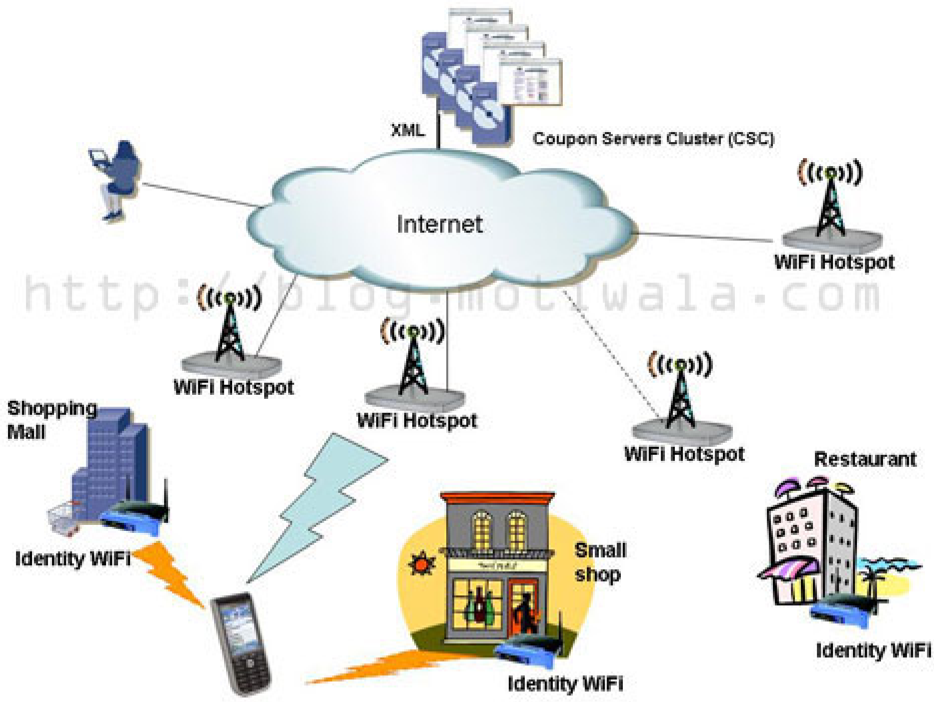


Fig 4.16.2 Deploying Wi-Fi Based Architecture

4.16.1 WI-FI Certification

Wireless technology gives you complete freedom to be connected anywhere if your computer is configured with a WI-FI CERTIFIED device. WI-FI certification means that you will be able to connect anywhere there are other compatible WI-FI CERTIFIED products. The WI-FI CERTIFIED logo means it's a "safe" buy. The color-coded Standard Indicator Icons (SII) on product packaging is the only assurance that a product has met rigorous interoperability testing requirements to ensure that compatible products from different vendors will work together.

Large corporations and campuses use enterprise-level technology and WI-FI CERTIFIED wireless products to extend standard wired Ethernet networks to public areas like meeting rooms, training classrooms and large auditoriums. Many corporations also provide wireless networks to their off-site and telecommuting workers to use at home or in remote offices. Large companies and campuses often use WI-FI to connect buildings.

WI-FI networks are also found in busy public places like coffee shops, hotels, airport lounges and other locations where large crowds gather. This may be the fastest-growing segment of WI-FI service, as more and more travelers and mobile professionals clamor for fast and secure Internet access wherever they are.

Soon, WI-FI networks will be found in urban areas providing coverage throughout the central city, or even highways, enabling travelers access anywhere they can pull over and stop.

Self-Examination Questions

1. ARPA stands for ________.
   (a) Atomic Research Project Academy
   (b) Atomic Research Project Agency
   (c) Advanced Research Project Agency
   (d) Advanced Research Project Academy
2. ____________ is a text document that contains links to other text documents, graphics, audio files, internet services such as e-mail, etc.
   (a) Web Page
   (b) Web Browser
   (c) Web Link
   (d) Web Service

3. In context to Internet, DOT stands for _____________.

   (a) Department of Transmission

   (b) Department of Transport

   (c) Department of Telecommunication

   (d) Department of Tourism

4. ___________ is a technology where the user opens a browser application and searchers for information.

   (a) Pull Technology

   (b) Push Technology

   (c) Cast Technology

   (d) Pin Technology

5. An _________ is a private network that uses Internet protocols, network connectivity, and possibly the public telecommunication system to securely share part of an organization's operations with suppliers, vendors, partners, customers or other businesses.

   (a) Extranet

   (b) Intranet

   (c) Internet

   (d) None of the above

6. ____ handles lower-level transmissions from computer to computer as a message makes its way across the Internet, ______ operates at a higher level, concerned only with the two end systems, for example your Web browser and a Web server.

   (a) TCP, IP

   (b) IP, TCP

   (c) FTP, IP

   (d) IP, HTTP

7. EBT stands for ___________.

   (a) Electronic Bank Transfer

   (b) Electronic Bank Transmission

   (c) Electronic Benefit Transmission

   (d) Electronic Benefit Transfer

8. __________ is a form of electronic commerce in which products or services are sold from a firm to a consumer
   (a) Business - to - Business
   (b) Business - to - Consumer
   (c) Consumer - to - Business
   (d) Consumer - to - Consumer
9. _________ is a broker and a type of company that helps consumers uses online shops easier and potentially in a user customized interface, by providing currency conversion, language translation, and payment and delivery solutions
   (a) Bounty
   (b) Metamediary
   (c) Search Agent
   (d) Shopping Facilitator
10. Upon receiving an order, the _________ ships products directly to the consumer or to a wholesaler or manufacturer for delivery
    (a) E-Traders
    (b) E-Brokers
    (c) E-Trailers
    (d) E-Providers
11. In __________________ model, companies allow users worldwide to interact with each other on the bases of similar areas of interest
    (a) Electronic-Based
    (b) Advertising-Based
    (c) Community-Based
    (d) Fee-Based
12. EBPP stands for _________________.
    (a) Electrical Bill Presentment & Payment
    (b) Electronic Bill Payment & Presentment
    (c) Electronic Bill Presentment & Payment
    (d) Electrical Bill Payment & Presentment

13. These are high priced merchandise that is ordered rarely and usually requires customization.
    (a) Commodity-like Goods
    (b) Specialty Goods
    (c) Digital Goods
    (d) Convenience Goods
14. CRM stands for ___________.
    (a) Consumer Retail Manufacturing
    (b) Customer Relationship Manufacturing
    (c) Consumer Relationship Manufacturing
    (d) Customer Relationship Management
15. A good CRM program needs to __________.
    (a) Identify customer success factors
    (b) Adopt customer based measures
    (c) Create a customer-based culture
    (d) All of the above
16. In this part of application architecture of CRM, support is given to analyze customer behavior and implements business intelligence alike technology.
    (a) Collaborative
    (b) Analytical
    (c) Design
    (d) Operational
17. ___________ provides information about the business environment, including competitors, industry trends, and macro environmental variables.
    (a) Enterprise Marketing Automation
    (b) Customer Service and Support
    (c) Sales Force Automation
    (d) None of the above

18. __________ is a functionality of CRM which has the ability to be used on a large scale, and to be reliably expanded to whatever scale is necessary.

    (a) Database

    (b) Workflow

    (c) Assignment

    (d) Scalability

19. The CRM system allows a business to maintain all customer records in one _____________ location that is accessible to an entire organization through password administration.

    (a) Decentralized

    (b) Centralized

    (c) Remote

    (d) None of the above

20. Supply Chain Management encompass _____________

    (a) the planning and management of all activities involved in sourcing and procurement, and conversion

    (b) all logistics management activities

    (c) coordination and collaboration with channel partners

    (d) All of the above

21. Supply Chain Management is a cross functional approach of managing the movement of _______ into an organization and the movement of _________ out of the organization toward the end-consumer.

    (a) finished goods, raw material

    (b) finished goods, semi-finished goods

    (c) raw material, semi-finished goods

    (d) raw material, finished goods

22. In EDI ________ helps the user to build a map and shows him how the data fields from his application corresponds to the elements of an EDI standard.

    (a) Communication Software

    (b) Transmission Software

(c) Translation Software

(d) Access Software

23. PDA stands for _______________.

(a) Personal Digital Adaptor

(b) Personal Display Adaptor

(c) Personal Display Assistants

(d) Personal Digital Assistants

24. SET is a combination of _______ designed for use by other application such as Web browser and a __________ for handling credit card transactions over the internet.

(a) Protocol, Standard

(b) Rules, Standard

(c) Standard, Rules

(d) Standard, Protocol

25. The instructions accompanying your electronic cheque would be processed by the _________ software installed at your bank, and distributed by the appropriate payment network.

(a) Electronic Payment Transmission

(b) Electronic Payment Transfer

(c) Electronic Payment Initiative

(d) Electronic Payment Handler

26. ________ is typically employed in conjunction with specific applications and certain electronic mail packages, for example, provide encryption and decryption for message security.

(a) Software Encryption

(b) Middleware Encryption

(c) Hardware Encryption

(d) None of the above

27. _________ is about the explosion of applications and services that are becoming accessible from Internet-enabled mobile devices.

(a) E-Commerce

(b) I-Commerce

(c) M-Commerce

(d) W-Commerce

28. Using _________ technology, smart phones offer fax, e-mail, and phone capabilities all in one, paving the way for m-commerce to be accepted by an increasingly mobile workforce.

(a) Bluetooth

(b) VLAN

(c) WLAN

(d) Wi-Fi

29. WLAN stands for ___________.

(a) Wide Location Area Network

(b) Wide Local Area Network

(c) Wired Local Area Network

(d) Wireless Local Area Network

30. _____________ means that you will be able to connect anywhere where there are other compatible Wi-Fi products.

(a) Wi-Fi Authenticated

(b) Wi-Fi Authorized

(c) Wi-Fi Certified

(d) None of the above

Answers:

1	c	**2**	a	**3**	c	**4**	a	**5**	a	**6**	b	**7**	d	**8**	b	**9**	d
10	c	**11**	c	**12**	b	**13**	b	**14**	d	**15**	d	**16**	b	**17**	a	**18**	d
19	b	**20**	d	**21**	d	**22**	c	**23**	d	**24**	a	**25**	d	**26**	a	**27**	c
28	a	**29**	d	**30**	c												

Short Term Questions

1. Differentiate between the following:-

(a) Data Retrieval and Data Publishing

(b) Push Technology and Pull Technology

(c) Intranet and Extranet

(d) Business-to-Business E-commerce and Business-to-Consumer E-commerce

2. Write short notes on the following:-

   (a) World Wide Web

   (b) Uniform Resource Locator

   (c) E-mail

   (d) Internet Protocol Suite

   (e) Factors contributing to Bullwhip Effect

3 .Mention the various problems which must be addressed by Supply Chain Management.

4. Give some examples of Electronic Fund Transfer (EFT) systems in operations.

5. Mention the various industries which are affected by M-commerce technology.

Long Term Questions

1. Discuss the various business uses of Internet giving some live examples.
2. Discuss the various types of Internet Connections.
3. Discuss the various benefits of E-commerce.
4. Explore the Internet's role in E-commerce.
5. Explain the implementation of Customer Relationship Management (CRM) along with its detailed description.
6. Discuss the various opportunities enabled by Supply Chain Management.
7. Discuss the various advantages of Electronic Data Interchange (EDI) along with its working.
8. Explain the processing of Credit Card during an online transaction with the help of a diagram.
9. Discuss the various risks and security consideration with respect to Internet and E-commerce.
10. Discuss in detail the Wi-Fi technology.

CHAPTER 5

INTRODUCTION TO FLOWCHARTING

Learning Objectives

This Chapter enables the student to obtain knowledge about :

- ♦ The various steps involved in programming process.
- ♦ The concept of algorithm.
- ♦ To analyze a given problem and represent its solution with the help of flowchart/ algorithm.
- ♦ Many practical problems and their solutions depicting flowcharts.

The digital computer does not do any thinking and cannot make unplanned decisions. Every step of the problem has to be taken care of by the program. A problem which can be solved by a digital computer need not be described by an exact mathematical equation, but it does need a certain set of rules that the computer can follow. If a problem needs intuition, guessing or is so badly defined that it is hard to put it into words, the computer cannot solve it.

5.1 PROGRAMMING PROCESS

The set of detailed instructions which outline the data processing activities to be performed by a computer is called a program : Computer programming is a process which results in the development of a computer program. Computer programming is not a simple job. It requires lot of planning and thinking. Thus, computer-programming process may be sub-divided into six separate phases.

(*i*) ***Program analysis*** **-** In this stage, the programmer ascertains for a particular application (e.g., up-dating of the stock file) the outputs required (*i.e.,* the up-dated stock file, listing of the replenishment orders, stock movements report, stock valuation report etc.), the inputs available (*i.e.,* the stock master file, the receipts and issues transaction file) and the processing *i.e.,* up-dating the physical balance, computing stock value for various items, determination of placement of the replenishment order etc.). The programmer then determines whether the proposed application can be or should be programmed at all. It is not unlikely that the proposal is shelved for modifications on technical grounds.

(*ii*) ***Program design*** **-** In this stage, the programmer develops the general organisation of the program as it relates to the main functions to be performed. Out of several other tools available to him input, output and file layouts and flowcharts are quite useful at this stage. These layouts, and flowcharts etc. are provided to the programmer by the system analyst. The flowchart depicts the flow of data, documents etc. very clearly, what are the steps to be repeated or what are the alternatives or branches at particular step are shown conspicuously. Such details may be difficult to bring out in descriptive language.

(*iii*) ***Program Coding*** - The logic of the program outlined in the flowchart is converted into program statements or instructions at this stage. For each language, there are specific rules concerning format and syntax. Syntax means vocabulary, punctuation and grammatical rules available in the language manuals which the programmer has to follow strictly and pedantically. There are special sheets for writing the program instructions in each language. The sheets format of these sheets facilitate writing error free programs. Just as a mathematical problem can be solved in several ways, so is the case with writing a program. Different programmers may write a program using different sets of instructions but each giving the same results. In fact, there is a great scope for elegance in writing the programs but the limitations of time stipulated by management would not encourage the programmers to strive for such elegance. In practice, therefore, the programmers broadly pursue three objectives : simplicity, efficient utilisation of storage and least processing time. It is highly desirable that the programs are simple to understand since a program written by one programmer is very difficult for the other to understand. Since, the programs, upon implementation, may require frequent modifications to suit the changing systems environment, there is a program maintenance group employed on a permanent basis for modifying the programs and this group is different from the ones who wrote the programs initially. It is, therefore, emphasised that programs should be written as simple as possible to start with. There is usually a trade off possible between the other two objectives : efficient utilisation of storage and least processing time.

Each coded instruction is then entered onto a magnetic media using a key-to-disketic device or a key board. This stored file then constitutes the source program *i.e.,* the program in the source language which may be a procedural language such as BASIC or C++. This program is then translated into the machine language of the computer on hand by an interpreter or a complier, both of which have diagnostic capabilities *i.e.,* they can point out several syntax errors like two labels used for the same location and invalid standard label, etc. The programmer, upon getting the print out of the assembly or compiler run, rectifies his program.

(*iv*) ***Program debugging*** - The assembly compilation run can detect only few syntax errors. Considering that a program of average size would include thousands of instructions, there is an ample scope for the programmers to make errors technically known as bugs. It is asserted that nobody can string together about 200 or more error free instructions. Therefore, before putting the program into use there is a real necessity to debug it *i.e.,* to cleanse it of errors, Towards this purpose, the programmers devise a set of test data transactions to test the various alternative branches in the program. Since the branches in a program tend to proliferate, a large number of transactions would have to be devised for a thorough test. The results of these tests on the master file are derived in long hand also as per the logic of the program. Then, the file is up-dated by the transactions via the computer with the program to be debugged stored in it. The results got from the computer are compared with the ones derived manually prior to computer processing. If the results do not tally for the reasons mentioned above, the programmer then sits away from the computer and verifies his flowcharts and coding sheets in a hunt for the bugs.

Since, debugging can be a tedious process, computer manufacturers frequently provide facility for memory dump *i.e.,* print out of the data contents and instructions of the various CPU locations. Having had a first round of debugging, a programmer would rectify his coding sheet and correct the instructions in source program and go in for another assembly or compilation run. It is, however, to be noted that the identical results obtained manually and by computer processing do not guarantee that there are no bugs in the program since the program may not provide correct results on different set of transactions. Towards explanation of this consider the past sales history of an item as 60, 62, 64, 66, 68, 78. The exponesstial smoothing model may be used here for sales forecasting and the forecasts derived manually in long hand according to appropriate formulas.

The exponential smoothing forecasting program may then be used to derive the forecasts via the computer. Identical results here would be no guarantee that the program would yield correct results in another sales history of say, 232, 230, 228, 229 etc. This example, should bring out the fact that program debugging can indeed be a formidable task. In a survey conducted by the IBM, It is estimated that program of some scope (trivial programs excluded) may require as many as 20 rounds of debugging before it is thoroughly cleansed of bugs.

(*v*) ***Program documentation*** - Each program should be documented to diagnose any subsequent program errors, modifying or reconstructing a lost program. Program documentation including the following may be assembled.

(*a*) The program specifications *i.e.,* what the program is supposed to do.

(*b*) The program descriptions *i.e.,* input, output and file layout plans, flowcharts etc.

(*c*) The test data employed in debugging the program. This could be highly useful later to the auditors.

(*d*) The operation manual which details the operating instructions for the computer operator, viz., insert the data floppy when program has been read into the memory, or load the paper on the printer etc.

(*e*) The maintenance documentation that is listings of any subsequent amendments to the program.

(*vi*) ***Program maintenance*** **-** The requirements of business data processing applications are subject to continual change. This calls for modification of the various programs. There are usually a separate category of programmers called maintenance programmers who are entrusted with this task. There is a difficult task of understanding and then revising the programs they did not write. This should bring out the necessity of writing programs in the first place that are simple to understand.

5.2 PROGRAM ANALYSIS

Program analysis is an important step in computer programming in which the computer programmer seeks the answer to the question "What is the program supposed to do?" Thus, first of all the programmer has to define the problem.

A good deal of thought must be put into defining the problem and setting it for the computer in such a way that every possible alternative is taken care of. Thus, the steps that comprise a computational procedure must be delineated before the procedure can be programmed for the computer and the computer procedure must be sufficiently detailed at each stage of a computation to permit the required calculations to be performed. Also, computer procedures are designed to solve a whole class of similar problems. The procedure for adding two signed (*i.e.,* positive or negative) numbers a and b serves as an example :

1. If a and b have the same sign, go to step 5.

   (If a and b have different signs, continue with step 2)

2. Subtract the smaller magnitude from the larger magnitude.

   (continue with step 3)

3. Give the result the sign of the number with the larger magnitude. (continue with step 4)

4. Stop

5. Add the magnitudes of the numbers a & b

   (continue with steps 6)

6. Give the result the sign of number a.

7. Stop.

The procedure, in this case, is fairly detailed and would work for any two numbers a and b. For example, (-5) + (-4) = -9, 16 + (-11) = 5, 10 + 20 = 30, and so forth.

Algorithm

A specific procedure of this type that exists as a finite list of instructions specifying a sequence of Operations and that give the answer to any problem of a given type is called an *algorithm.* Computer programs are based on the concept of an algorithm.

Example - Consider an algorithm used to generate a sequence of numbers as Fibonacci numbers.

1, 1, 2, 3, 5, 8, 13, 21, 34 ....

If Fi denotes the ith Fibonacci number, Then $F_1 = F_2 = 1$ AND $F_i = F_{i-1} + F_{i-2}$; for all i greater than 2.

An algorithm for computing Fibonacci numbers that are less than 100 is given as follows :

1. Set N1 to 0. (This is not a Fibonacci number, and is used only to start the procedure).
2. Set N2 to 1 (This is first Fibonacci no.).
3. Write down N2.
4. Set N3 equal to N1 + N2.
5. If N3 is greater than 100, then stop the calculations.
6. Write down N3.
7. Replace N1 by N2.
8. Replace N2 by N3.
9. Continue the calculations with step 4.

An algorithm exists for each computational problem that has a general solution. The solution may exist as a set of mathematical equations that must be evaluated or a set of procedural steps that satisfy a pre-established procedure such as the well-known procedure for calculating income tax liability.

Example - Consider the Euclidean algorithm stated as follows :-

Given two positive integers A and B, find their common divisor.

The algorithm involves the construction of descending sequence of numbers.

The first is the larger of the two numbers, the second is the smaller, the third is the remainder from dividing the first by the second, the fourth is the remainder from dividing the second by the third; and so forth. The process ends when there is zero remainder. The greatest common divisor is the last divisor in the sequence. For example, the descending sequence of numbers for greatest common divisor of 44 and 28 is

44 28 16 12 4 0.

The lst divisor is 4, which is the result. The algorithm can be summarized in the following list of instructions :

1. Write down A and B.
2. If B is greater than A, exchange them.
3. Divide A by B giving the remainder.
4. If R is equal to zero, stop; B is the G. C.D.
5. Replace A by B; (that is, B $\rightarrow$ A).
6. Replace B by R; (that is, R $\rightarrow$ B).
7. Go to step 3.

From the above discussion, several characteristics of an *algorithm* can be given :

1. It consists of a finite no. of instructions, however, some instructions may be executed more than once and other may not be executed at all depending on the input data.
2. The instructions are precise.
3. The instructions are unambiguous.
4. The no. of operations that are actually performed in solving a particular problem is not known beforehand; it depends on the input and is discovered only during the course of computations.

5.3 FLOWCHARTS

For many applications, a simple list of the steps that comprise an algorithm is sufficient for stating the problem in a clear and unambiguous manner, However, when procedure is complex and different options exist, then a list of instructions is hard to follow. For describing a complex process, a flow diagram (or flowchart) is prepared. A flowchart is a diagram, prepared by the programmer, of the sequence of steps, involved in solving a problem. It is like a blueprint, in that it shows the general plan, architecture, and essential details of the proposed structure. It is an essential tool for programming and it illustrates the strategy and thread of logic followed in the program. It allows the programmer to compare different approaches and alternatives on paper and often shows interrelationships that are not immediately apparent. A flowchart helps the programmer avoid fuzzy thinking and accidental omissions of intermediate steps.

Flowcharts can be divided into 4 categories as below and as such they may be likened to the geographical map with regard to the extend of detail :

1. System outlines charts (Global map)
2. System flowcharts (National map)
3. Run flowcharts (State map)
4. Program flowcharts (District Map)

1. System outline charts -These charts merely lists the inputs, files processed and outputs without regard to any sequence whatever. An example of this chart of sales order Processing is given below in fig 5.3.1 :

Title *Sale Order Processing (SOP)*	*System* *S*	*Document* *3.1*	*Sheet* *1*
Inputs Customer Order Details		Processes Order entry (clerical) Order acknowledgement (computer) Despatch (clerical) Despatch update (computer) →	
Files Product Catalogue Customer Index Cards ← Doubtful Cost List Delivery Cost List Factory Stock List Customer N/A Card Product Card file Outstanding Order File Product Order Book Order Ledger		→ Outputs Error reports Balance Order Set Advice Notes Set Invoice Details Tape	
Notes, Cross references			
Issue : Date :			

Fig 5.3.1 System Outline Charts

2. **System flowchart -** It is designed to present an overview of the data flow through all parts of a data processing system. It represents the flow of documents, the operations or activities performed and the persons or work-stations. It also reflects the relationship between inputs, processing and outputs. In manual system, a system flowchart may comprise of several flowcharts prepared separately, such as document flowchart, activity flowchart etc. In a computer system, the system flowchart consists of mainly the following :

(i) the sources from which input data is prepared and the medium or device used.

(ii) the processing steps or sequence of operations involved.

(iii) the intermediary and final output prepared and the medium and devices used for their storage.

An example of a system flowchart is given below in fig 5.3.2 :

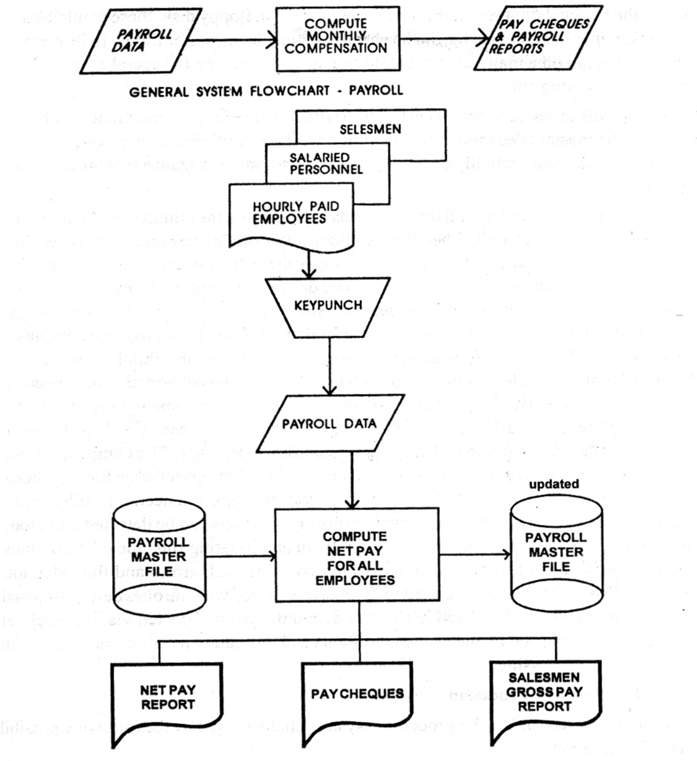


Fig. 5.3.2 System Flowchart-Payroll

3. Run Flowcharts - These are prepared from the system flowcharts and show the reference of computer operations to be performed. The chart expands the detail of each compute box on the system flow chart showing input files and outputs relevant to each run and the frequency of each run.

The sales order processing application has been discussed in fig 5.3.3 by means of a run flowchart.

The transactions in these applications are keyed on floppy disk and processed periodically against the master files to produce the desired reports, summaries projections etc. in a computer step (also known as the computer run). The Transactions may have to be sorted before the file up dating run. If these transactions are on floppy disk, these would be sorted by the key in which the master file has been arranged using sort utilities. If, however, the transactions are on a magnetic tape, they can be sorted on line in several cases in what is known as a sorting run.

The floppy diskettes have been used for the transaction files and the magnetic tape has been used for the master files merely for illustration, Alternative media, however, can be employed. Which media actually to employ in a given situation is again a system analysis and design matter.

It is to be carefully noted that all the data fields appearing on the output reports, summaries, projections etc. are after all either directly picked up from the transactions/master files or derived, after some arithmetic operations, from these. If, therefore, the layouts of the outputs are well-defined and the input layouts designed to suit the former, writing of the program for a particular updating run becomes simple and can be entrusted to the programmers. Incidentally, we can also assert if the student is clear about layouts of outputs and of transactions/master files for an application, the run flowcharts should flow out of his hands naturally. Besides, in the program have also to be incorporated some checks and controls to serve as what we call, judgment. For Example, in a manual system if a clerk finds the price of a washer as Rs. 50 instead of 50 Paise, he would be suspicious, run around, get the correct price and amend the records accordingly. The computer does not possess any such judgment and it would accept Rs. 50 as the correct price for a washer and even pass the invoices sent by the supplier. Therefore, there is a need for built in checks and controls in the program so that, such errors or omissions can be detected and brought to the notice of the computer users. Invariably, in an up-dating run, one of the outputs is an error list and summary information which contains such errors and the batch totals computed by the computer. These totals are then compared with the ones derived manually prior to processing and the errors detected via the checks and controls are scrutinized by the user departments and ultimately rectified and re-submitted for computer processing.

5.3.1 Sales Order Processing system

A computer-based sales order processing system characterised by the following possibilities of integration :

1. Sales accounting and sales analysis are integrated with accounts receivable operation and records.
2. Credit functions can be integrated as far as possible into the overall flow of automated processing.
3. The sales application is closely related to inventory control processing.

Input preparation

The sales department prepares the sales order in duplicate upon receipt of the customers purchase order or telephonic information from a salesmen or the customer after satisfying themselves that the customer's account is not delinquent. One of the outputs of a computer run to be discussed subsequently is the list of delinquent accounts which the sales department consults to establish credit worthiness of the customer. One of the copies of the sales order is sent to the customer as an acknowledgement of the receipt of his purchase order. The other copy is sent to the shipping department as an authorisation to ship the goods to the customer. The format of the sales order should be so designed that it facilitates error-free and quick entry of data from the customer's purchase order as also transcription of data from it on to floppy diskette subsequently. The sales department enters the quantity shipped and quantity back ordered against each line on the order, *i.e.,* for each stock item on order, the price having already been entered by the sales department. The Shipping department assembles the sales order in daily batches and compiles the following batch totals for it on an adding machine, perhaps : record count, financial total of the values of items shipped and hash totals of quantities shipped, quantities back ordered, customer's account numbers and stock item numbers. The batch of the sales orders together with the control slip bearing these batch totals is then forwarded to the data processing department for transcription on the floppy disk.

Likewise, the mailroom assembles the daily batch of remittance advises received from the customers and compiles the following batch totals for it : record count, financial total of the amounts remitted and the hash total of the customer account numbers. The batch together with the control slip bearing these totals is forwarded to the data preparation section.

We are dealing with only two types of transactions for this application for simplification of illustration though in practice there would also be the following inputs :

(i) Addition of new records to the file

(ii) Credits for sales returns and allowance

(iii) Account right-offs

(iv) Changes of addresses and other routine adjustment and corrections.

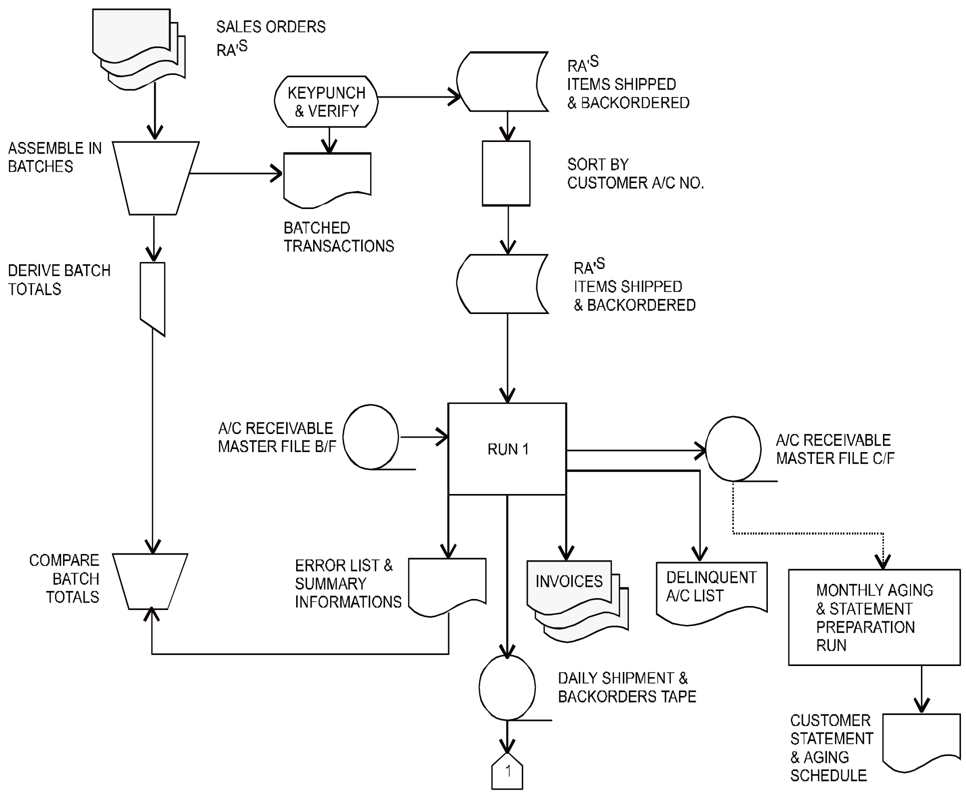


Fig. 5.3.3 Sales order purchasing

The data preparation section of the data processing department records data on floppy disc for each item back-ordered each time shipped and each remittance advice on the data entry machine. This floppy disc is then given to the verifier operator who verifies the records by re-entering the transaction data via the verifier keyboard. For economies in verification time it may, however, be desired that just the critical data files on the records are verified.

These verified records are then sorted using SORT utility with the customer account number as the key.

The sorted file constitutes the transaction file which is used to update the accounts receivable master file by the account receivables update program in computer run. In this run, customer accounts are updated for the sales. Typically, the accounts receivable master file contains the following fields :

(i) Customer account number (control field).

(ii) Customer name and address.

(iii) Credit rating.

(iv) Credit limit

(v) Balance due as of last monthly statement.

Following are the particulars of each transactions :

(i) Transaction type code.

(ii) Documents number.

(iii) Data.

(iv) Amount.

(v) Current balance.

Incorporated in the programme are also the various control checks which check the accuracy of the contents of the various data fields. The outputs of this run are as follows:

(i) The updated A/c receivable master file.

(ii) Delinquent accounts list which contains the particulars of those customers who have crossed either the credit limit or the credit rating assigned to them.

(iii) Invoices in as many copies as desired. It has to be noted that invoice would be prepared for only the Items shipped. A specimen of the invoice is given below :

XYZ Manufacturing Company						
15, High Street, Sometown Tax .... Tel .... Invoice No						
INVOICE						
Customer Order No.	Date	Salesman Code	Cost Acct No.			
Sold to ABC Mfg. Co 13. Nehru Road Allahabad		Ship to name				
Shipper	Date Shipped	Invoice Date	Terms of Sale			
Item *Code*	*Description*	*Qty ordered*	Qty *Back-Ordered*	*Qty shipped*	*Unit Price*	*Total Price*

(*iv*) *Daily Shipment and back-orders tape* - The data stored on floppy disc is put on to magnetic tape for a subsequent speedier resorting by stock item number as well as speedier processing against inventory file.

(*v*) *Error list and summary information* - This contains the rejects *i.e.,* those transactions which could not pass the control checks. These are ultimately investigated by the user department, rectified and re-submitted to the data processing department for re-processing. The summary information consists of all the batch totals derived by the computer. These batch totals are compared with the ones derived manually prior to processing and entered into control slips travelling with the batches of the transactions.

The accounts receivable file is also processed every month to produce the customer statements and aging schedules a specimen of which is shown below.

Statement			
XYZ Manufacturing Company 15, High Street Sometown To ABC Limited 13, Nehru Road Allahabad Invoice	Date		Account No
Date	Number	Charges	Credits
			Previous Balance .... Current Account .... Total Amount
Past Due Amounts Over 30 days.......... Over 60 days........ Over 90 days.........			

5.3.2 Benefits of flowcharts

The benefits of flowcharts are elucidated below :-

(*i*) *Quicker grasp of relationships* - Before any application can be solved, it must be understood, the relationship between various elements of the application must be identified. The programmer can chart a lengthy procedure more easily with the help of a flowchart than by describing it by means of written notes.

(*ii*) *Effective Analysis* - The flowchart becomes a blue print of a system that can be broken down into detailed parts for study. Problems may be identified and new approaches may be suggested by flowcharts.

(*iii*) *Communication* - Flowcharts aid in communicating the facts of a business problem to those whose skills are needed for arriving at the solution.

(*iv*) *Documentation* - Flowcharts serve as a good documentation which aid greatly in future program conversions. In the event of staff changes, they serve as training function by helping new employees in understanding the existing programs.

(*v*) *Efficient coding* - Flowcharts act as a guide during the system analysis and program preparation phase. Instructions coded in a programming language may be checked against the flowchart to ensure that no steps are omitted.

(*vi*) *Orderly check out of problem* - Flowcharts serve as an important tool during program debugging. They help in detecting, locating and removing mistakes.

(*vii*) *Efficient program maintenance* - The maintenance of operating programs is facilitated by flowcharts. The charts help the programmer to concentrate attention on that part of the information flow which is to be modified.

5.3.3 Limitations of flowcharts

The limitations of flowcharts are as given below :

(*i*) *Complex logic* - Flowchart becomes complex and clumsy where the problem logic is complex.

(*ii*) *Modification* - If modifications to a flowchart are required, it may require complete re-drawing.

(*iii*) *Reproduction* - Reproduction of flowcharts is often a problem because the symbols used in flowcharts cannot be typed.

(*iv*) *Link between conditions and actions* - Sometimes it becomes difficult to establish the linkage between various conditions and the actions to be taken there upon for a particular condition.

(*v*) *Standardisation* - Program flowcharts, although easy to follow, are not such a natural way of expressing procedures as writing in English, nor are they easily translated into Programming lauguage.

(*vi*) The essentials of what is done can easily be lost in the technical details of how it is done.

(*vii*) There are no obvious mechanisms for progressing from one level of design to the next *e.g.,* from system flowchart to run flowcharts, program flowchart etc.

5.4 PROGRAM FLOWCHARTS

The program flowcharts are the most detailed and are concerned with the logical/arithmetic operations on data within the CPU and the flow of data between the CPU on the one hand and the input/output peripherals on the other. Prior to taking up an actual program flowcharts, we first discuss below a flowchart (fig 5.4.1) of the morning routine of an office employee to bring out concepts and the use of the following flowcharting symbols involved.

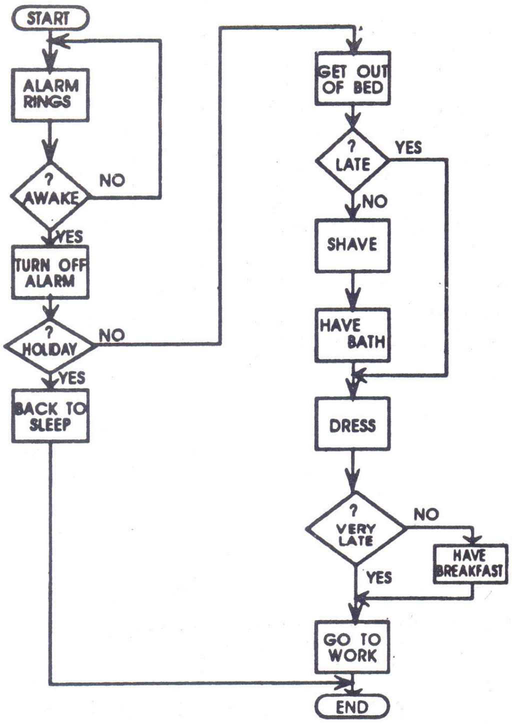


Fig. 5.4.1 Flow chart of morning routine of an employee

Box

Fig. 5.4.2
Action symbol

Diamond

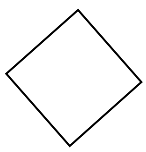


Fig. 5.4.3
Decision making symbol

Fig. 5.4.4
Start/end symbol

The box in Fig 5.4.2 is an action symbol. Such actions as “dress” etc. would be written within the box. In the context of program flowcharting, such actions would, for example, consist of the various arithmetic operations.

The diamond shown in fig 5.4.3 is the symbol for posing a question and it leads to two branches with yes and no as answers to the question. In program flowcharting, however, this is a comparison or conditional symbol. For example, if in an inventory control application, reorder level has reached, the program instructions for placement of the replenishment order would be executed. If it has not reached, a different path would be taken. This path may involve alternative set of instructions. Suppose that reorder level is placed in location number 536 and the stock level is placed in location number 637, the necessary comparison may be symbolized in either of the ways given in Fig. 5.4.5.

Fig 5.4.4 is the symbol for start and end of a routine.

In fig. 5.4.1, the loop starting from the diamond symbol for “awakes” and enclosing the box for “alarm rings” should be of interest in view of its importance in program flowcharting. It portrays the recurrence of the alarm until the person is awake. Later, in a program flowchart, we shall encounter a loop for computing 2^7.

Some other points of relevance to program flowcharting are well brought out by this flowchart. Obviously, different people have different approaches to the routine. Likewise, a problem may be flowcharted or programmed differently by different programmers. For example, consider the problem of finding the value of the expression $2^7 \times\ 7$. One programmer may compute 7 first and then 2^7. Another programmer may do just the reverse. Still another programmer may work in the following fashion:

$$(2 \times 7) \times (2 \times 6) \times (2 \times 5) \times (2 \times 4)\ldots\ldots\ldots$$

Whereas in personal routines one is at complete liberty, in Program flowcharting, one of the objectives is to keep the program as simple as possible. Therefore, the third approach of computing $2^7 \times\ 7$ in the fashion of

$$(2 \times 7) \times (2 \times 6) \times (2 \times 5)\ldots\ldots\ldots$$

is rather clumsy and, therefore, not sound.

Another point concerns the level of detail in flowcharting. In the Box “dress” we have implied dress including combing the hair. But someone may want to use two boxes for dressing and combing. For example, the computation $2 \times 3 \times 7 = 42$ may be shown in just one box as such or in two boxes as $2 \times 3 = 6$ and $6 \times 7 = 42$. The most detailed program flowchart would have exactly one instruction for each symbol in the flowchart *i.e.,* coding would be simple and straightforward but the flowchart being biggish would defeat its purpose of showing the flow of data at a glance.

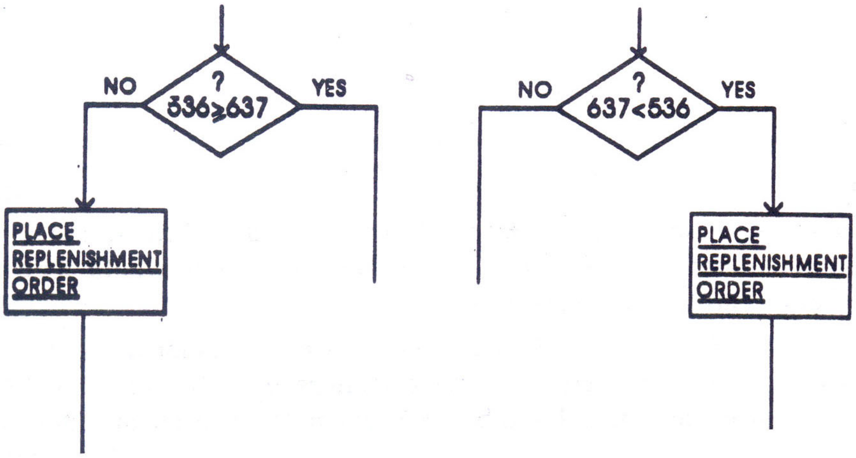


Fig. 5.4.5

Finally, abbreviations, annotation etc. of the various operations, comparisons etc. are desirable and, in fact, necessary to save cluttering the flowchart with long plain English expressions. For example, in fig 5.4.5 “637 < 536” is the abbreviation for “Are the contents of location 637 less than those of location 536”?

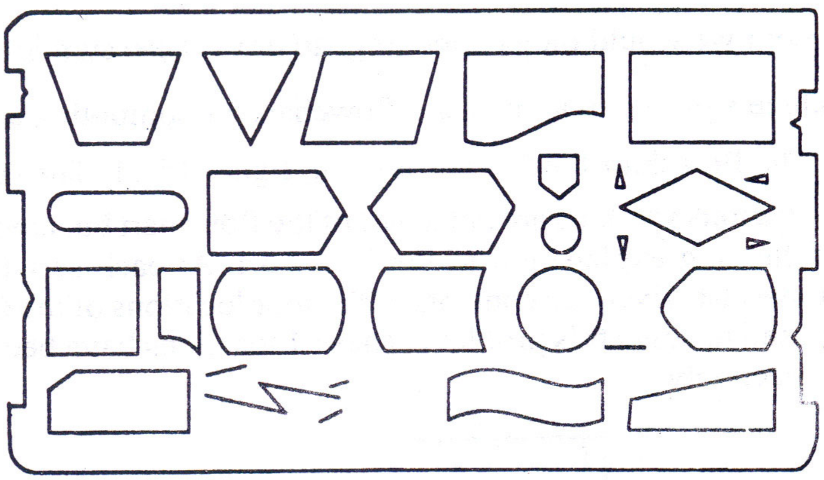


Fig. 5.4.6

COMPUTER FLOWCHARTING SYMBOLS

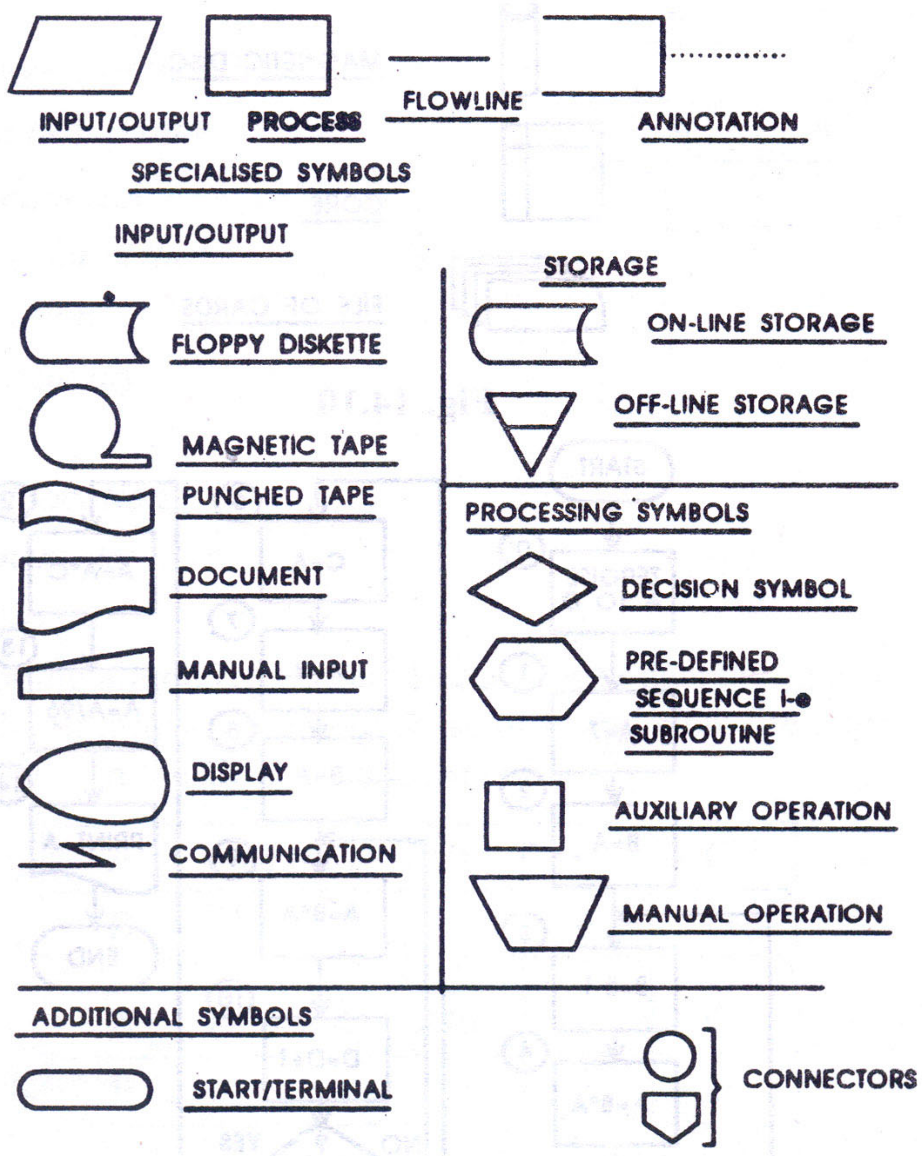


Fig. 5.4.7

More flowcharting symbols are explained in Fig. 5.4.7 & Fig. 5.4.8. There are being marketed flowcharting stencils (fig 5.4.6) but neither they are readily available nor really necessary for the student whom we would rather encourage to draw these symbols in free hand.

Let us now introduce a problem on program flowchart for computing and printing the result of $\frac{22x\;\;7}{96}$ The flowchart for this is shown in fig 5.4.9. The serial numbers in circles against the various symbols are not a part of the flowchart but are merely intended to facilitate the following explanation to the flowchart. At each serial number in this explanation, we have also given the contents of the four locations of the CPU, 001 to 004 which have been used to solve this problem. These 4 locations have been symbolised as A, B, C and D respectively.

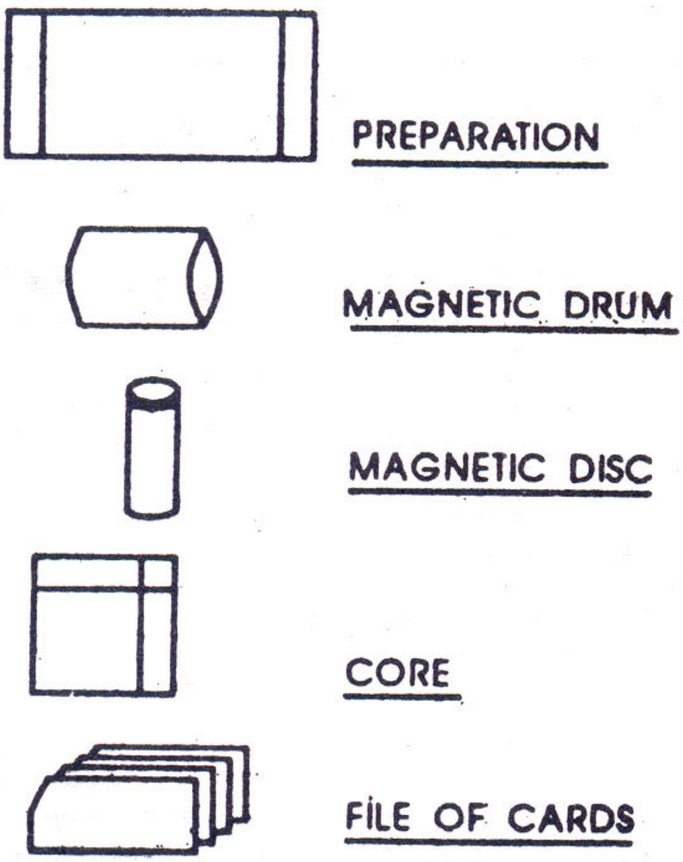


Fig. 5.4.8

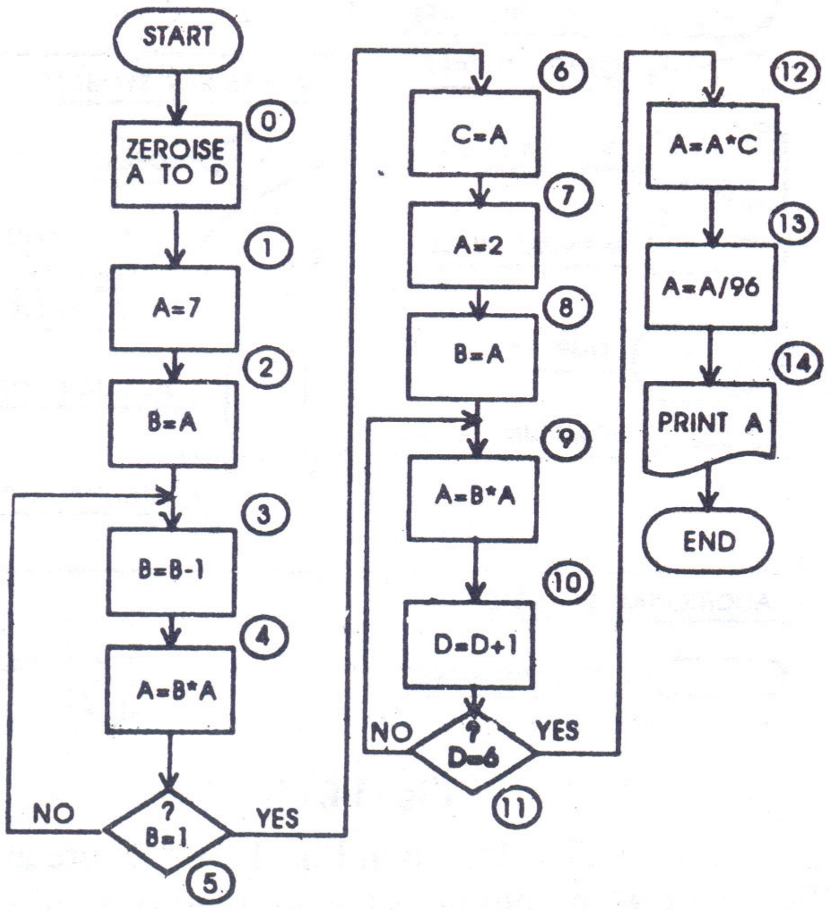


Fig. 5.4.9

The = sign should be interpreted as "becomes" and not equal to, e.g. in step 3, B = B-1 means contents of location B becomes one less than its original contents.

Serial Number *Contents of CPU*

1 *Zeroise A to D (*i.e.,* clear all working location.

A	0	0	C
B	0	0	D

2 *Put 7 in location A*

This is with the view to start computation of 7)

A	7	0	C
B	0	0	D

3. *Transfer the contents of location A to location B (Transfer here implies copy)*

A	7	0	C
B	7	0	D

4. *Subtract one from the contents of location B.*

A	7	0	C
B	6	0	D

5. *Multiply the contents of location A with those of location B and put the result in location A. (It is to be carefully noted that 42 has come in location A, 7 having been automatically erased).*

A	42	0	C
B	6	0	D

6. *If the contents of location B equal 1, go to the next step, otherwise go back to step 3.*

This amount to looping alluded to earlier. The idea is to decrease the contents of location B by 1 successively, multiply these with those of A and store the intermediate results in A. Intermediate results in the CPU are shown below).

A	(42x5) = 210	0	C
B	5	0	D

A	(210x4) = 840	0	C
B	4	0	D

A	(840x3) = 2520	0	C
B	3	0	D

A	(2520 x2) = 5040	0	C
B	2	0	D

A	(5040x1) = 5040	0	C
B	1	0	D

(Thus, at the end of step 5 we have 7 = 5040 in location A).

7. *Transfer the contents of location A to location C.*

A	5040	5040	C
B	1	0	D

(It is to be noted that transfer really means copy *i.e.,* we transfer the contents of location A to location C and also they are retained, and are not erased, in location A).

8. *Put 0002 in location A*

A	2	5040	C
B	1	0	D

(This, of course, erased 5040 held earlier by location A. This has been done with the view to start the computations of 2^7).

9. *Transfer the contents of location A to location B.*

A	2	5040	C
B	2	0	D

10. *Multiply the contents of location A with those of location B and put the results in location A.*

A	4	5040	C
B	2	0	D

(Note that we have to multiply the contents of A six times to obtain the value of 2^7. We have done this once at this stage.)

11. *Add 1 to the contents of location D.*

A	4	5040	C
B	2	1	D

(This is with the view to "remember" that the aforesaid multiplication has been carried out once. This is quite similar to men doing the counting on their finger tips as to how many times the multiplication has been done. In the loop to follow at the next step we shall go on incrementing the contents of location D by 1 until it equals 6. In the technical jargon, we have "set a counter" in location D to keep track of the number of times this multiplication has been carried out).

12. *If the contents of location D equal 6, go to the next step, otherwise go back to step 9.*

(This is the loop to carry out the multiplication six times. The intermediate results are shown below.)

A	(4×2)=8	5040	C
B	2	2	D

(Multiplication 2 times)

A	(8×2) = 16	5040	C
B	2	3	D

(Multiplication 3 times)

A	(16×2) = 32	5040	C
B	2	4	D

(Multiplication 4 times)

A	(32 × 2) = 64	5040	C
B	2	5	D

(Multiplication 5 times)

A	(64 × 2) = 128	5040	C
B	2	6	D

(Multiplication 6 times)

The final result 128 is retained in location A.

13.Multiply the contents of location A with those of location C and put the results in location A

A	645120	5040	C
B	2	6	D

14. Divide contents of location A with 96 and put the results back in A.

A	6720	5040	C
B	2	6	D

15. Print the contents of location A on the continuous stationary.

Several points emerge from the discussion on flowcharting and allied matters above.

(*a*) In the above explanation to the program flowchart, the unbracketed sentence against each serial number is instruction in plain English, *viz.,* "Put 7 in location 001" is an instruction. The serial number gives the instruction number. There are 15 instructions, the flowchart being detailed to the maximum extent *i.e.* each symbol in it corresponds to one instruction. These plain English instructions are quite amenable to codification in the assembly language. The student must not confuse the expressions in the various symbols in this flowchart of Fig. 5.4.9 as these are codified instruction in the assembly language. They are usually arbitrarily devised by the programmers.

The program flowchart is basically intended to facilitate encoding *i.e.,* writing the program instructions. And it is a function of the language in which coding is desired *i.e.,* it may differ from one language to another. Sometimes, especially when the problem is small or simple, coding can be carried out directly without flowcharting; but, it is highly desirable to first draw the flowchart.

(*b*) The flowcharts, except for loops, should ordinarily proceed top to bottom and from left to right.

(*c*) As mentioned earlier, different programmers may approach the same problem in different ways. During the last few centuries in the history of engineering, a design principle has emerged, "Simple engineering is the best engineering". This is as much applicable to program design *i.e.,* flowcharts and systems design.

(*d*) Another objective of programming, aside from its simplicity, is to use the minimum possible storage space. In this example, we have used 4 CPU locations for computations, another 15 would be needed by the instructions *i.e.,* a total of 19 locations have been used. Considering that practical problems are much larger, it is highly desirable to conserve the CPU storage space.

(*e*) The third objective of programming is to ensure that processing time is the least. In this regard, it may be pointed out that divisions, multiplications, subtractions, additions, transfers and comparisons take decreasing computer time in this order.

(*f*) These three objectives of programming are conflicting. For example, the programmer would get several opportunities where he can save on storage space by approaching a problem in rather complex way and *vice versa i.e.* he may economise on computer time by using the storage space lavishly, etc. He has to reconcile the three conflicting objectives. If, for example, the storage space is at premium *i.e.,* the CPU is small and the program is likely to require slightly more or less space that it can make available, the programmer may sacrifice the other two objectives of simplicity and least processing time and keep the emphasis on economising on storage space.

Program flowcharting, to some extent, is a function of the language in which the program will be ultimately coded *i.e.,* it will vary to some extent from one language to another. Therefore, it also depends upon the instruction repertoire or mix of the computer on hand.

Nevertheless the variations are minor. The following hypothetical instruction mix (say, for computer X) will be utilised throughout as a basis for drawing the flowcharts.

5.4.1 Logical/Arithmetic operations

1. Addition

(*i*) Add the contents of two locations, say A and B, and put the results in A or B either or any other location. An example follows :

C = A + B	Means add the contents of two locations A and B, and put the
or	results in location C. However, this interpretation is assembly
C = B + A	Language oriented. The compiler language orientation would be "C becomes the sum of A and B". In this interpretation by '=' is meant 'becomes' and not "equal to". Also in this interpretation C, A and B are treated as if they are variables. Most flowcharting in this chapter is compiler language oriented. However, we shall use assembly language interpretations at places though rather sparingly.
A = A + B	A assumes the sum of the previous value of A and the value of B
or A = B + A	
B = A + B	B assumes the sum of the value of A and the previous value of B.
or B = B + A	

(*ii*) Add a constant to the contents of a location or the value of a variable

C = A + 13	C becomes the value of A plus 13.
A = A + 13	A becomes the previous value of A plus 13.

2. Subtraction

The student can interpret these on the lines of interpretations of the addition operations above.

B = A - B

C = B - A

A = A - B

A = B - A

B = A - 14

A = A - 14

3. Multiplication

The multiplication is best represented by an asterisk in flowcharting so that it does not confuse with the widely used letter, ×. The student can interpret the following operations himself.

C = A *B

C = B * A

A = A * B

A = B * A

A = A * 7

B = A * 7

4. Division

Two types of division can be carried out. Suppose for example, that we divide 7 by 4. In one type, we get 1.75. In the other type, we just get the quotient 1 and the remainder 3 is consigned to a location reserved for remainder by the computer manufacture say, REM. We shall use the same format for the two types as below :

Type 1 Results in the location on L.H.S.	Type 2 Only the Quotient in the location on the L.H.S. The remainder is consigned to standard location symbolised by REM.	
		Remainder i
C = A/B	C = A/B	REM
C = B/A	C = B/A	REM
A = A/B	A = A/B	REM
A = B/A	A = B/A	REM
A = A/131	A = A/131	REM
B = A/131	B = A/131	REM

Though we are not using in the study note any symbol for exponentiation (raising to power) the student may use ** *e.g.* **3 means cube x.

5. Transfer

Transfer the contents of one location into another location. In other words, the variable of the R.H.S. becomes (or assumes) the value of the variable on L.H.S. Examples follow:

A = B If B were 13 and A were 7 or whatever, A would now become 13.

The value of B remains 13 with this operation.

A = 17 A, whatever its previous value, becomes 17.

All these operations 1 to 5 above are depicted in the flowchart in a box. For example, A = A - 14 would be depicted as below :

$\boxed{A = A - 14}$

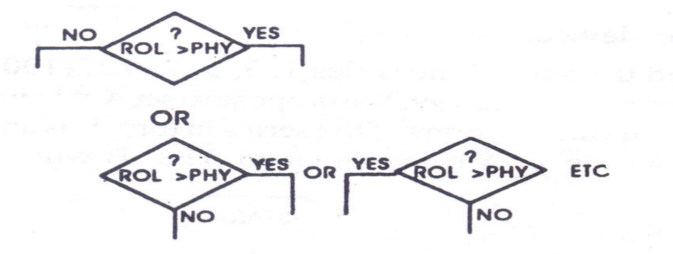
It may also be desired to designate a location or a variable by a suggestive symbol. Thus the step below means that we want to increment “COUNT” by 1.

$\boxed{Count = Count + 1}$ Count becomes the previous value of Count plus 1.

Desirably the length of symbols should not exceed six characters. Also, they must start with an alphabet, letter and never with a numeric or a special character. However, the remaining five characters could be of any kind. These symbols are devised by the person who draws the flowchart. Alphabets must be in capitals.

6. Comparison

In it, the value of two variables (*i.e.* contents of two locations are compared and one action is taken if the answer to the comparison is “yes” and other action if the answer is ‘no’. A comparison is always shown in a diamond as below in which ROL (the symbol for reorder level) is compared with PHY (the symbol for the physical balance). If ROL is greater than PHY, we would place the replenishment order, otherwise not.



The following types of comparisons are possible in most instructions repertoirs.

Variables on R.H.S.	Constant on R.H.S.	
A > b	A > 13	Instead of constants
A < B	A < 13	alphabetic character (s)
A = B	A = 13	or special symbol (s)
A = B	A ≠ 13	can be had on R.H.S.

7. Print

The following types of print operation formats are available.

(*i*) Print (Material) at position....(literally)

e.g., Print "Ramu, 28" at 005.

We want to print RAMU, 28 which constitutes the material. The continuous stationery usually can accommodate 160 characters. Thus, there are 160 print positions from 001 to 160. In the example above, we want to start printing at position 005.

(*ii*) Print (Location or Variable) at position.....*e.g.,* Print A at 010, with which we want to print the value of the variable (or the contents of location) A starting at position 010.

8. Feed

This means raising the continuous stationery by 1 or more lines for printing the next line.

The format is as in the examples below :

1 Line C.S. feed

3 Line C.S. feed

We shall write other input/output instructions (*viz.,* read a record) in plain English. With some exceptions to be explained where the use is made.

5.5 EXAMPLES ON PROGRAM FLOW CHARTING

Numerous examples on program flowcharting follow. The student should, however, familiarize himself with example on $\frac{2^7}{96} \times 7$ this stage before proceeding with the following material.

Example 5.5.1 Draw the program flowchart for finding the sum of first 100 odd numbers.

Solution. The flowchart is drawn as fig 5.5.1.1 and is explained step by step below. The step numbers are shown in the flowchart in circles and as such are not a part of the flowchart but only a referencing device.

Our purpose is to find the sum of the series 1, 3, 5, 7, 9.....(100 terms.) The student can verify that the 100th term would be 199. We propose to set A = 1 and then go on incrementing it by 2 so that it holds the various terms of the series in turn. B is an accumulator in the sense that A is added to B whenever A is incremented. Thus B will hold

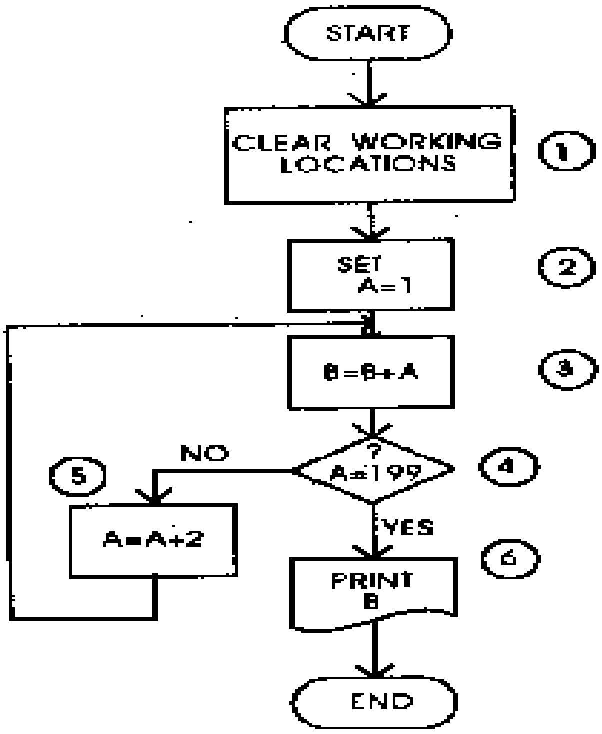


Fig. 5.5.1.1

1
1 + 3 = 4
4 + 5 = 9,
9 + 7 = 16, etc. in turn.

Step 1 - All working locations are set at zero. This is necessary because if they are holding some data of the previous program, that data is liable to corrupt the result of the flowchart.

Step 2 - A is set at 1 so that subsequently by incrementing it successively by 2, we get the wanted odd terms : 1,3,5,7 etc.

Step 3 - A is poured into B *i.e.,* added to B. B being 0 at the moment and A being 1, B becomes 0 + 1 = 1.

Step 4 - In step 5, we shall increment A by 2. So that although at the moment A is 1, it will be made 3 in step 5, and so on. Since we have to stop at the 100th terms which is equal to 199, step 4 poses a question. “Has A become 199 ?” If not, go back to step 3 by forming loop. Thus, A is repeatedly incremented in step 5 and added to B in step 3. In other words, B holds the cumulative sum upto the latest terms held in A.

When A has become 199 that means the necessary computations have been carried out so that in step 6 the result is printed.

Perhaps more suggestive symbols for A and B could be ODD and SUM respectively.

Example 5.5.2 - Draw the flowchart for finding the value of K where K represents an integer greater than one whose value will be read into the computer each time the program is run.

Solution: The flowchart is drawn as fig 5.5.2.1. It may be recalled that we drew a flowchart for computing factorial of 7 but here we intend to generalize for any value designated by K. Thus, the number for which the factorial is needed, is read into the CPU (via, Keyboard) and this number is held in a location which is designated as K. Thus, K may be given any integral value, *viz*., 7, 17, 20 etc. This is done in step 1.

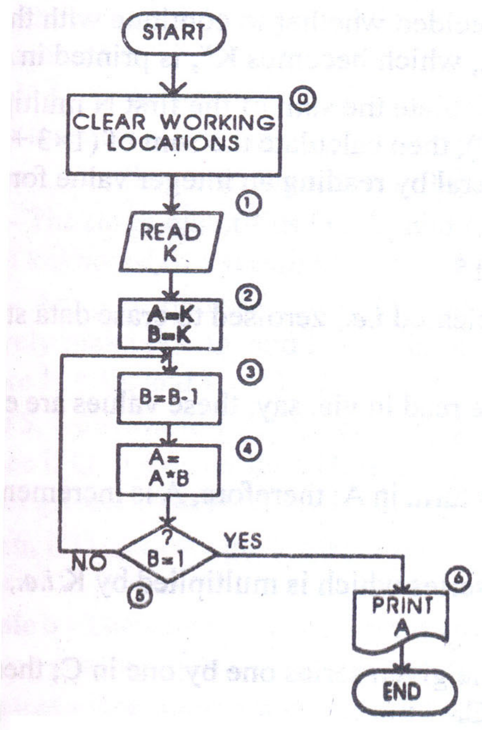


Fig 5.5.2.1

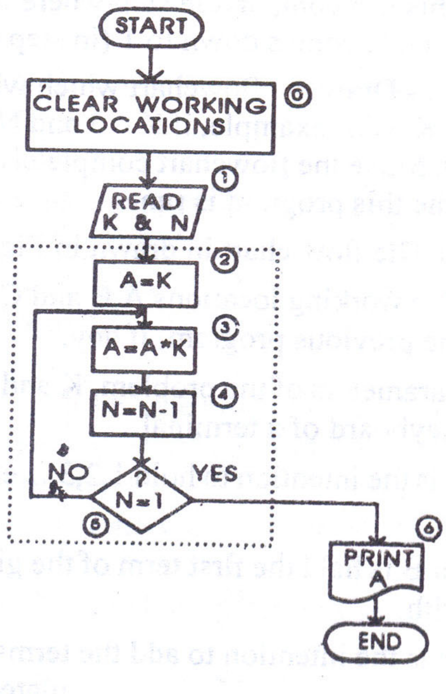


Fig. 5.5.3.1

Step 2 - A and B are both equated to K. In the following steps, we shall repeatedly decrement B by 1 and go on multiplying it with A successively so that A holds K(K-1), K(K-1)(K-2) etc. in turn and B becomes K,(K-1), (K-2), etc. in turn.

Step 3 - As already stated above, B is brought down from K to K-1.

Step 4 - A becomes the product of A and B i.e., K(K-1).

Step 5 - It is a comparison step for looping. Obviously the factorial would have been computed when B, after having been successively decremented by 1, becomes 1. But since at the moment B has come down to K-1 and not 1, by looping we go back to step 2 where B becomes (K-2) and A, in step 3, becomes K(K-1)(K-2); so on until A holds the value of the K, which is printed in step 6.

Example 5.5.3 - Draw the flowchart for finding the value of K^N where K and N are read into the computer each time the program is run, N has to be >1.

Solution : The flow chart in given in Fig 5.5.3.1 (Please ignore dotted lines. They are referenced in a subsequent examples).

Step 0 - We zeroise all working locations.

Step 1 - Values of K and N are read, say, these values are entered through keyboard of a terminal.

Step 2 - A is equated to K. We shall subsequently go on multiplying A by K successively via a loop so that A is made A^2, A^3, etc. in turn.

Step 3 - A becomes AK *i.e.,* A^2 since K is equal to A.

Step 4 - We have to carry out the multiplication of A by K, (N-1) times to get the value K^N. In this step, therefore, we decrease N by 1. Via the loop we shall continue to decrement it by 1 until it is brought down to 1.

Step 5 - This is a comparison step where it is decided whether to continue with the loop or not. When N comes down to 1 (in step 4). A, which becomes K^N, is printed in step 6.

Example 5.5.4 - Draw the flowchart which will calculate the sum of the first N multiples of an integer K. (For example, if K = 3 and N = 10), then calculate the sum of (1×3 + 2×3 + ...+ 10×3). Make the flowchart completely general by reading an integer value for N and K each time this program is run.

Solution : The flow chart in drawn in Fig. 5.5.4.1

Step 0 - The working locations A,B and C are cleared *i.e.,* zeroised to erase data sticking in from the previous program, if any.

Step 1 - Parameters of the problem, K and N are read in via, say, these values are entered through keyboard of a terminal.

Step 2 - It is the intention to hold 1,2,3,... etc., in turn, in A; therefore, A is incremented by 1.

Step 3 - In B is held the first term of the given series which is multiplied by K *i.e.,* 1 × K, to start with.

Step 4 - It is the intention to add the terms of the given series one by one in C; therefore, the first term, to start with, is accumulated in C.

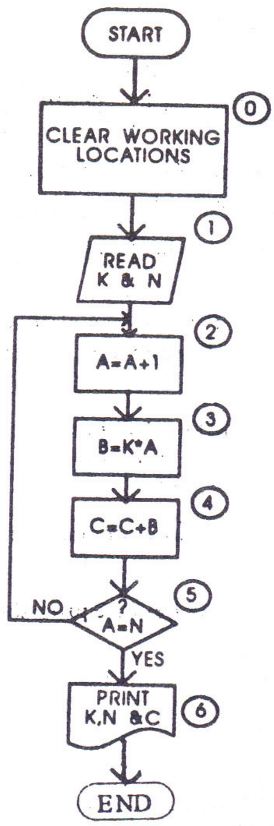


Fig 5.5.4.1

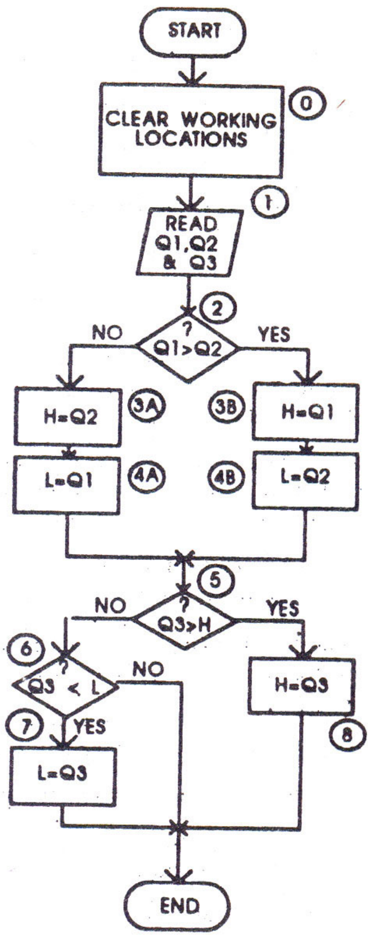


Fig. 5.5.5.1

Example 5.5.5 - There are three quantities; Q_1 Q_2 and Q_3. It is desired to obtain the highest of these in location H and lowest of these in location L.

Solution : The flow chart is given in fig 5.5.5.1.

Step 1 - The three quantities Q_1, Q_2 and Q_3 are read in via, say, these values are entered through keyboard of a terminal.

Step 2 - Any two quantities, say Q_1 and Q_2 are compared. If Q_1 is greater than Q_2, we tentatively make H = Q_1 and L = Q_2 in Steps 3B and 4B: otherwise, in Steps 3A and 4A, we make H = Q_2 and L = Q_1.

At Step 5, we are holding the higher of Q_1 and Q_2 in H and the lower of these in L. In Step 5, we see if Q_3 is greater than H. If it is so, obviously in Step 8, H is made equal to Q_3. If Q_3 is not greater than H, we compare Q_3 with L in Step 6.

In Step 6, if $Q_3 < L$, we go to Step 7 and make L = Q_3, otherwise, the job has already been done prior to Step 5.

Example 5.5.6 - The square root of a number can be computed by an iterative procedure. The following computational steps are performed.

1. Select a first guess for the desired square root. A reasonable value for the first guess might be obtained by dividing the given number by 2.
2. Divide the given number by the assumed square root.
3. If the quotient and divisor are sufficiently close, then the desired square root has been obtained to a sufficient degree of accuracy and the computation ceases.
4. If the quotient and divisor do not agree, then a new guess must be obtained for the square root and the procedure repeated. The new guess is obtained by calculating the arithmetic average of the most recent divisor and quotient. The computation then returns to step. 2.

   Say, N = the given number whose square root is desired.

   D = the divisor.

   Q = the quotient.

   R = the desired square root.

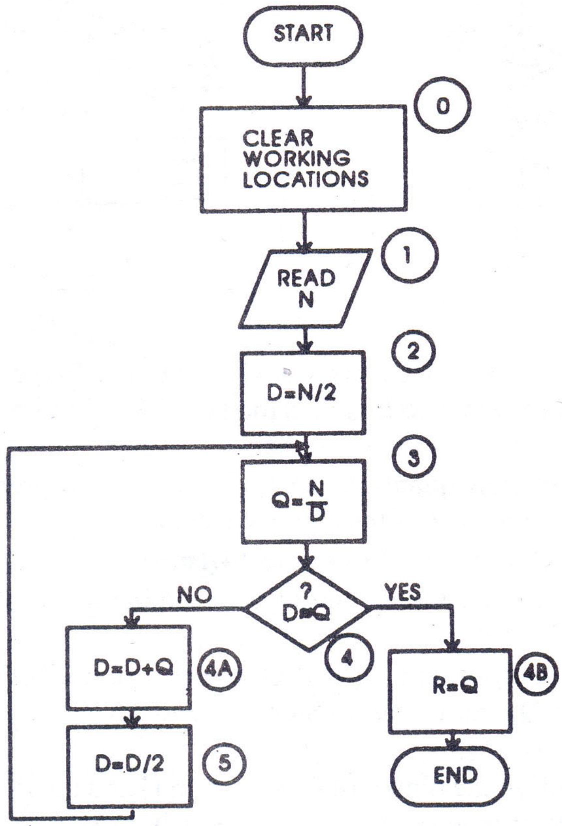


Fig. 5.5.6.1

(Let us now apply this method to a problem namely, computing the square root of 8. The computation will proceed in the following steps.

(a)	$D_1 = \frac{1}{2}(8) = 4$	$Q_1 = 8 \div 4 = 2$
(b)	$D_2 = \frac{1}{2}(4 + 2) = 3$	$Q_2 = 8 \div 3 = 2.6666$
(c)	$D_3 = \frac{1}{2}(3 + 2.6666) = 2.83333$	$Q_3 = 8 \div 2.83333 = 2.82353$
(d)	$D_4 = \frac{1}{2}(2.83333 + 2.82352)$	$Q_4 = 8 \div 2.83843 = 2.8242$
	$= 2.82843$	

Solution : The flowchart is given above in Fig. 5.5.6.1.

Step 1. N, the number for which the square root is wanted.

Step 2. D is made half of N as the initial estimate of square root of N (=8 may be imagined).

Step 3. N(= 8) is divided by the estimate D to get Q.

Step 4. If D is approximately equal Q, we have computed the square root which however, is not the case as yet (since D = N/2 = 4 and Q = N/2 = 8/4 = 2 and D ≠ Q); therefore, go to steps 5 and 6. In these two steps, we find the average of D and Q and put it in D. This average [= (2 + 4)/2 = 3] is taken in D as the new estimate of the square root and we loop back to step 3.

*In fact, there does not exist any instruction in any computer by which we can compare if two quantities are roughly equal. What therefore, would actually be done is to find the difference between D and Q and if it is ≤ prescribed difference, say 0.001, we accept as equal.

Example 5.5.7 - Draw the flowchart for deriving the sum of the squares of first 20 odd numbers.

Solution : The flowchart is shown in Fig. 5.5.7.1.

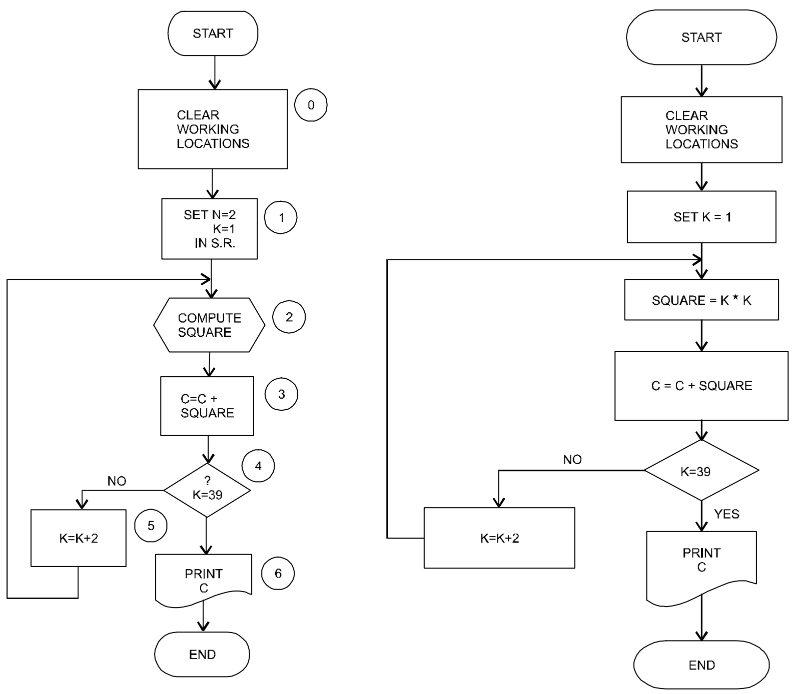


Fig. 5.5.7.1 **Fig. 5.5.7.2**

Step 0 - All working locations are assigned the value zero

Step 1 - The first odd number is 1 so we set K = 1

Step 2 - The square of first odd number is computed by multiplying K with K and the result so obtained is stored in location SQUARE.

Step 3 - We accumulate the first term *i.e.* square of the first odd number 1 in location C.

Step 4 - The 20th odd number is 39, therefore in this step we see if K has become 39 or not (by step 5)

Step 5 - K is increment by 2 *i.e.,* it becomes 1+2 = 3.

Note - The problem can be solved using a subroutine as depicted in fig 5.5.7.2. The procedure for the same is given below :

Step 0 - All working locations are assigned the value zero.

Step 1 - In step 2, we employ the square subroutine (which is the set of steps enclosed in the dotted box in FIG 5.14 for computing K^2). Therefore, we set N = 2 for ever in this program and K = 1.

Step 2 - K^N *i.e.,* 1^2 is computed by the aforesaid subroutine (S.R.) AS.R. is being depicted in the hexagonal symbol in program flowcharting.

Step 3-5 - Remaining the same as discussed above.

Example 5.5.8 - The weights of newly born babies in a hospital are input to computer. The hospital incharge is interested to find the maximum, minimum and mean weights of all the weights of the babies.

Draw a suitable flow chart for his problem. A value of zero can be used at the end of the list of baby weights. This denotes the end of the list.

Solution - The required flowchart is given in fig 5.5.8.1.

Explanation - The weight of the first baby is inputted through console and stored in location W. This value is assigned to three locations *viz.,* MINW, MAXW and TOTW. MINW is a location in which minimum of all weights will be stored. MAXW location will be used for storing maximum of all weights and TOTW for accumulating all the weights.

COUNT is a counter used for keeping a track of the number of transactions read. It is set at 1 after reading the first transaction. Next transaction is then read. Since W = 0 will indicate end of the list of baby weights, check whether the value of W is equal to zero or not.

If W = 0, then calculate the mean of all weights by dividing the TOTW by COUNT and storing the result in location MEANW; and print the values of MXW, MINW and MEANW.

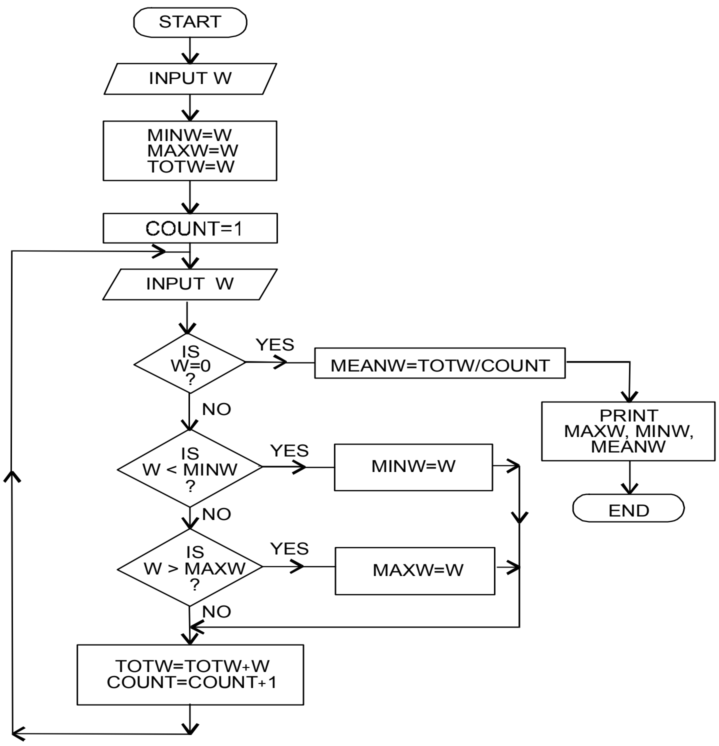


Fig. 5.5.8.1

If W is not equal to zero, then check whether the value of W is less than the value of MINW. If yes, then assign MINW = W. If not, then check whether W is greater than MAXW or not. If yes, then assign MAXW = W.

Accumulate totals of all weights in location TOTW and increase the value of the counter COUNT by 1. Then go back to read the next transaction.

Example 5.5.9 - Draw the program flowchart for computing the annual acquisition, inventory carrying and total costs for lot sizes of 100,200... 2400. The various variables of interests are supposed to be there in the locations symbolized below :

REQ	Annual requirements of the item
ACQ	Procurement costs/order
COST	Cost per unit
Rate	Inventory-carrying rate, I.

Solution : The flowchart is drawn in Fig 5.5.9.1. The following symbols represent the working locations that are put to use by this flowchart.

LOTSIZ	Lot size
IVCOST	Annual inventory-carrying cost
AQCOST	Annual acquisition cost
TOCOSTS	Annual total costs

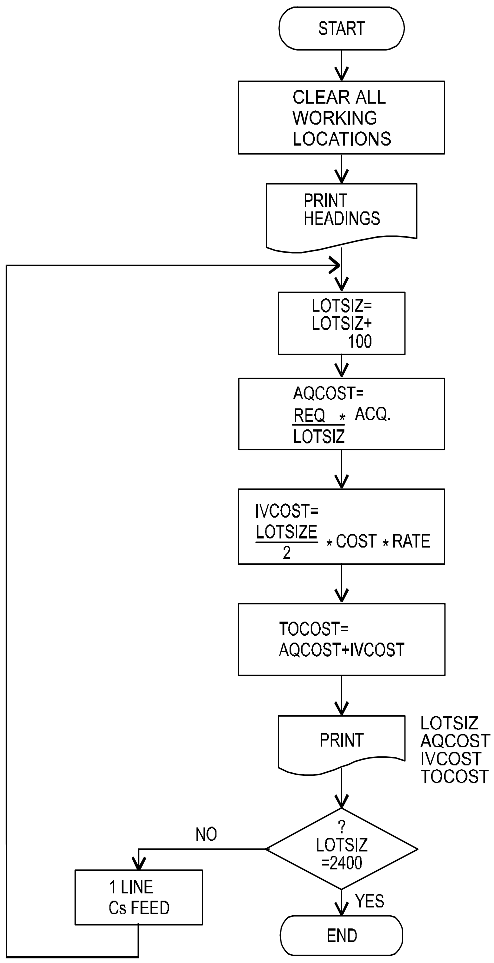


Fig. 5.5.9.1

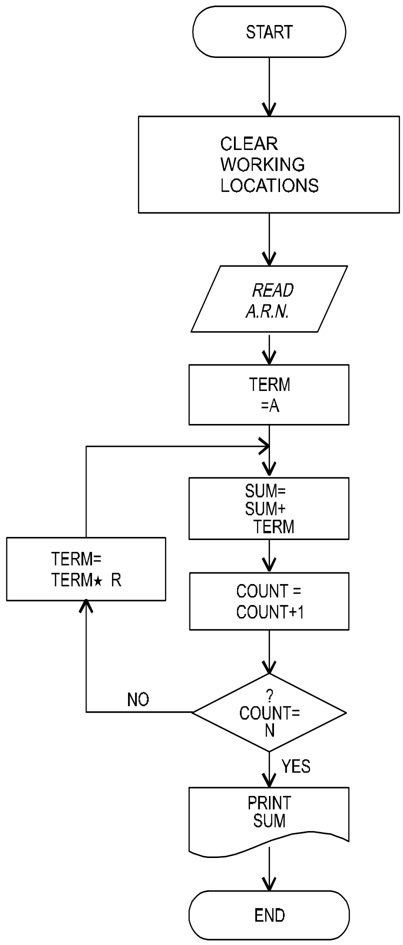


Fig. 5.5.10.1

Example 5.5.10 : Draw the flowchart for finding the amount of an annuity of Rs. A in N years. Rate of interest = r %, R = (1 + r). This amount is given by the following series :

$A + AR + AR^2 + ...AR^{N-1}$.

Solution : The flowchart is drawn in fig 5.5.10.1. The following symbols are employed:

TERM	To hold A, AR, etc. (i.e., the various terms) in turn.
SUM	In it is accumulated the sum of term.
COUNT	Counter to count the number of terms accumulated.

Example 5.5.11 : (On computing Customs Duties) : Assume that imported goods from foreign countries are classified into 4 categories for the purpose of levying customs duty. The rate for each category is as follows :

Class No. (K)	*Class of Goods*	*Customs duty (%), on Values of Goods V*
1	Foods, beverages	10
2	Clothing, footware	15
3	Heavy machinery	17½
4	Luxury items	40

Draw the flowchart for computing the appropriate customs duty :

Solution : The required flowchart is given in fig 5.5.11.1

Example 5.5.12 : The problem is to compute, for a series of transactions, the gross sales (G), the quantity discounts, (D), if any; and the net sales (N). The raw data to be supplied in the program includes the quantity sold (Q) and unit price (P). The quantity discount schedule is as follows :

If quantity sold is :	*The discount rate would be :*
less than 100 units	none
100 to less than 200	10%
200 and over	20%

Solution : The flowchart is drawn in fig 5.5.12.1

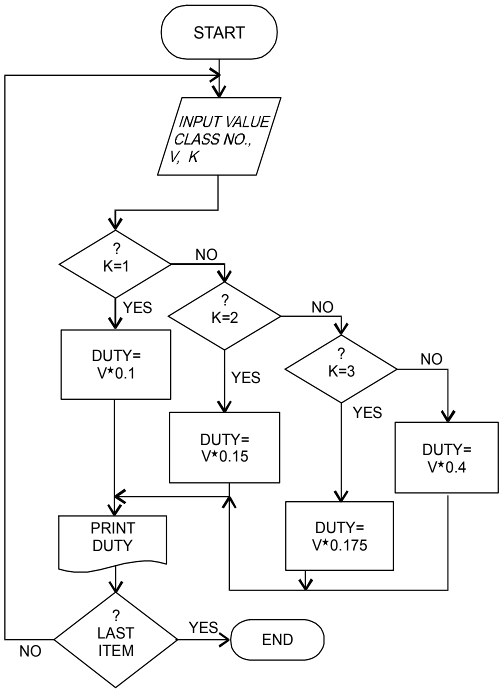


Fig. 5.5.11.1

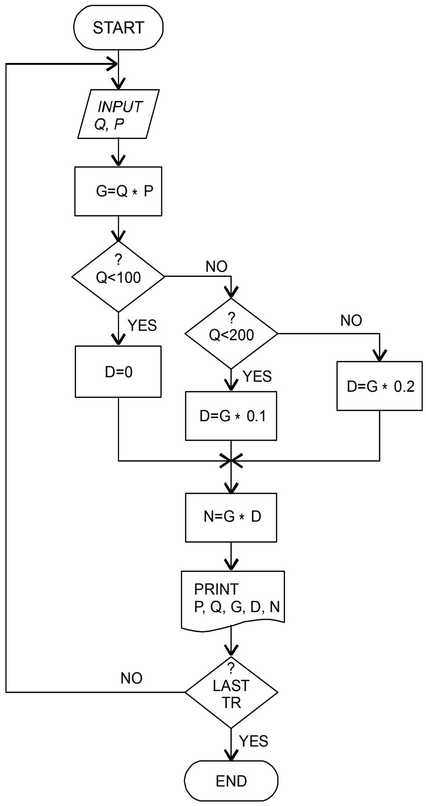


Fig. 5.5.12.1

Example 5.5.13 : A bicycle shop in Delhi hires bicycles by the day at different rates as shown in the following table :-

Season	*Charges per day*
Spring (March - May)	*Rs. 8.00*
Summer (June - August)	*Rs. 9.50*
Autumn (Sept - Nov.)	*Rs. 5.00*
Winter (Dec. - Feb.)	*Rs. 6.00*

To attract his customers, the proprietor also gives a discount on the number of days a bicycle is hired for. If the hire period is more than 10 days, a reduction of 15% is made. For every bicycle hired, a deposit of Rs. 20 must be paid. Develop a flowchart to print out the details for each customer such as name of customer, number of days a bicycle is hired for, hire-charges and total charges including the deposit. It is also assumed that there are 25 customers and complete details for each customer such as name of customer, season and number of days the bicycle is required for is inputted through console.

Solution : The required flowchart is drawn in fig 5.5.13.1.

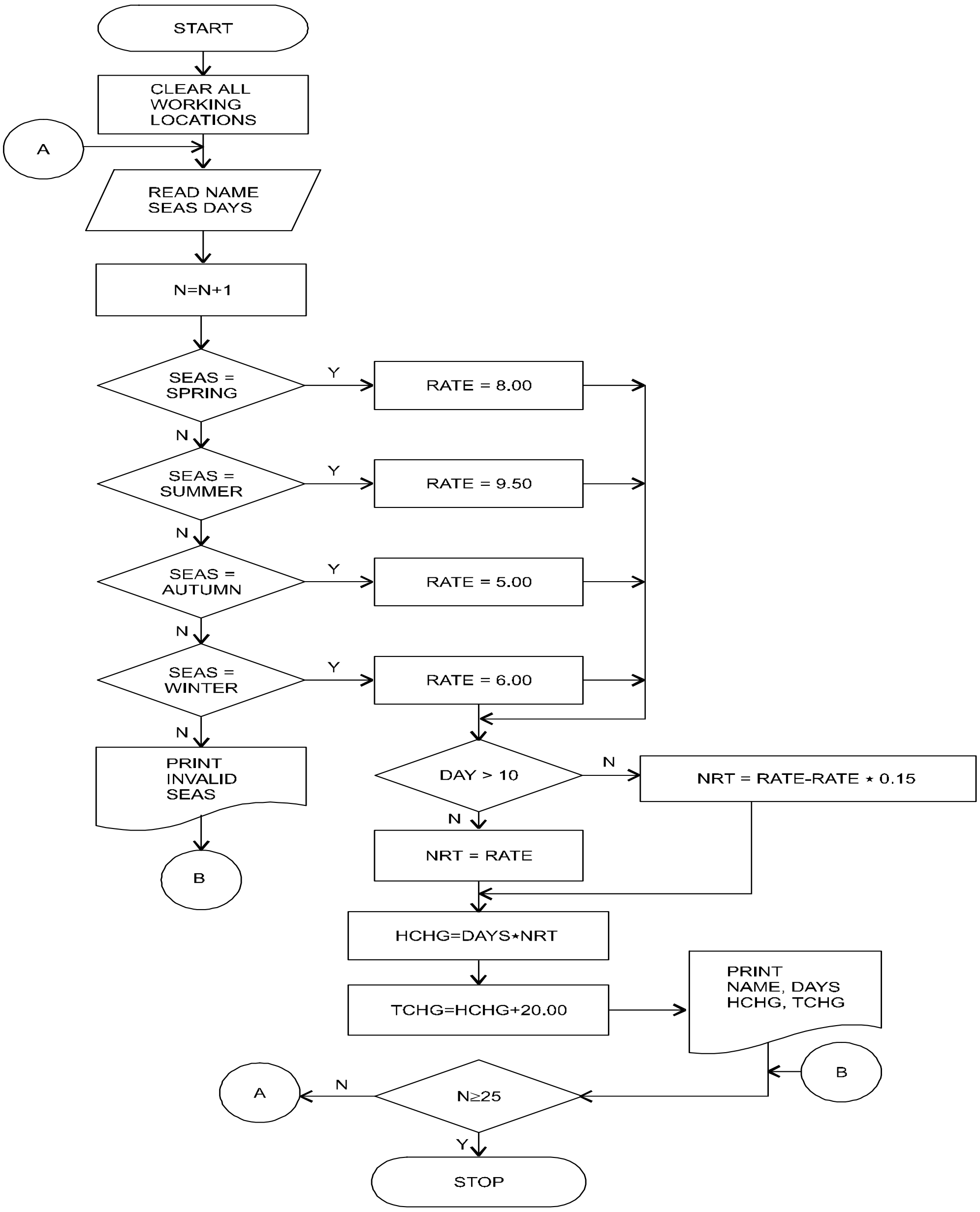


Fig. 5.5.13.1

In this example, N is a counter used for keeping a track of the number of customers for whom data is read and processed. In the beginning it is initialized so that its value is 0.

A transaction is then inputted through console and the value of the counter N is increased by 1.

The season code is then checked. If the season is 'SPRING', the rate of hire charges is Rs. 8 per day and we go to check the No. of days for which a bicycle is hired. If the season is not 'SPRING', check whatever it is 'SUMMER' and so on.....

Once the rate for hire charges is decided, check whether the No. of days for which a bicycle is hired is greater than 10 days or not. If 'days' is greater than 10, the rate is increased by 15% otherwise not. Then hire charges are calculated by multiplying the rate by No. of days.

The hire charges are then added to Rs. 20 and stored in a location TCHG to calculate the total of hire charges for a customer. Details of a customer namely his name, No. of days, hire charges, and total hire charges are then printed.

Since there are in all 25 customers, then check counter N to see if details for all the customers have been read and processed or not. If not, then go back to read the next transaction. If yes, then stop.

Example 5.5.14 - Given the following set of data :

Account No.	*Age of customer*	*Sex*	*Unpaid Balance*
			Rs.
13466	28	M	145.23
4156	20	F	49.50
33215	45	F	89.24
44178	19	M	115.23
56723	28	F	75.95
47892	33	F	25.78
24567	19	M	54.75
56783	55	M	24.78
43579	39	F	67.85
56782	30	M	150.97
79134	18	F	39.95
63423	29	F	69.95

Draw the flowchart to compute and print out the following :

Average Customer Age		*Unpaid Balance* *Males*		*Females*
Under 20	Rs.	XXX.XX	Rs.	xxx.xx
20 to Under 30		XXX		XXX
30 to Under 40		XXX		XXX
40 and over		XXX		XXX

Solution : The program flowchart is given in Fig. 5.5.14.1. M1 to M4 accumulate balances for the 4 age groups of male customers and likewise F1 to F4 for the female customers. Age is symbolized by A, balance by B and Sex is codified as M or F. The last record is dummy.

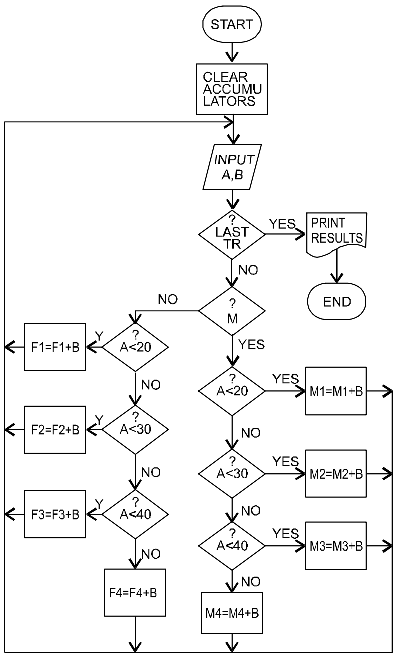


Fig. 5.5.14.1

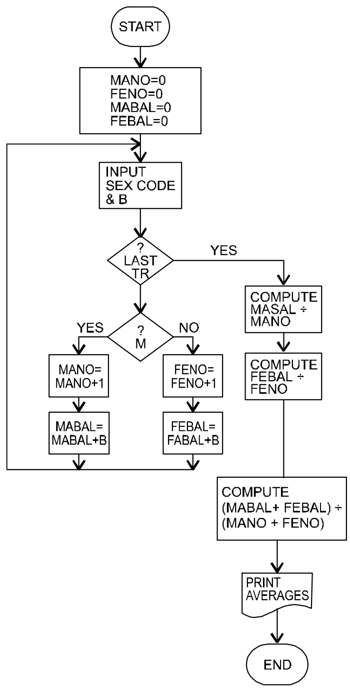


Fig. 5.5.15.1

Example 5.5.15 : Using the data of the previous example, draw a flowchart for computing and printing out the following statistics :

Sex	*Average Unpaid Balance* *Rs.*
Male	XXX.XX
Female	XXX.XX
Overall	XXX.XX

Solution : The program flowchart is shown in Fig. 5.5.15.1 above. The following Symbols are used:

MANO	Counter for males	FENO	Counter for females
MABAL	Sum for male balances	FEBAL	Sum for female balances

Example 5.5.16 - Flowchart Binary Search, (Re. Magnetic Disc)

Solution : The required flow chart is given in fig. 5.5.16.1

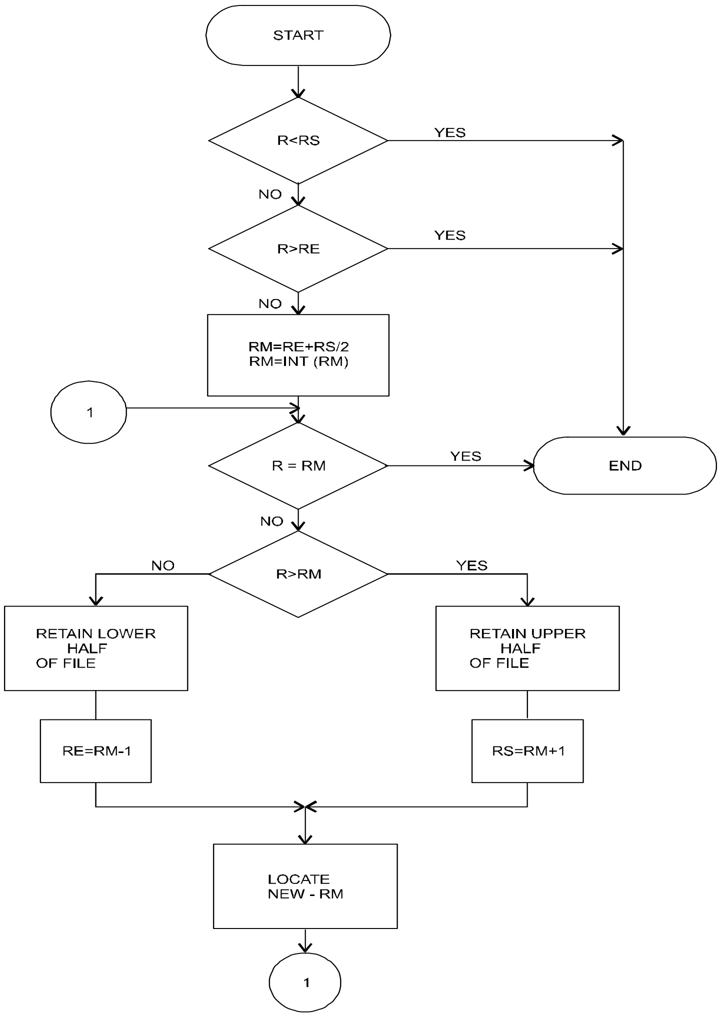


Fig. 5.5.16.1

Modification/Initialization Instructions

These Instructions can change the value of a variable location number in an existing instruction during the program execution process. The initialization instruction can set or reset the value of this variable to any desired number. The modification instruction can increment/decrement this variable during the loop execution by any constant (*viz.,* 12,30).

Example 5.5.17 : Marks on each student (in a class) in 12 papers are entered through keyboard of a terminal and are read into the CPU locations MARKS 001 to MARKS 012. You are required to draw the flowchart for computing and printing the average marks of each student.

Solution : MARKS 001, MARKS 002....MARKS 012, are holding the marks in 12 papers of a student. We propose to accumulate them as ACCUM. This could be accomplished in 12 instructions as below :

ACCUM = ACCUM + MARKS 001

ACCUM = ACCUM + MARKS 002, etc. to...

ACCUM = ACCUM + MARKS 012

But we do not do this way. We all shall adopt a cleverer approach which is made possible by the facility of what is known as the “modifying” instructions in the instruction repertoire.

It is to be seen that the 12 instructions above can be generalized as

ACCUM = ACCUM + MARKS (X)

We have to start with X = 1 and then go on incrementing it by one to generate the above 12 instructions. This we do as shown below in fig 5.5.17.1 :

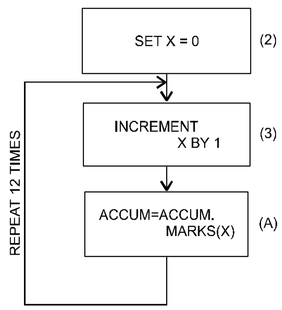


Fig. 5.5.17.1

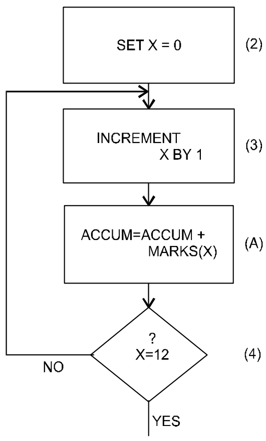


Fig. 5.5.17.2

Set X = 0 in (A)

Increment X by 1 in (A)

ACCUM = ACCUM + MARKS (X)

By step (2), we made X in step (A) = 0 and by step (3), we incremented it by 1 so that MARKS (X) in A has been made MARKS (1) which is the same thing as MARKS001. If we repeat step (3) and (A) 12 times as per the left flowchart segment above, we, in effect, will have performed the aforesaid 12 instructions.

But, how do we repeat this loop 12 times ? This is accomplished by including the comparison step (4) as per R.H.S. segment as shown in fig 5.5.17.2. In this step, we pose the question if X has become 12?

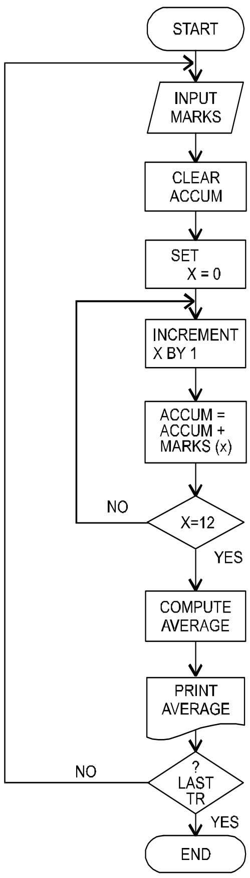


Fig. 5.5.17.3

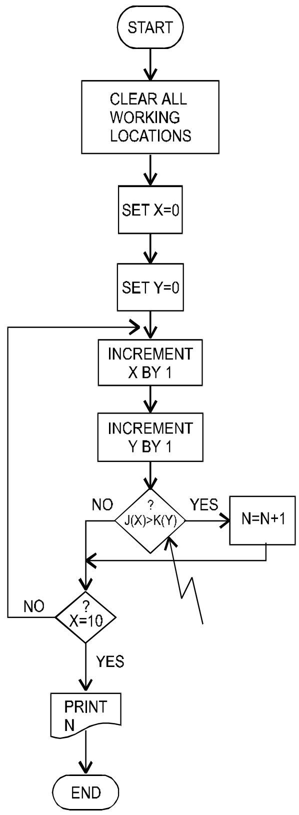


Fig. 5.5.18.1

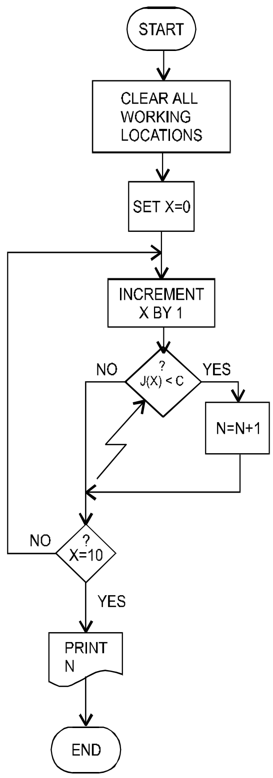


Fig. 5.5.19.1

The complete flowchart is shown in Fig. 5.5.17.3.

Step (3) in Fig. 5.5.17.2 corresponds to what is known as the modifying instruction since it modifies the instruction corresponding to step (A). The step (2) is a sort of initialization step or instruction since it sets the value of variable X at 0 for each student's 12 papers.

Modification of the 'Comparison' Step.

Example 5.5.18 : Prices for ten commodities in the current year are designated by J(X), X varying from 1 to 10. Likewise, their last year's prices are designated by K(Y), Y varying from 1 to 10. Draw the flowchart for finding the number, N of commodities of which prices have increased.

Solution : The flowchart is drawn in fig 5.5.18.1

The *crooked arrow shows the comparison step that is initialized and modified for looping. The following is the comprehensive list of comparisons of this type that are valid:

$$J(X) > K(Y)$$

$$J(X) = K(Y)$$

$$J(X) \neq K(Y)$$

$$J(X) < K(Y)$$

Example 5.5.19 : Prices of commodity in ten major cities are designated by J(X), X varying from 1 to 10. The price prevailing in the capital is designated by C. Find the number of cities having the price less than that in the capital.

Solution : The flowchart is drawn in Fig 5.5.19.1. With the crooked arrow showing the comparison step that is initialized and modified for looping. The following is the comprehensive list of this type of comparisons possible in flowcharting.

$$J(X) < C$$

$$J(X) = C$$

$$J(X) > C$$

$$J(X) \neq C$$

Example 5.5.20 : A company has 2,500 employees. Their salaries are stored as J(s), 1, 2, ---- 2500. The salaries are divided in four categories as under :

(*i*) Less than Rs. 1,000 (*ii*) Rs. 1,000 to Rs.2,000

(*iii*) Rs. 2,001 to Rs. 5,000 (*iv*) Above Rs. 5,000.

Draw a flow chart for finding the percentage of the employees in each category.

Solution : The flow chart is drawn in fig 5.5.20.1.

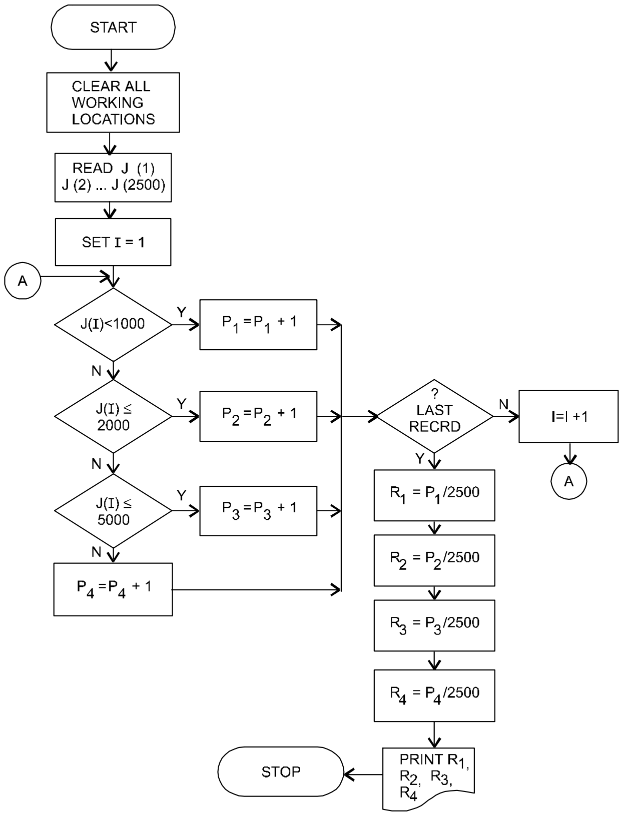


Fig. 5.5.20.1

Example 5.5.21 : A file contains 1000 records of students who appeared for an examination. Each record consists of the roll number of a student, his name and marks obtained by him in 10 papers. Records are read into the CPU one by one for finding for each student the number of papers, N in which he scored distinction by obtaining 75 out of 100 or more marks. Name is held by NAME, Roll number by ROLL NO and marks by J(X), X = 1, 2, 3 ...10.

Solution : The flowchart is shown in fig 5.5.21.1 the crooked arrow shows the comparison step of major interest. This comparison involves a constant 75. The following is the comprehensive list of this type of comparisons valid in flowcharting.

$J(X) < 75$ (On R.H.S., alphabetics of

$J(X) = 75$ special symbols can also be had).

$J(X) \neq 75$

$J(X) > 75$

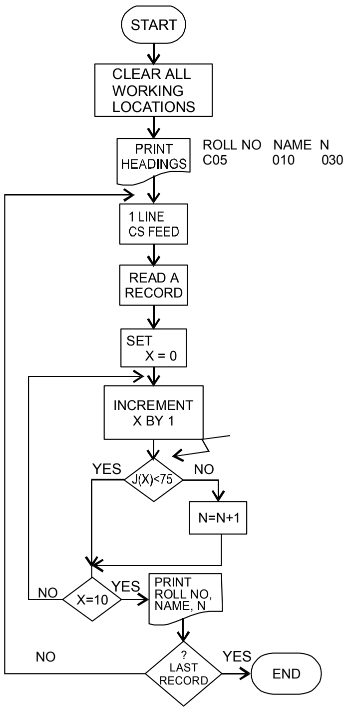


Fig. 5.5.21.1

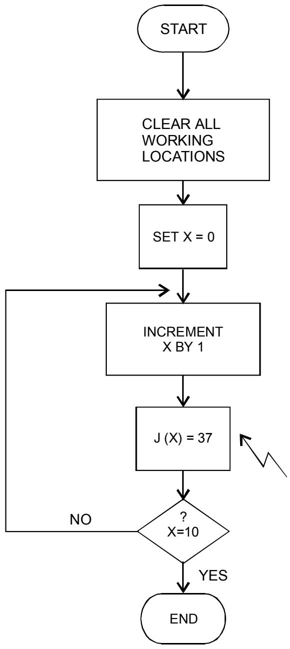


Fig. 5.5.22.1

Modification of the "Transfer step"

Example 5.5.22 : Assign a value of 37 to each of the array, J(X), X = 1, 2...10.

Solution :The crooked arrow in the flowchart of Fig. 5.5.22.1 shows the "transfer" step of interest wherein 37 is put in each of the 10 locations designated in general by J(X).

Example 5.5.23 : Transfer the contents of locations J(X), X = 2,4, 8, 10...20 to K(Y) = 1, 2, 3...19.

Solution :The flowchart is shown in fig 5.5.23.1. The crooked arrow shows the step of major interest wherein K(Y)'s are successively equated to J(X)'s.

Example 5.5.24 : Transfer the contents of location J(0) to each of the following 10 locations.

Solution :The flowchart is shown in fig 5.5.24.1 for transferring the content of J(0) to each of J(1), J(2), J(3)...J(10). The crooked arrow shows the step of major interest.

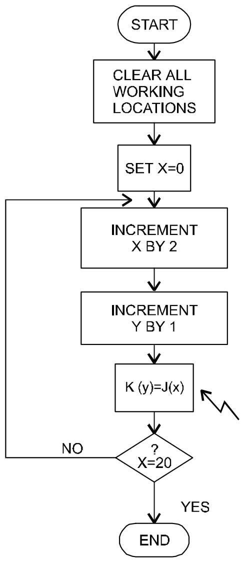


Fig. 5.5.23.1

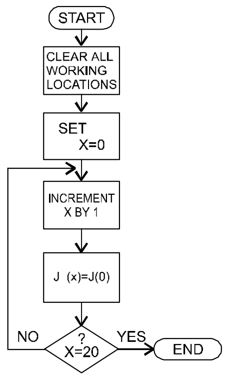


Fig. 5.5.24.1

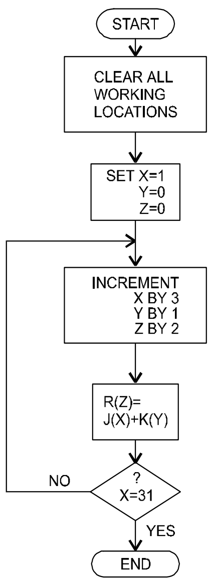


Fig. 5.5.25.1

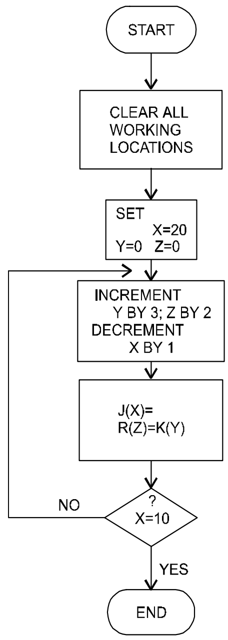


Fig. 5.5.26.1

Modification of Arithmetic Steps

Example 5.5.25 : It is desired to add contents of 10 locations J(X), X = 4, 7, 10...31 and K (Y), = 1, 2, 3...10 on a one to one basis and put the results in R(Z),Z = 2, 4, 6...20.

Solution : The flowchart is shown in fig 5.5.25.1. The step of major interest has a crooked arrow to it. The following is the comprehensive list of such types of steps.

R(Z) = J(X) + K(Y)	Such types are
R(Z) = J(X) - K(Y)	also valid :
R(Z) = J(X) * K(Y)	R(Z) = R(Z) + J(X)
R(Z) = J(X) / K(Y)	R(Z) = R(Z) / J(X), etc.

More Examples on Modification of Arithmetic operations

Example 5.5.26 : Multiply R(Z), Z = 2,4,6....20 and K(Y), Y = 3,6,9,...30 on a one to one basis and put the results in J(X), X = 19,18,17...10

Solution : The flowchart shown in fig 5.5.26.1. It is the intention here to bring out the fact that decrementing of L.H.S.J(X) (in general even one or both designations R.H.S.) is also valid by one (in particular and general any integer).

Example 5.5.27 : Add Rs. 45 (a constant) to the wages of 10 persons designated by J(X), X = 1,2...10.

Solution : The flowchart is drawn in fig 5.5.27.1. The crooked arrow shows the step for adding a constant to the contents of a location. Other permissible steps of this type are as below:

J(X) = J(X) - 45
J(X) = J(X) * 45
J(X) = J(X) / 45
J(X) = J(X) + 45, etc.

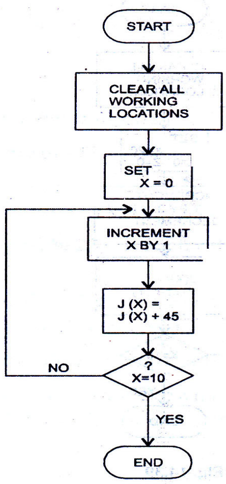


Fig. 5.5.27.1

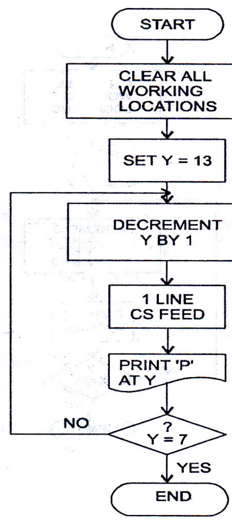


Fig. 5.5.28.1

Example 5.5.28 : Print 6 'P's in the pattern given below.

012(print position)

p

p

p

p

p

p

007 (print position)

Solution : The flowchart is drawn in fig 5.5.28.1. The print instruction has the following two formats. Printing is done in one line by an instruction.

1. Print (Given material as 'P' here) starting at print position (001 to 160). We want to print 'P' at starting print position 012; therefore, we give the instruction "Print 'P' at Y". Y is the print position on the continuous stationery which usually can accommodate 160 characters in one line. We want to print 'P' at the Y the position. In the given pattern 'p' in the first line is to be printed at position 12; therefore, we set Y at 13 and then it is decremented by 1. This is followed by "1 line CS feed" which means program instructs the printer to raise the continuous stationery by one line so that it is set for printing the 2nd 'P' in the 2nd line. By means of the loop, Y is decremented from 012 position by one so that 'P's are printed at positions 012, 011, 010, 009, 007 in successive lines.
2. Print (contents of a location at starting print position) (001 to 160).

This type is illustrated in the following example.

Example 5.5.29 : 64 locations J(X), X = 1, 2...64 hold 64-3 digit quantities. It is required to draw the flowchart for printing these in an 8×8 matrix as below :

412 331 602 400 405 403 408 421

424 425 423 422 421 420 419 426

:

:

:

531 310 410 212 111 402 124 429

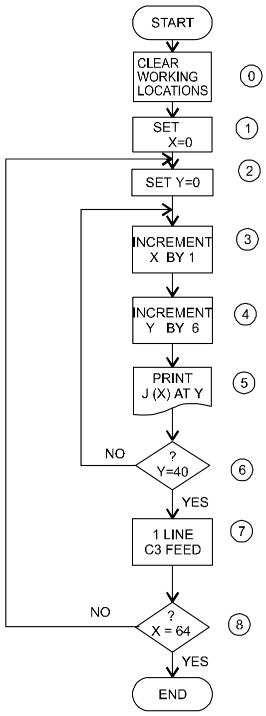


Fig. 5.5.29.1

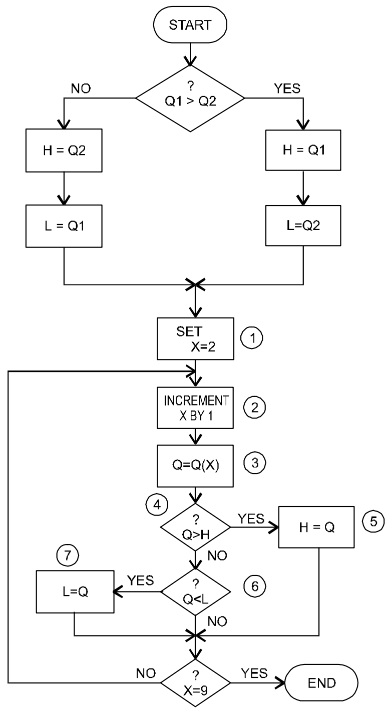


Fig. 5.5.30.1

Solution : The flowchart is drawn in fig 5.5.29.1. The first row figs in the above matrix are the contents of J(1) to J(8). The second row figures in the above matrix are the contents of J(9) of J(16). Moving this way, the figures of the last row are the contents of J(57) to J(64).

The first column is printed at start position Y = 005, and 2nd column at Y = 010 and so on, so that the 8th column has the print position, Y = 040. Thus, in the flowchart, when Y becomes 040, it is a signal that the printing of a line is over, therefore, the continuous stationery is raised by a line, Y reset at 005 for commencing the printing of the next line.

We are giving an increment of 5 to Y which is the minimum necessary. It could be more but it should not be less because the three digits and the sign (for say, debit/credit as + or -) would require 4 print positions and the fifth position would be left blank as a gap between two quantities.

Example 5.5.30 : Q(X) holds 9 quantities Q1, Q2...Q9. Obtain the highest quantity in location H and the lowest quantity in location L.

Solution : The flowchart is shown FIG 5.5.30.1. In addition to the given symbols, another symbol Q [which is the same as Q (O)] is used to hold Q3, Q4...Q9 in turn.

We start in the manner of example 5. Having put that way the higher of Q1 and Q2 in H and the lower in L tentatively, from step 1 onwards, we want to compare Q3, Q4...Q9 in turn with H and L. In fact, steps 4 to 7 are similar to the later part of the flowchart of example 5.

In steps 1 and 2, we prepare X = 3 for step 3 which now reads "Q = Q(3)". What we have done is that we have put the contents of Q(3) in Q and in steps 4 to 7 we work on Q instead of Q(X). Why are we reluctant to work with Q(X) straight in steps 4 to 7? Well we could do so and we would get the wanted results. But by working with Q(X) directly in step 4 to 7, these steps would read as below on the L.H.S. 'rather than on the R.H.S. as in the flowchart.

Step 4	Q(X) > H		Q > H
Step 5	H = Q (X)	rather	H = Q
Step 6	Q (X) < L	than	Q < L in the flowchart
Step 7	L = Q(X)		L = Q

So, if we work with Q(X) straight in steps 4 to 7, we shall have to set X = 3 in each of these steps. But by having equated Q with Q(X) we can work with Q and we do not have any problem of setting X in steps 4 to 7.

Example 5.5.31 : In locations J(X), X = 1, 2....200 are held 200 quantities. Draw flowchart for finding the ratio of the total number of quantities indivisible by 10 to that of divisible by 10.

Solution : The flowchart is shown in fig 5.5.31.1. The following symbols are used in it.

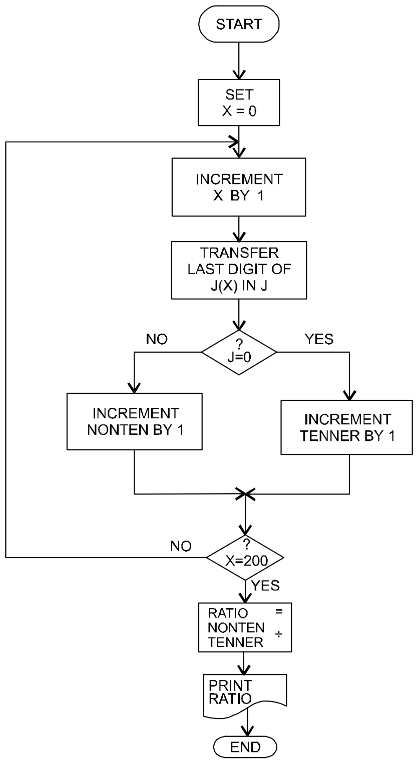
NONTEN	Total number of items not divisible by 10
TENNER	Total number of items divisible by 10
RATIO	Ratio NONTEN/TENNER

J(X), X = 1,2...200 are used to hold the last digit of a quantity.

Partial transfer (as we have down in this flowchart) of one or more consecutive digits from one location into another location is valid.

Example 5.5.32 : It is required to compute the geometric mean of six past prices for each commodity in an inventory of 50 commodities. The 6 prices having been entered through a keyboard of a terminal which are read into the CPU in locations designated by VALUE001 to VALUE006. Draw the flowchart. Use would be made of a S.R. to compute the 1/6 powers.

Solution : Here again in Fig. 5.5.32.1, Modification instruction is put to use, which is always the case whenever an array or a list of variables are to be processed similarly.



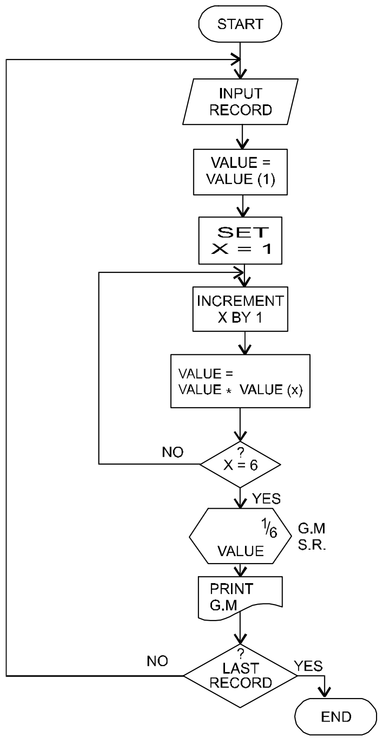


Fig. 5.5.31.1 **Fig. 5.5.32.1**

Example 5.5.33 : It is desired to sort 5 quantities in a list held in the CPU locations symbolized by LIST001 TO LIST005. Draw the program flowchart.

Solution : Switching or Exchange method of Sorting within the CPU

The LIST X to be sorted is assumed to be as follows :

LIST X (1)

LIST X (2)

LIST X (3)

LIST X (4)

LIST X (5)

The logic of method depicted in the flowchart in Fig. 5.5.33.1 may be summarized as follows:-

1. Check the first pair of values in the LIST X that is, compare X(1) and X (2). If they are in the right order, X(1) ≤ X(2), leave them alone and proceed to check the next pair of values. If however, X(1) > X(2), they are in the wrong order and need to be switched *i.e.* exchanged before proceeding to a check of next pair, X(2) and X(3).
2. After one pass through comparing each neighbouring pair of the value of X, it is necessary to go through another pass to ensure that each pair of values is now in the right order (that is if no switching occurs during the pass) another pass is still required to ensure that a sorted list is being achieved.

For illustration of how the sorting logic works, the LIST X is assumed to be as follows before sorting begins :

LIST X (1) = 1

LIST X (2) = 5

LIST X (3) = -2

LIST X (4) = 7

LIST X (5) = 4

The values of the elements of X during the first pass through the list are summarised below :

LIST	VALUE OF X DURING 1ST PASS				AFTER 1 LOOP
	I=1	I=2	I=3	I=4	
X(1)=	1	1	1	1	1
X(2)=	5	5	-2	-2	-2
X(3)=	-2	-2	5	5	5
X(4)=	7	7	7	7	4
X(5)=	4	4	4	4	7
? STITCHING	NO	YES	NO	YES	
VALUE OF S	0	1	1	2	2

The value of I only goes from 1 to 4 since when I = 4, the last pair of values of X, X (4) and X (5), will be compared.

As demonstrated above, after one pass through the list, the value in LIST X are not all in the right order since two switches occurred during the pass. Hence, a second pass through list is required. The value of the elements of X during the second pass are as follows :

	VALUE OF X DURING 2nd PASS				AFTER 1
LIST	I = 1	I = 2	I = 3	I = 4	LOOP
X(1) =	1	-2	-2	-2	-2
X(2) =	-2	1	1	1	1
X(3) =	5	5	5	4	4
X(4) =	4	4	4	5	5
X(5) =	7	7	7	7	7
? SWITCHING	YES	NO	YES	NO	
VALUE OF S	1	1	2	2	2

In the third pass no switching would be there *i.e.* S = 0 meaning that the list is sorted.

The steps for the flowchart drawn in Fig. 5.5.33.1 are explained below :

Step 1. The switch counters is set equal to zero.

Step 2. This step initializes the loop to follow.

In steps 4 and 5, we are using LIST (X) as the general symbol for the five locations :

LIST(1), LIST(2), LIST(3), LIST (4) and

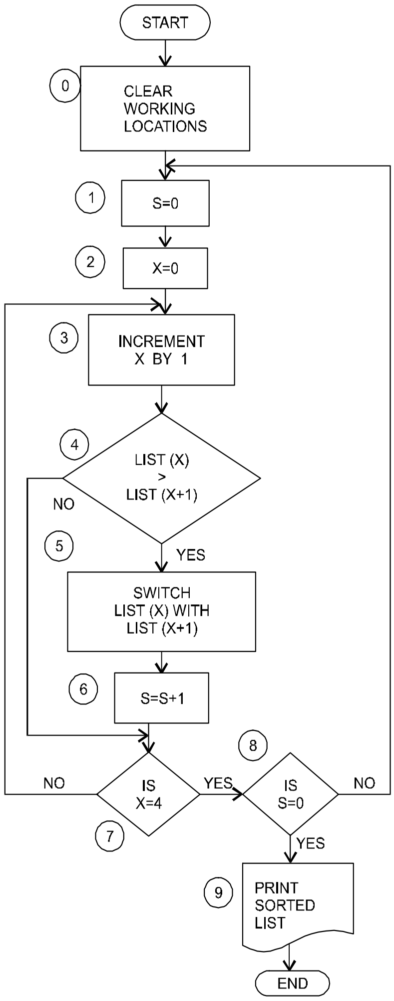
LIST (5) holding the five numbers to be sorted in the ascending order. Naturally, therefore, if LIST(X) is made LIST (0) by setting X = 0 in step 2 under explanation, LIST (X + 1) would mean LIST (1). Thus having set X = 0 in steps 4 and 5, LIST (X) means LIST (0) and LIST (X + 1) means LIST (1). Surely LIST (0) is not one of the five locations holding the five numbers. This is set right in step 3.

Step 3. X is incremented by 1 in the following steps, 4 and 5. This makes LIST (1) of LIST (X) and LIST (2) of LIST (X + 1).

Step 4. LIST (1) is compared with LIST (2).

Since we know LIST (1) = 1 and LIST (2) = 5 are in the right (ascending) order, no switching is needed; therefore, steps 5 and 6 are bypassed.

Step 7. Since X = 1 and not 4 therefore, the program flowchart loops back to step 4.



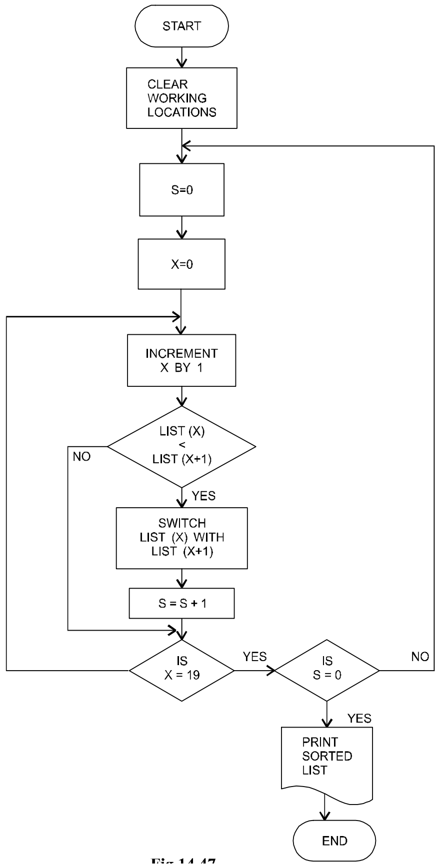


Fig. 5.5.33.1 **Fig. 5.5.34.1**

Step 3. X is incremented by 1 so that step 4 reads "Is LIST (2) > LIST (3) ?" Since we know LIST (2) = 5 and LIST (3) = -2 and as such the answer to the question of step 4 is in affirmation. We, therefore, proceed with step 5 and switch the contents of the two locations. In step 6, the switch counter is incremented by 1 to count that one switching has taken place.

In this manner, the loop is executed 4 times (X = 4 in step 7) and then we take up step 8 which poses the question. "Is S, switch counter = 0 ?". We know S ≠ 0: therefore, the flowchart loops back to step 1 for the 2nd pass.

Note 1 - If it were required to draw the flowchart for sorting these quantities in the descending order the above flowchart with step 4 modified as below would serve the purpose.

LIST (X) < LIST (X + 1)

Ref. to example 33 (B)

Note 2 - In the above flowchart, we have condensed the printing step 9. Supposing the list were to be printed in the format below, expand step 9 as an exercise.

-2 (Start print position 035)

1

4

5

7

Example 5.5.34 : Write a computer programming flowchart to arrange 20 Members in descending order.

Solution : *See Fig* 5.5.34.1

Miscellaneous Solved Examples

(After having gone through these the student may want to redraw these by closing the book.)

Example 5.5.35 : Draw a flow chart to calculate the local taxes as per the following details :

Code No.	Type of Goods	Tax Rate
001	Perishable	15%
002	Textiles	10%
003	Luxury Items	20%
004	Machinery	12%

Solution : The required flowchart is drawn below in fig 5.5.35.1:

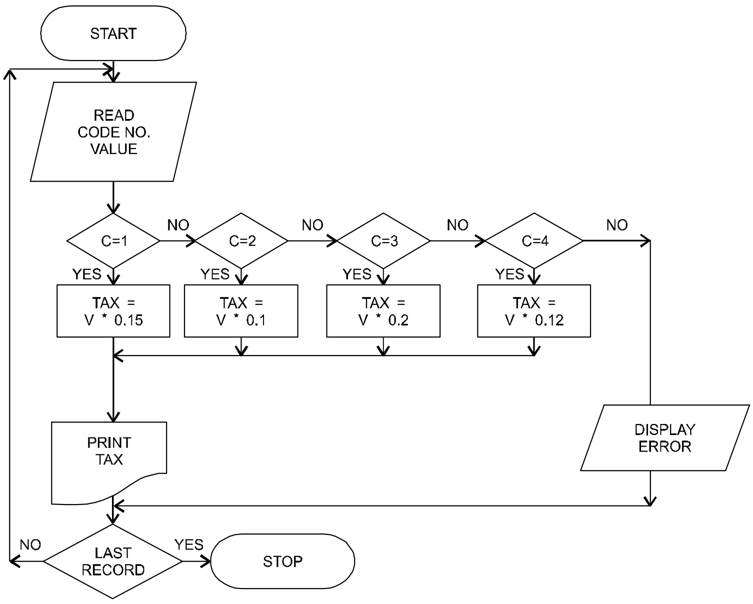


Fig. 5.5.35.1

Example 5.5.36: Draw a flow chart to illustrate the following situation. Vishnu Limited calculates discounts allowed to customers on the following basis :

Order Quantity	*Normal Discount*
1-99	5%
100-199	7%
200-499	9%
500 and above	10%

These discounts apply only if the customer's account balance is below Rs. 500 and does not include any item older than three months. If the account is outside both these limits, the above discounts are reduced by 2%. If only one condition is violated, the discounts are reduced by 1%. If a customer has been trading with Vishnu Limited for over 5 years and conforms to both of the above credit checks, then he is allowed an additional 1% discount.

Solution : The required flowchart is drawn in fig 5.5.36.1.

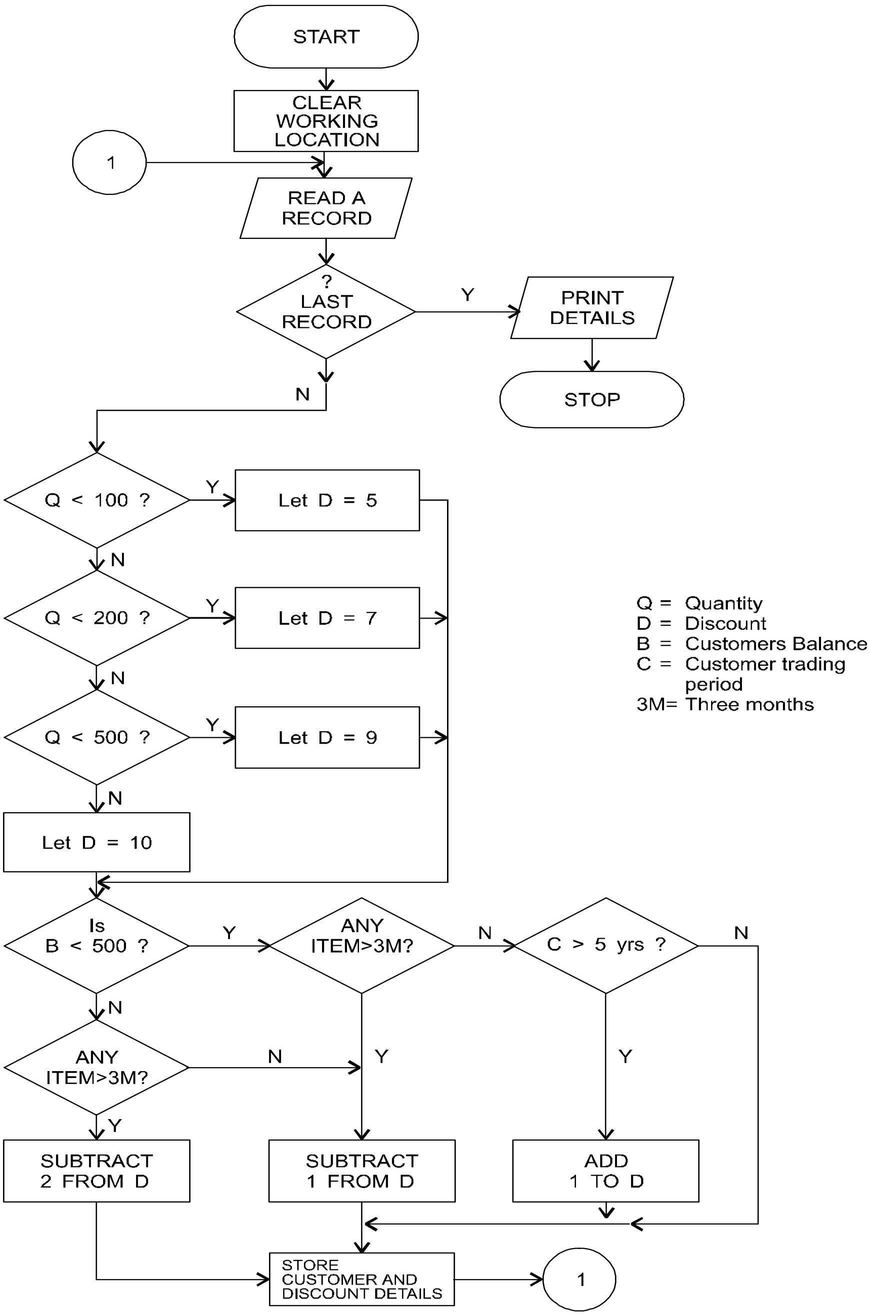

START
CLEAR WORKING LOCATION
1
READ A RECORD
? LAST RECORD
Y
PRINT DETAILS
STOP
N
Q < 100 ?
Y
Let D = 5
N
Q < 200 ?
Y
Let D = 7
N
Q < 500 ?
Y
Let D = 9
N
Let D = 10
Q = Quantity
D = Discount
B = Customers Balance
C = Customer trading period
3M= Three months
Is B < 500 ?
Y
ANY ITEM>3M?
N
C > 5 yrs ?
N
N
ANY ITEM>3M?
N
Y
Y
Y
SUBTRACT 2 FROM D
SUBTRACT 1 FROM D
ADD 1 TO D
STORE CUSTOMER AND DISCOUNT DETAILS
1

Fig. 5.5.36.1

Example 5.5.37: Draw a flow chart to compute and print for 50 transactions (assuming all are correct).

The Gross Sales (GS)

Discount Allowed (DA), and

Net Sales (NS).

The input document shall provide the Quantity Sold (QS) and the Unit Price (UP). The discount is allowed as under :

No. of units sold	Discount admissible
Less than 100	Nil
100-200	2%
201-500	5%
501-1000	10%
More than 1000	20%

It should also be noted that 25 transactions must be printed on one page. Suitable column headings such as Gross Sales, Discount allowed and Net Sales must be printed on every page.

Solution : The required flowchart is drawn in fig 5.5.37.1**.**

Example 5.5.38 : Salaries of 100 persons are designated by J(S), S = 1, 2, 3...100. Draw flowchart for finding % age of the following salary range.

< Rs. 1500 (per month)

1500 to 3000

> 3000

Solution : The flowchart is drawn in fig 5.5.38.1

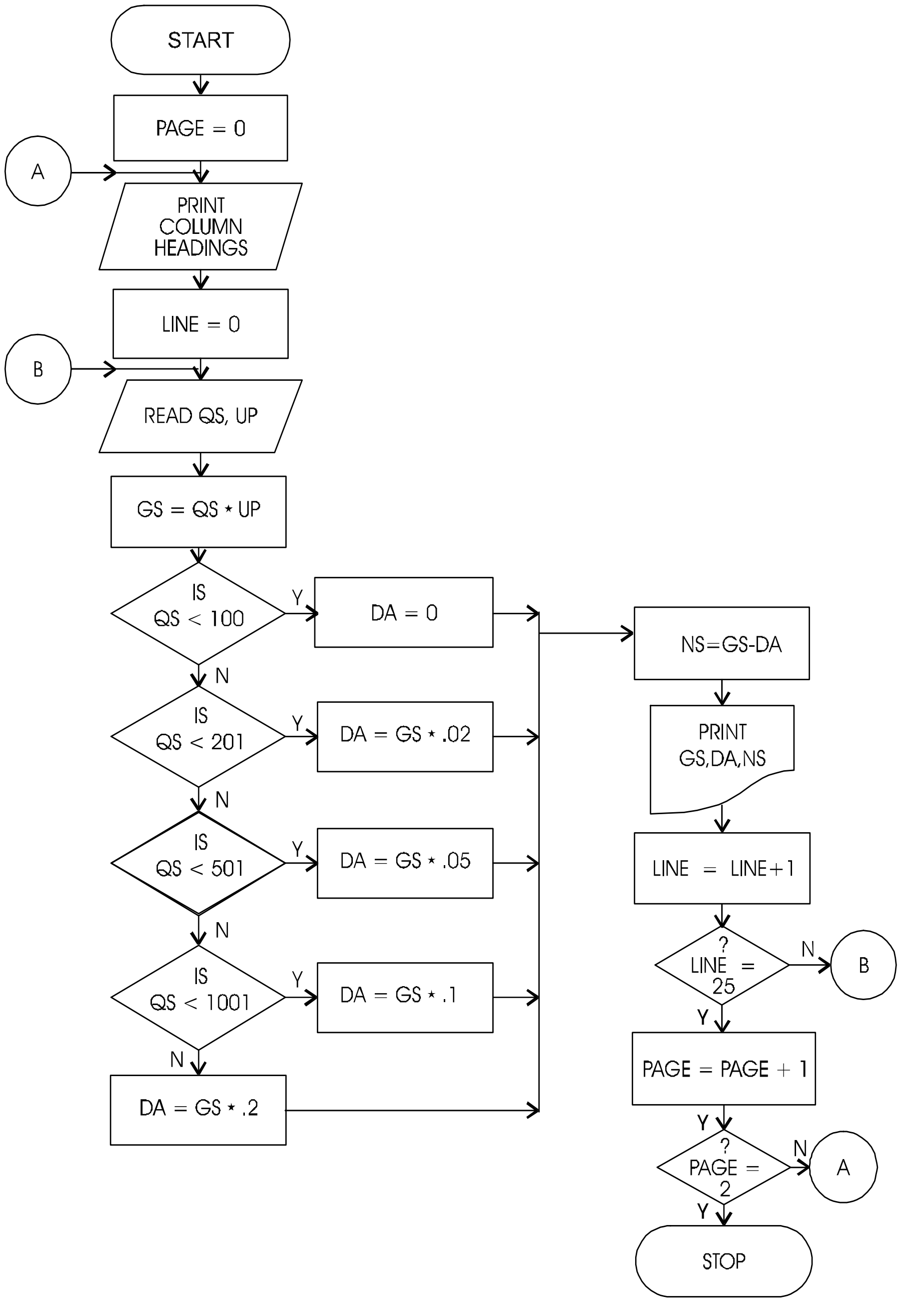

START
PAGE = 0
A
PRINT COLUMN HEADINGS
LINE = 0
B
READ QS, UP
GS = QS * UP
IS QS < 100
Y
DA = 0
N
IS QS < 201
Y
DA = GS * .02
N
IS QS < 501
Y
DA = GS * .05
N
IS QS < 1001
Y
DA = GS * .1
N
DA = GS * .2
NS=GS-DA
PRINT GS,DA,NS
LINE = LINE+1
? LINE = 25
N
B
Y
PAGE = PAGE + 1
Y
? PAGE = 2
N
A
Y
STOP

Fig. 5.5.37.1

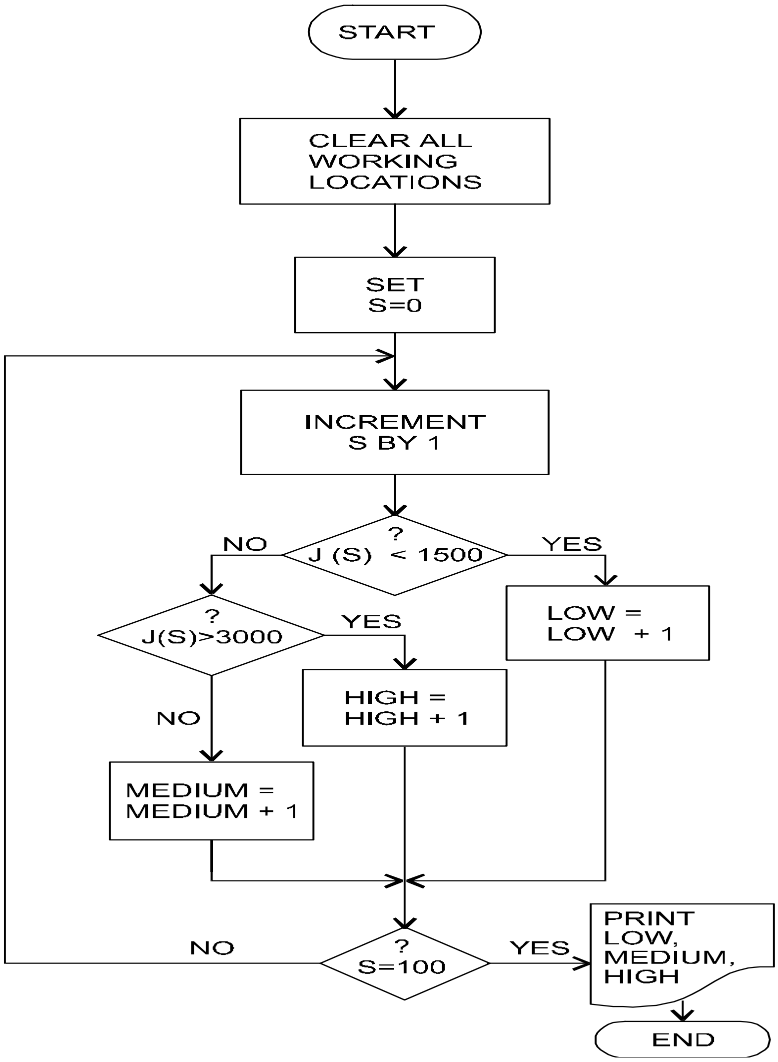


Fig. 5.5.38.1

Example 5.5.39 : Draw a program flowchart to compute and print the sum of squares of the following ten numbers:

3, 5, 10, 17, 26, 37, 50, 65, 82, 101

Solution : The required flowchart is drawn in fig.5.5.39.1

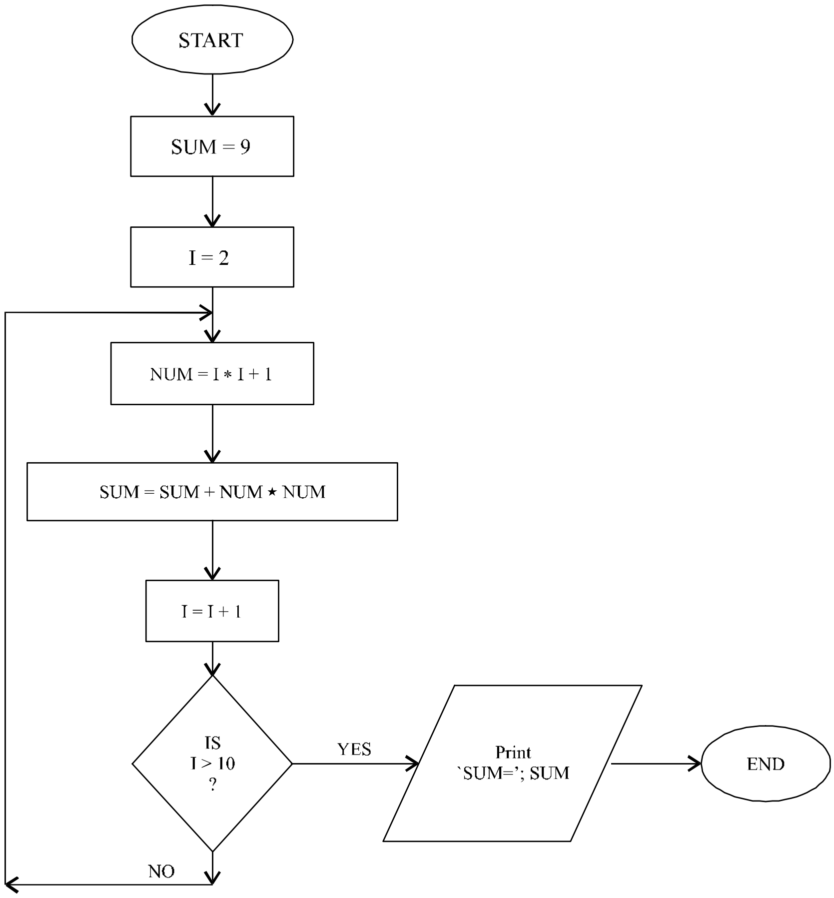


Fig. 5.5.39.1

Example 5.5.40: A Nationalized Bank has the following policy to its depositors :

On deposits of Rs. 5,000 or above and for three years or above, the interest payable is 10%, on deposits for the same amount and for less than three years, the interest is 8% and on deposits below Rs. 5,000, the interest rate is 7% irrespective of the period.

Draw a flow chart to compute the interest for the above given information and print the same.

Solution : The flowchart is given in fig.5.5.40.1.

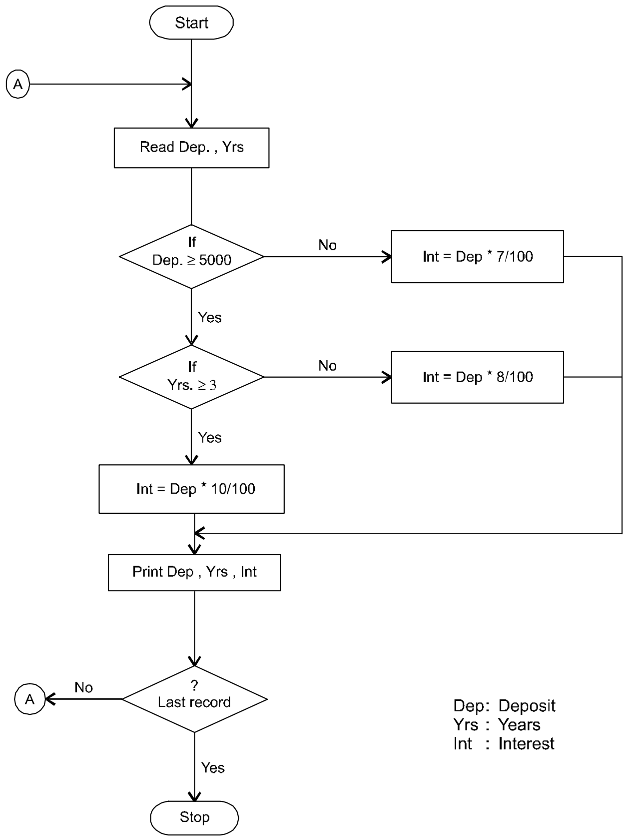


Fig. 5.5.40.1

Example 5.5.41: Draw a flow chart to compute and print income-tax and surcharge on the income of a person, where income is to be read from terminal and tax is to be calculated as per the following rates :

Upto Rs. 40,000	No tax
Upto Rs. 60,000	@ 10% of amount above Rs. 40,000
Upto Rs. 1,50,000	Rs. 2,000 + 20% of amount above Rs. 60,000
Above Rs. 1,50,000	Rs. 20,000 + 30% of amount above Rs. 1,50,000

Charge surcharge @ 2% on the amount of total tax, if the income of a person exceeds Rs. 2,00,000.

Solution : The required flow chart is given in fig.5.5.41.1:

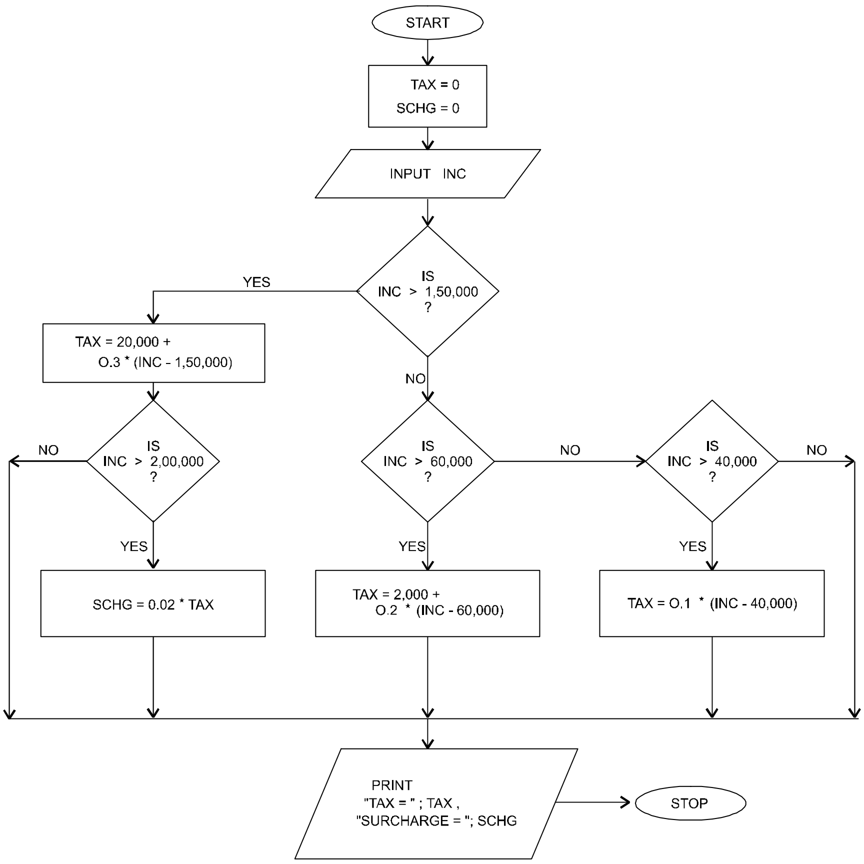


Fig. 5.5.41.1

Example 5.5.42 : Acme India is engaged in selling of electrical appliances to different categories of customers. In order to promote its sales, various types of discounts are offered to various customers. The present policy is as follows :

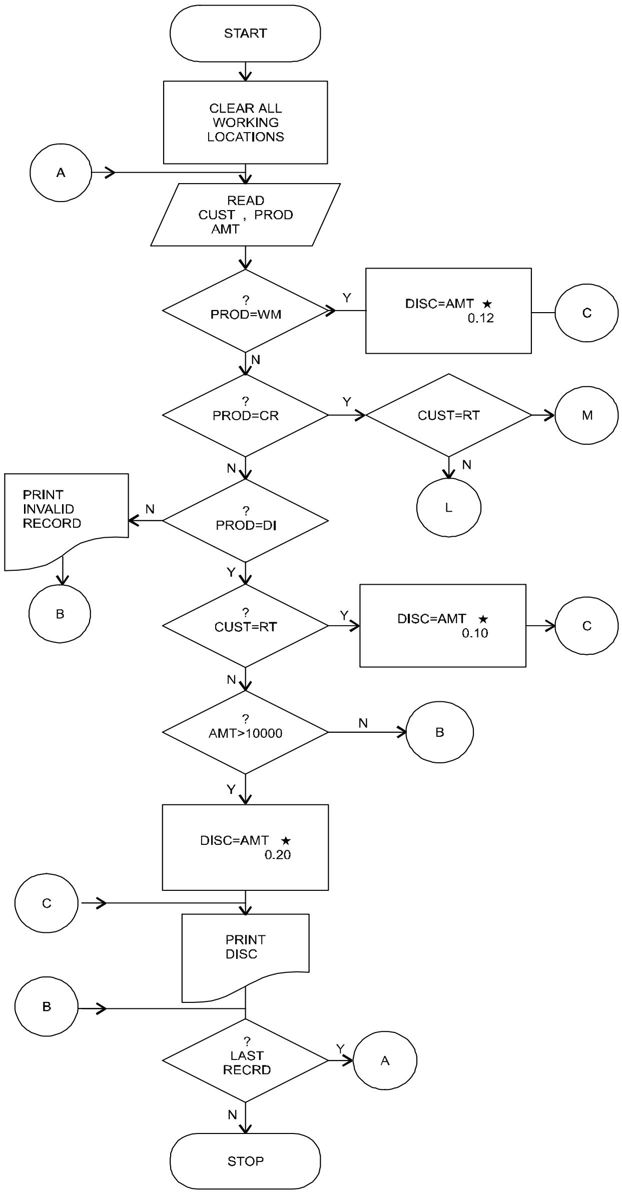
(*i*) On cooking range, a discount of 10% is allowed to wholesaler and 7% to retailers if the value of the order exceeds Rs. 5000. The discount rates are 12% and 9½%, if the value of the order is Rs. 10,000 and above.

(*ii*) A discount of 12% is allowed on washing machine irrespective of the class of customer and value of the order.

(*iii*) On decorative items, wholesalers are allowed a discount of 20% provided the value of the order is Rs. 10,000 and above. Retailers are allowed a discount of 10% irrespective of the value of the order.

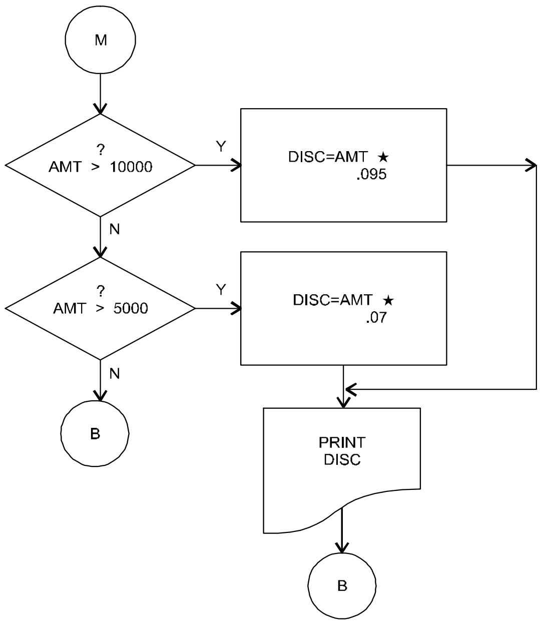
Draw a program flowchart for the above procedure.

Solution : *See* Fig 5.5.42.1(A) & 5.5.42.1(B)



START
CLEAR ALL WORKING LOCATIONS
A
READ CUST , PROD AMT
? PROD=WM
Y
DISC=AMT ★ 0.12
C
N
? PROD=CR
Y
CUST=RT
M
N
L
N
PRINT INVALID RECORD
N
? PROD=DI
B
Y
? CUST=RT
Y
DISC=AMT ★ 0.10
C
N
? AMT>10000
N
B
Y
DISC=AMT ★ 0.20
C
PRINT DISC
B
? LAST RECRD
Y
A
N
STOP

Fig. 5.5.42.1(A)


M
?
AMT > 10000
Y
DISC=AMT ★
.095
N
?
AMT > 5000
Y
DISC=AMT ★
.07
N
B
PRINT
DISC
B

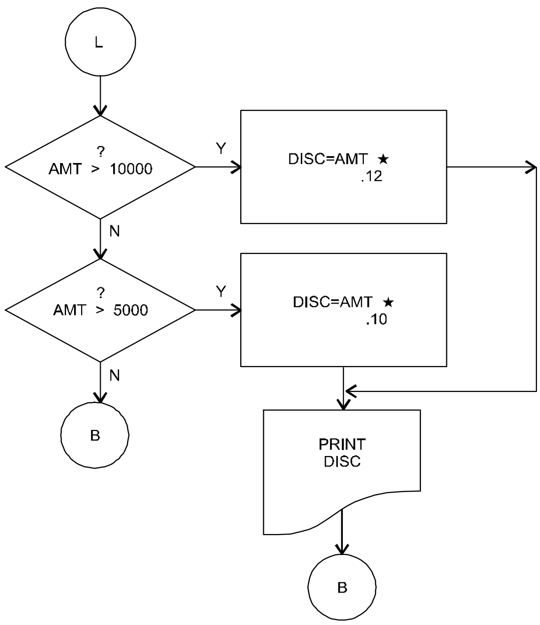

L
?
AMT > 10000
Y
DISC=AMT ★
.12
N
?
AMT > 5000
Y
DISC=AMT ★
.10
N
B
PRINT
DISC
B

Fig. 5.5.42.1(B)

5.6 DRY RUN AND DEBUGGING THE PROGRAM

In Chapter 6, we stated that any program of some scope even written with great care is likely to contain some mistakes known as bugs in the technical jargon. There, therefore, is a need to remove these mistakes or to debug the program. Debugging should start with the review of the flowchart through review of the Program code and finally testing the program with fictitious data in one or more computer set-ups.

Review of the flowchart is also carried out by means of fictitious data and as such is known as the dry run since no computer setup is involved. We shall take up the flowchart of example 5 to elucidate the means to carry out the dry run. This flowchart is concerned with picking up the highest and the lowest of three quantities: Q1, Q2, and Q3 putting them in locations designated by H and L respectively.

The flowchart of Fig 5.5.5.1 is reproduced below in Fig. 5.6.1 except for the deliberate mistakes indicated by the crooked arrows in this Fig (5.6.1). “Yes” and “No” have been interchanged, *i.e.,* bugs have been deliberately introduced. Now let us see how these bugs are detected by means of the dry run.

We shall try three sets of values for Q1, Q2 and Q3 as below :

	Q1	Q2	Q3	
Set 1	6	2	14	Q3 > Q1 > Q2
Set 2	3	7	15	Q3 > Q2 > Q1
Set 3	2	4	3	Q2 > Q3 > Q1

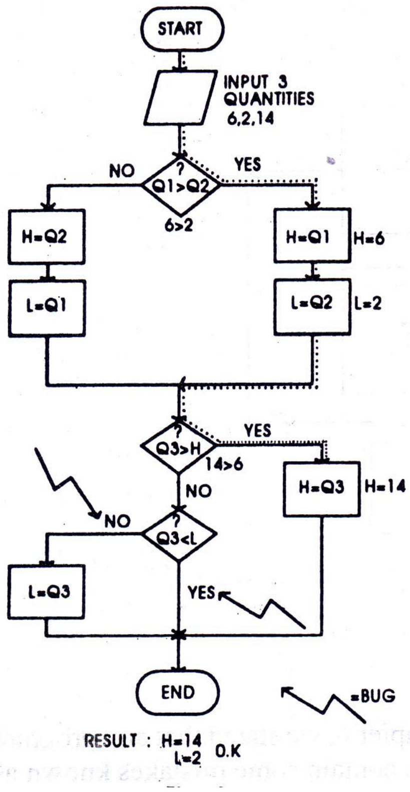


Fig. 5.6.1

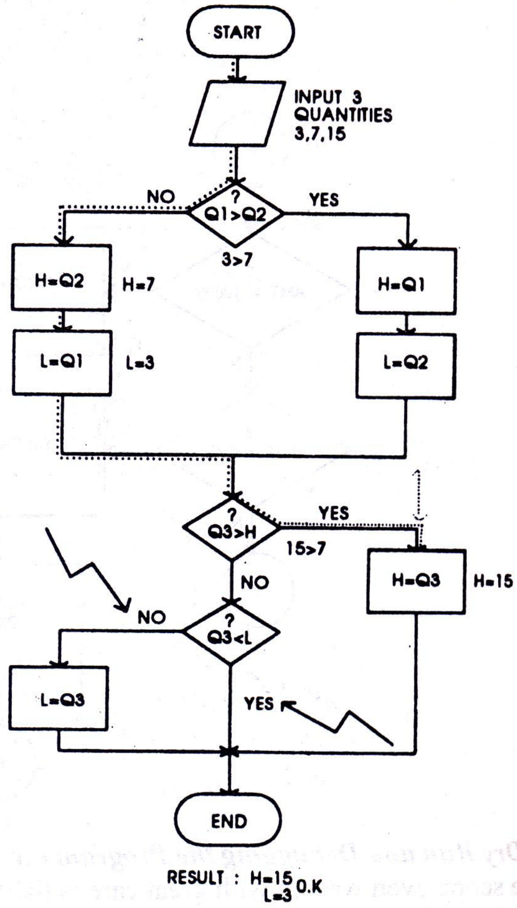


Fig. 5.6.2

In Fig. 5.6.1, the data of the 1st set have been ‘flown’ in the flowchart and it flows across the dotted lines in the flowchart. Ultimately, we end up with 14 in H and 2 in L. This is correct since we can see for ourselves that in the first set 14 is the highest and 2 is the lowest.

In Fig. 5.6.2, the data of the 2nd set is flown and it flows across the dotted lines in this flowchart. Again, we end up with the correct result, 15 as the highest and 3 as the lowest in H and L respectively.

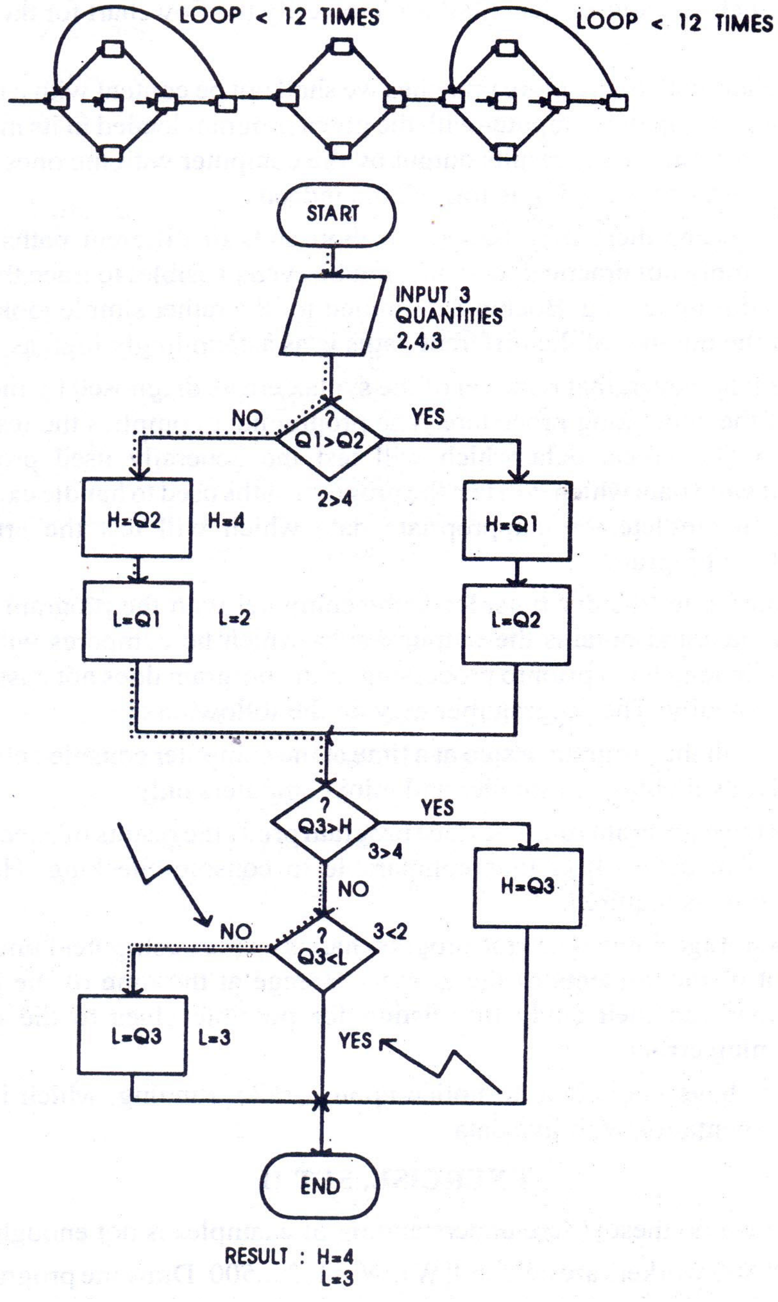

LOOP < 12 TIMES
LOOP < 12 TIMES
START
INPUT 3
QUANTITIES
2,4,3
?
Q1>Q2
NO
YES
2>4
H=Q2
H=4
H=Q1
L=Q1
L=2
L=Q2
?
Q3>H
YES
3>4
H=Q3
NO
?
Q3<L
NO
3<2
L=Q3
L=3
YES
END
RESULT : H=4
L=3

Fig. 5.6.3

In Fig. 5.6.3 the data of the 3rd set is flown. Here we end up with 4 in H and 3 in L which is wrong since we can see that 2 is the lowest in the 3rd set where as we are getting 3 as the lowest. This arouses our suspicion and we would carefully scrutinize the lower portion of the flowchart until we detect the bugs.

Following this up we shall rectify the flowchart and the program code.

[By means of such dry runs student may want to verify the flowchart for the exercises he draws].

In larger flowchart with many more branches we shall not be content with a mere dry run. We shall actually set up the computer with the given program loaded in its memory, input the test data, and compare the results output by the computer with the ones computed in longhand. The task of debugging is formidable indeed.

In complex programs there may be tens of thousands of different paths through the program. It is simply not practical (and may not be even possible) to trace through all the different paths during testing. Boehm determined for the rather simple looking program flowchart that the number of the different paths is as astoundingly high as 10^{20}.

It is to be noted; however, that removal of the syntax errors diagnosed by the compiler is not the part of the debugging procedure. The programmer complies the test data which should contain (1) typical data which will test the generally used program paths; (2) unusual but valid data which will test the program paths used to handle exceptions; and (3) incorrect, incomplete, or inappropriate data which will test the error handling capabilities of the program.

The programmer, after the dry runs, loads the computer with the program to be tested, inputs the test data and obtains the output results which he compares with the results derived by him in long hand prior to processing. If the program does not pass the test, *i.e.,* the results do not tally, The programmer may do the following :

1. Trace through the program, a step at a time at the computer console : but this facility is, usually, available with smaller and mini computers only.
2. Call for a trace program run. The trace program prints the results of execution of each instruction in detail. It is thus comparable to console checking. However, less machine time is required.
3. Call for a storage dump when the program hangs up (*i.e.,* computer hums) *i.e.,* obtain a printout of the contents of the primary storage at the time of the hangup. The programmer can then study this listing for possible clues to the cause of the programming errors.

However, more bugs may come to notice upon parallel running, which is done upon program implementation with live data.

Self Examination Questions

Multiple Choice Questions

1. ______________the computer programming process by which the programmer devises a set of test data transactions to test the various branches in the program.

   (a) Program Analysis

   (b) Program Documentation

   (c) Program Coding

   (d) Program Debugging

2. Choose the correct order of the algorithm steps to generate Fibonacci numbers.

   S1. Replace N1 by N2

   S2. Set N1=0 and N2=1

   S3. Display N2

   S4. Set N3=N1+N2

   S5. Display N3

   S6. Replace N2 by N3

   S7. If N3 >100, then stop

   S8. Continue step S4.

   (a) S2,S3,S4,S7,S5,S1,S6,S8

   (b) S4,S2,S3,S5,S8,S7,S2,S1

   (c) S2,S4,S5,S6,S7,S8,S1,S3

   (d) S4,S5,S8,S4,S2,S1,S3,S6

3. ___________the flowchart that presents the data flow through all parts of a data processing system.

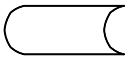
   (a) System outline flowchart

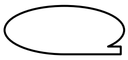
   (b) Run flowchart

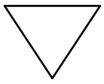
   (c) Program flowchart

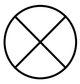
   (d) System flowchart

4. The computer flowchart symbol to represent on-line storage.

   (a) 

   (b) 

   (c) 

   (d) 

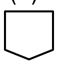
5. ________the flowchart prepared from a system flowchart and represents each compute box in detail.

   (a) Program flowchart

   (b) System flowchart

   (c) Run flowchart

   (d) Outline flowchart

6.  symbol used in a flowchart to represent:-

   (a) Start connector

   (b) Stop terminator

   (c) Off-page connector

   (d) On-page connector

7. A program flowchart is generally read in a ……………..

   (a) Linear approach

   (b) Top to bottom approach

   (c) Bottom to top approach

   (d) Horizontal parsing approach

8. Flowcharting symbols are connected together by means of ……………..

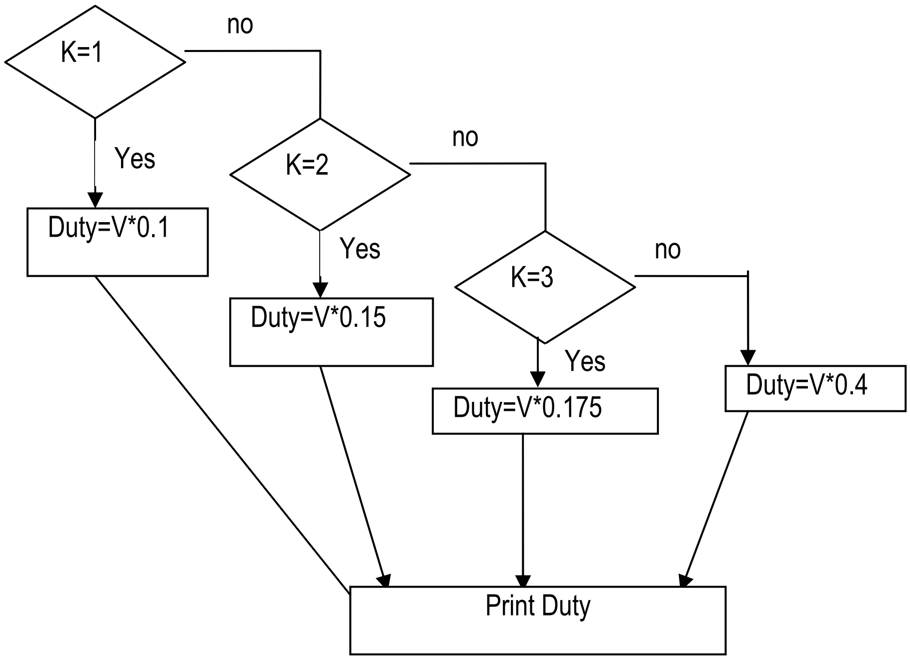
   (a) arrows lines

   (b) data lines

   (c) flow lines

   (d) thread lines

9. Answer the question 9A – 9C based on the below flowchart.



9A. The output duty when k=2 and V =10.5

(a) 10.5

(b) 1.58

(c) 2.56

(d) 0.58

9B. The duty calculated when k= 0.5

(a) Duty=V*0.1

(b) Duty=V*0.4

(c) Duty=0

(d) Duty=1

9C. The duty displayed when k=4 and V=0.5

(a) 2.0

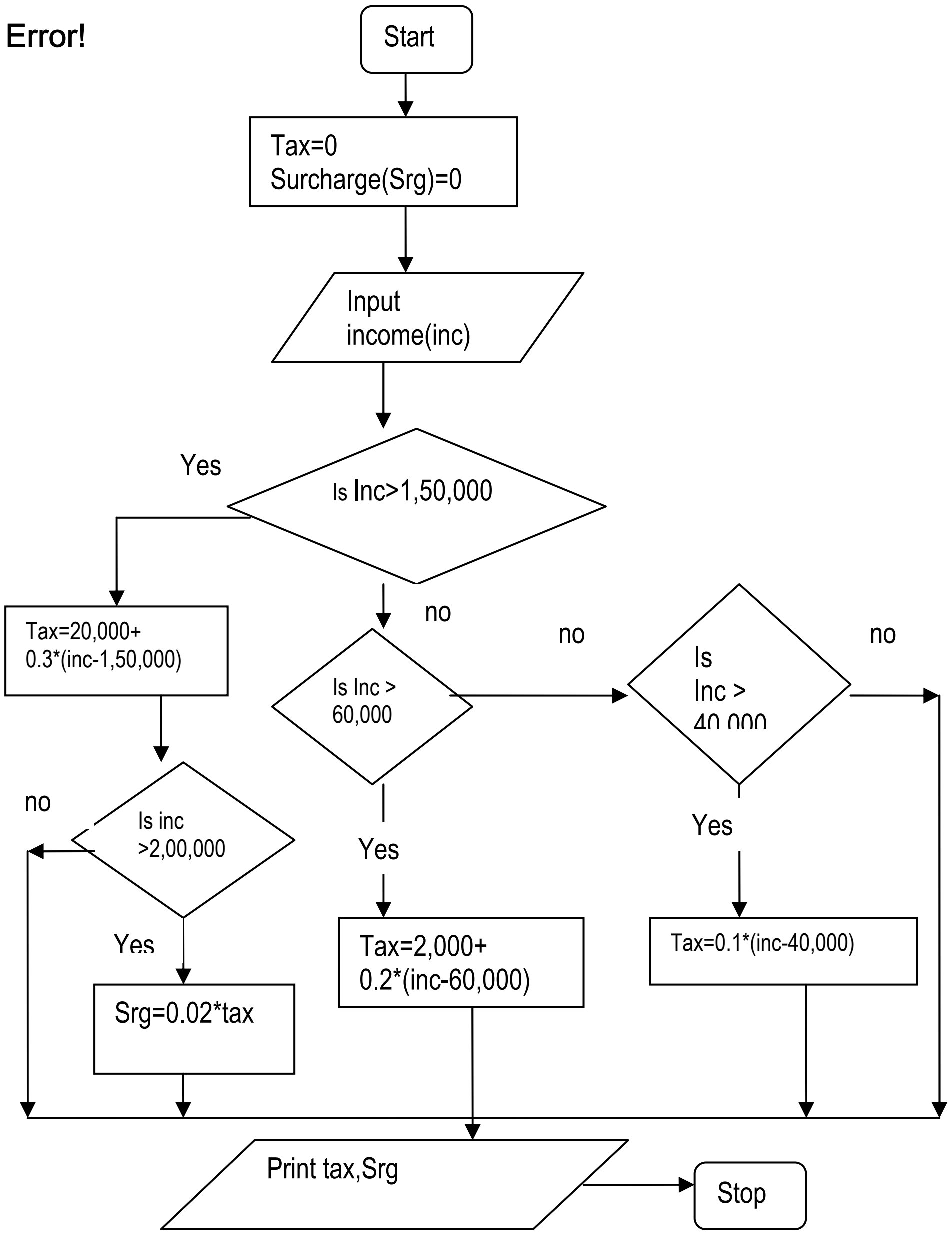
(b) 10

(c) 0.2

(d) 1.5

10. Answer the questions 10A to 10C based on the flowchart given below:-

Error!



10A. The tax and surcharge output if income is 1,50,000 :-

(a) Tax= 20,000 surcharge= 0

(b) Tax= 20,000 surcharge=2000

(c) Tax= 200 surcharge=0

(d) Tax=2000 surcharge=0

10B. The tax and surcharge output if income is 60,000

(a) Tax= 0 surcharge=0

(b) Tax=2000 surcharge=2000

(c) Tax= 0 surcharge=2000

(d) Tax= 2000 surcharge=0

10C. The tax and surcharge output if income is 40,000

(a) Tax=0 surcharge=4000

(b) Tax= 400 surcharge=400

(c) Tax=0 surcharge=0

(d) Tax=0 surcharge=2000

Answers

1	d	**2**	a	**3**	d	**4**	a	**5**	c	**6**	c	**7**	b	**8**	c	**9A**	b
9B	b	**9C**	c	**10A**	a	**10B**	d	**10C**	d								

Short Term Questions

1. Write a program flowchart to compute the mean and S.D. of Numbers denoted by J(X), X = 1, 2...N.

2. Draw the program flowchart for summing up 1, 11, 111, 1111,...(10 terms)

3. Names of eleven cricket players are held in J(X), X = 1, 3, 5.... 21 and their respective batting average in J(X), X = 2,4...22. You are to arrange the eleven players in the descending order of their batting averages.

Long Term Questions

1. Out of an array of number J(N), N = 1, 2...100, 5 numbers are known to be zeros. You have to draw the program flowchart for squeezing the zeros out *i.e.*, rearrange the 95 non-zeros number in location J(N), N = 1, 2...95.

   Also, extend the flowchart for printing these 95 numbers in a 19 × 5 matrix: assume that a number is at most of six digits.

2. J(E), E = 1, 2..,.42 contains 42 quantities of 7 × 6 matrix. Draw the program flowchart for printing its transpose; assume that a number is at most of 5 digits.

3. A + ve integer is called “perfect” if it equals the sum of its proper divisors. For example, the numbers 6 and 28 are perfect because,

   $$6 = 1 + 2 + 3$$

   $$28 = 1 + 2 + 4 + 7 + 14$$

   Write a flowchart to decide whether a given + ve integer is perfect.

4. Draw a flowchart for finding the 16th root of a number.

5. Draw a flowchart for computing and printing the simple interest for 10, 11, 12, 13, and 14 years at the rate of 3% per annum on an investment of Rs. 10,000.

CHAPTER 6

DECISION TABLE

Learning Objectives

This Chapter enables the student to obtain knowledge about :

- The concept of Decision Tables.
- Various types of decision tables.
- Many practical problems and their corresponding decision tables..

INTRODUCTION

A decision table is a table which may accompany a flowchart, defining the possible contingencies that may be considered within the program and the appropriate course of action for each contingency.

Decision tables are necessitated by the fact that branches of the flowchart multiply at each diamond (comparison symbol) and may easily run into scores and even hundreds. If, therefore, the programmer attempts to draw a flowchart directly, he is liable to miss some of the branches.

A decision table is divided into four parts :

(1) ***Condition Stub*** **-** (which comprehensively lists the comparisons or conditions);

(2) ***Action Stub-*** which comprehensively lists the actions to be taken along the various program branches;

(3) ***Condition entries*** **-** which list in its various columns the possible permutations of answer to the questions in the conditions stub); and

(4) **Action entries - (**which lists, in its columns corresponding to the condition entries the actions contingent upon the set of answers to questions of that column)

A decision table is given below as an example :—

		Granting Credit Facility	R1	R2	R3	
Part 1	C1	Credit limit Okay	Y	N	N	Part 3
	C2	Pay experience Favourable	-	Y	N	
Part 2	A1	Allow Credit Facility	X	X		
	A2	Reject Order			X	Part 4

There are two conditions: C_1 and C_2 in this table and two actions: A_1 and A_2. According to R_1 (a set of rules), if there is a "Yes" to C_1 and C_2 is to be bypassed, action A_1 will be taken, that is, "Allow credit facility". Under R3, Nos to both C_1 and C_2 requires action A_2 to be taken. With this example, we give below the components of the decision table in more detail.

(*a*) ***Condition Statement*** - Statement which introduce one or more conditions (*i.e.,* factors to consider in making a decision)

(*b*) ***Condition Entries*** **-** Entries that complete condition statements.

(*c*) ***Action Statements*** - Statements which introduce one or more actions (*i.e.,* steps to be taken when a certain combination of conditions exist)

(d) **Action Entries** - Entries that complete the action statements.

(*e*) ***Rules*** - Unique combinations of conditions and actions to be taken under those conditions.

(f) **Header -** Title identifying the table.

(g) **Rule Identifiers** - Code (R1, R2, R3,) uniquely identifying each rule within a table.

(h) **Condition Identifiers** - Codes (C1, C2, C3,...) uniquely identifying each condition statements/entry.

(*i*) ***Action Identifiers*** - Codes (A1, A2, & A3...) uniquely identifying each action statement/entry

These items are contained within the body of the table which is divided into four major sections by double or heavy vertical and horizontal lines as in the table above.

6.1 TYPES OF DECISION TABLE

Limited Entry Tables - In a limited entry table the condition and action statements are complete. The condition and action entries merely define whether or not a condition exists or an action should be taken. The symbols used in the condition entries are :

Y: Yes, the condition exists

N: No, the condition does not exist.

— : Irrelevant, the condition does not apply, or it (or blank) makes no difference whether the condition exists or not.

The symbols used in the action entries are:

X : Execute the action specified by the (or blank) action statement.

— : Do not execute the action specified by the (or blank) action statement.

Extended Entry Table : The condition and action statements in an extended entry table are not complete, but are completed by the condition and action entries.

Example :

	Granting Credit Facility	**R1**	**R2**	**R3**
C1	Credit Limit	OK	Not OK	Not OK
C2	Pay Experience	-	Favourable	Unfavourable
A1	Credit Facility	Allow	Allow	-
A2	Credit Action	-	-	Reject Order

Mixed Entry Table : The third type of decision table is the mixed entry form which combines both the limited and extended entry forms. While the limited and extended entry forms can be mixed within a table, only one form may be used within a condition statement/entry or an action statement/entry.

Example :

	Granting Credit Facility	**R1**	**R2**	**R3**
C1	Credit Limit Okay	Y	N	N
C2	Pay Experience	-	Favourable	Unfavourable
A1	Credit	Allow	Allow	-
A2	Reject Order			X

A systematic approach to the development of a limited entry decision table is presented below

6.2 STEPS IN PREPARING A LIMITED ENTRY DECISION TABLE

1. List conditions and actions.
2. Combine conditions which describe the only two possibilities of a single condition. In other words, delete conditions which can be derived from the responses of the other conditions.
3. Make yes or no (Y or N) responses and mark actions to be taken for each rule with X.
4. Combine redundant rules to simplify table.
5. Check for completeness.

An example will be used to explain and illustrate the procedure.

6.2.1 Solved Examples

Example 1 : A shop owner allows credit facility to his customers if they satisfy any one of the following conditions :

1. Holding the present job for more than 3 years and residing in the same place for more than 5 years.
2. Monthly Salary exceeds Rs. 1500 and holding the present job for more than 3 years.
3. Residing in the same place for more than 5 years and monthly salary exceeds Rs. 1500.

The facility is rejected for all other customers.

Solution : *Step 1 is to write down all of the conditions and actions :*

Conditions involved in the problems are :

1. Holding the present job for more than 3 years.
2. Holding the present job for 3 years or less than 3 years.
3. Monthly salary exceeds Rs. 1500.
4. Monthly salary equals Rs. 1500 or less than Rs. 1500.
5. Residing in the same place for more than 5 years.
6. Residing in the same place for 5 years or less than 5 years.

Actions involved in the problem are :

1. Allow credit facility.
2. Reject credit facility.

Step 2 is to combine conditions which only describe the two possibilities of a single condition :

"Holding the present job for more than 3 years" and "Holding the present job for 3 years or less than 3 years" can be combined. A single condition "holding the present job for more than 3 years" can represent both because a "No" answer means holding the present job for more than 3 years or less than 3 years. The same reasoning allows the combination of 3 & 4 and also 5 & 6.

There are thus only three conditions :

1. Holding the present job for more than 3 years.
2. Monthly salary exceeds Rs. 1500.
3. residing in the same place for more than 5 years.

Step 3 is to prepare the Yes and No responses using Y and N for all possible combinations of conditions and for each set of conditions, mark the actions to be taken with an X.

No. of rules = $2^{\text{no of conditions}}$

In the example, there are three conditions, so there will be 2^3 or 8 rules. The Y's and N's can be inserted in any order, but a systematic method will reduce the effort of filling in the table and reduce the chance of error. Start with the bottom row of the condition entries and fill in the row starting with Y and then alternating between N and Y. The row above this is filled in by writing two Y's, two N's, two Y's etc. The third row from the bottom uses sets of four Y's and four N's. This doubling of the sets of Y's and N's continues until the table is complete. Then analyse each rule and fill in the action entries. The Figure below shows the completed table at this stage.

	Allowing Credit Facility	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**
C1	Holding the present job for more than 3 years	Y	Y	Y	Y	N	N	N	N
C2	Monthly salary exceeds Rs. 1500	Y	Y	N	N	Y	Y	N	N
C3	Residing in the same place for more than 5 years	Y	N	Y	N	Y	N	Y	N
A1	Allow credit facility	X	X	X		X			
A2	Reject credit facility				X		X	X	X

Step 4 is to combine rules where there are redundancies :

Two rules can be combined into a singie rule if :

(*i*) all of the conditions except one have the same Y or N (or—) condition entries and

(*ii*) the actions are the same for both.

Rule with impossible combination of condition entries can be combined with any other rule if

(*iii*) all of the conditions except one have the same Y or N (or—) condition entries. (see Example 2)

Combine the two rules into one and replace the condition entry of Y and N with a dash (–), which means the condition does not affect the action to be taken. Using this procedure, rule R1 and R2 can be combined. In other words, if holding the present job for more than 3 years and monthly salary exceeds Rs. 1,500, then the credit facility is allowed without regard to the third condition *viz.* residing in the same place for more than 5 years. Rules R7 & R8 (or R4 & R8) can be combined. The resulting table, after redundancies removed, is shown below :

	Allowing Credit Facility	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**
C1	Holding the present job for more than 3 years	Y	Y	Y	N	N	N
C2	Monthly salary exceeds Rs. 1500	Y	N	N	Y	Y	N
C3	Residing in the same place for more than 5 year	—	Y	N	Y	N	—
A1	Allow credit facility	X	X		X		
A2	Reject credit facility			X		X	X

Step 5 is to check for completeness of the rules :

(1) Count number of dashes in the condition entries for each rule. The number of rules "represented" by each rule are 2^m where m is the number of dashes. Where there are no dashes, the number represented is 2^0 or 1. A single dash means 2 rules have been combined etc.

(2) Sum the number of rules represented by the different rules as computed above.

(3) Compare the number of rules represented by the reduced table with the number to be accounted for, which is 2^n (n no of conditions) If they are equal (and all other features are correct), the table is complete.

In the example, rules R1 & R6 have one dash and rules R2, R3, R4 and R5 have no dashes. The sum of the rules represented by the rules in the reduced table is 2+1+1+1+1+2 which is equal to 2^3 or 8.

Therefore, the reduced table is complete.

Example 2 : Select the largest of three distinct numbers A,B,C

Solution : *Step 1* - Conditions involved in the problem are :

1. A > B
2. A > C
3. B > A
4. B > C
5. C > A
6. C > B

Actions involved in the problem are :

1. A is largest
2. B is largest
3. C is largest

Step 2 - Conditions 1 & 3 can be combined

Conditions 2 & 5 can be combined

Conditions 4 & 6 can be combined

Therefore, there are only three conditions :

1. A > B
2. A > C
3. B > C

Step 3 - No. of rules = 2^{nd} conditions

$= 2^3 = 8$

	Select Largest	R1	R2	R3	R4	R5	R6	R7	R8
C1	A > B	Y	Y	Y	Y	N	N	N	N
C2	A > C	Y	Y	N	N	Y	Y	N	N
C3	B > C	Y	N	Y	N	Y	N	Y	N
A1	A is largest	X	X						
A2	B is largest					X		X	
A3	C is largest				X				X

*R3 & R6 contain impossible combination of condition entries.

Step 4 - R1 & R2 can be combined

R3 & R4 can be combined

R5 & R7 can be combined

R6 & R8 can be combined

	Select largest	R1	R2	R3	R4
C1	A > B	Y	Y	N	N
C2	A > C	Y	N	—	—
C3	B > C	—	—	Y	N
A1	A is largest	X			
A2	B is largest			X	
A3	C is largest		X		X

Step 5 - All the rules in the reduced table have one dash. Therefore, the sum of the rules represented by rules in the reduced table is $2^1 + 2^1 + 2^1 + 2^1$ which is equal to 2^3 or 8. No. of conditions is 3 and hence the No. of rules to be accounted for is 2^3 or, 8. Therefore the reduced table is complete.

If problem has many conditions, the decision table may become quite large and difficult to follow. Since the objective of the table is to show the logic of the procedure as clearly and as simply as possible, a large, complex table should be avoided. In most cases, a large problem with many conditions can be subdivided into two or more tables. One or more of the actions of the first table will specify that the user should proceed to another table to complete the logic. An example is given to illustrate this use of more than one table.

Example 3 : A sales organization is seeking to hire some salesmen and sales-women having special characteristics. They need only unmarried personnel between the age of 18 and 30. If male, they want the salesman to be over 5½ ft in height but less than 75 Kg. in weight and not bald. If female, the saleswoman is to be less than 5½ ft. in height and less than 55 kg. in weight and is to have shoulder-length hair.

Solution : This problem has nine conditions, which would mean a table with 2^9 = 522 rules before reduction. But the problem fits logically into three parts : the overall criteria, male criteria, and female criteria. This suggests that three decision tables should be used-initial screening, male selection and female section. The result of this use of three tables is shown below. All tables have redundancies removed.

	Initial screening	**R1**	**R2**	**R3**	**R4**
C1	Unmarried	Y	Y	Y	N
C2	Age between 18 & 30	Y	Y	N	—
C3	Male	Y	N	—	—
A1	Go to male selection table	X			
A2	Go to female selection table		X		
A3	Reject			X	X
	Male selection	**R1**	**R2**	**R3**	**R4**
C1	Over 5½ ft. in height	Y	Y	Y	N
C2	Less than 75 Kg. in weight	Y	Y	N	—
C3	Not bald	Y	N	—	—
A1	Hire	X			
A2	Reject		X	X	X
	Female selection	**R1**	**R2**	**R3**	**R4**
C1	Under 5½ ft. in height	Y	Y	Y	N
C2	Less than 55 kg. in weight	Y	Y	N	—
C3	Shoulder-length hair	Y	N	—	—
A1	Hire	X			
A2	Reject		X	X	X

As a reader develops some skill, he may be able to arrive more directly at the final table. However, the beginner should proceed carefully.

6.2.2 Exercises

1. Analyse the completeness of the following decision table :

	Table X	**R1**	**R2**	**R3**	**R4**	**R5**
C1	Condition A	Y	N	N	N	N
C2	Condition B	Y	Y	N	N	N
C3	Condition C	—	N	—	Y	N
C4	Condition D	—	—	—	N	N

A1	Action 1	X		X	X	
A2	Action 2		X			X

3. Prepare decision table for each of the following.

A cheque is presented at a bank. The cashier has to decide what to do. The rules state that "on presentation of a cheque the cashier is required to ensure that there are sufficient funds in the account to meet the amount specified and to check that there exist no reasons why the cheque should not be honoured. Those cheques accepted and which are of outstation are charged a handling fee, otherwise a charge at standard rates will be made".

4. A University has the following criteria for deciding whether or not to admit a student for its graduate school :

2. Complete and simplify the following decision table.

Reservation procedure	**RULES**															
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**R15**	**R16**
C1 Request for I Class																
C2 Requested Space available																
C3 Alternate Class acceptable																
C4 Alternate Class available																
A1 Make I Class reservation																
A2 Make tourist reservation																
A3 Name on I Class wait list																
A4 Name on tourist wait list																

Admit a student who has undergraduate grades of B or better, has test scores of the admission tests of over 550 and has a grade average of B or better for the past two years. Also, admit if overall grade average is less than B but the last two years average is B or better and the test scores is over 550. Admit on probation if the over all and 2 years grade averages are B or better and test scores is 550 or less. Admit on probation if overall grades are B or better and test score is above 550 but last 2 years grade averages are below B. Also, admit on probation if overall grade average are less than B and test score is 550 or less, but grades for past two years are B or better. Refuse to admit all others.

Prepare a decision table for the above criteria.

6.3 FLOWCHART FOR A DECISION TABLE

Example : Below is given the decision table on the wage calculation in an organisation. Gross Pay (G.P.) is derived from the Guaranteed Minimum (G.M.) as follows:

G P	=	1.05 GM when quantity produced,	$Q \geq 100$
	=	1.15 GM when	$Q \geq 120$
	=	1.25 GM when	$Q \geq 130$

Also awarded is the quality bonus if a certain level of quality has been attained by the worker. However, in case $Q \geq 130$ and the worker also attains the aforesaid quality level, his gross pay GP = 1.25 GM + Quality bonus is subject to an overall maximum check which is performed by means of subroutine, SR 2 with the details of which we would not concern ourselves for the limited purpose ahead. In the programme also incorporated is SR 3 which validates the Wage No. in a transaction *i.e.,* it checks if the wage No. is correct. Here again we would not be concerned with the details of the subroutine which are beyond the scope of this discussion. The exist from the program is made to a subroutine, SR4, the details of which we ignore. The description has been captured in the first two parts of the decision table below :

Part I Contains all the possible questions, 5 in number.

Part II Lists all the possible actions.

Part III Lists the 9 feasible sets of answers. For example, the first set has 'Yes' to all the 5 questions and the last set has 'No' to the first question and it bypasses the other questions which is noted by dots in its column.

Part IV Indicates, by means of crosses (X) the actions to be taken for each set of condition entries. For example, under the set of answers, 1 (all yes) there are four actions to be taken as noted by 4 crosses in the action entry column below it.

The systems analysts/programmer will first compile this decision table and therefrom draw the flowchart because he can set out the table without any likelihood of ignoring an answer set. In this section, our endeavor is to explain how the flowchart is drawn from a given table. We shall take this table as an example.

N.B., Often the flowchart for a decision table (when it is small) can be drawn by common sense by comprehending its items.

Conditions		Rules									
		1	2	3	4	5	6	7	8	9	
	Valid wage No. ?	Y	Y	Y	Y	Y	Y	Y	Y	N	
Part I	Qty. produced^{3}100?	Y	Y	Y	Y	Y	N	N	N	-	
	Qty. produced^{3}120?	Y	Y	Y	Y	Y	N	-	-	-	Part III sets of Answer
	Qty. produced ^{3}130?	Y	Y	N	N	-	-	-	-	-	
	Quality bonus ?	Y	N	Y	N	Y	N	Y	N	-	

	Gross pay = GP	-	-	-	-	-	-	X	X	-	
	GP = 1.05 GM	-	-	-	-	X	X	-	-	-	
	GP = 1.15 GM	-	-	X	X	-	-	-	-	-	
Part II	GP = 1.25 GM	X	X	-	-	-	-	-	-	-	Part IV
	Add quality bonus	X	-	X	-	X	-	-	-	-	sets of
Actions	do max. check	X	-	-	-	-	-	X	-	-	Answer
	SR. 2										
	do invalid wage										
	No SR 3	-	-	-	-	-	-	-	-	X	
	go to this table	-	-	-	-	-	-	-	-	X	
	do deductions										
	calculations	X	X	X	X	X	X	X	X		

In Fig. 6.3.1, we draw the segment of the flowchart for answers and actions of column 1 in the table.

In Fig. 6.3.2, we endeavor to superimpose the segment of column 2 (shown in dotted line in Fig. 6.3.2) on Fig. 6.3.1. But we see for the question "quality bonus" ?, for both 'yes' and 'no' to it we find

GP = 1.25 G.M.

Obviously then we should first compute

GP = 1.25 G.M.

and then pose this question *i.e.* Fig.6.3.2 needs modification which has been done in Fig 6.3.3.

In Fig. 6.3.4, we have superimposed the segment for col. 3 (in crosses) onto that of fig. 6.3.3 and we notice that the question "quality bonus ?" has to be posed once again.

In this manner, we continue column-wise superimposition of segments until we end up with final flowchart as in Fig. 6.3.5 below,

This shows that the flowchart is drawn by trial and error from the given table and quite a few erasures and rework would be involved. Also, when the final flowchart has been drawn, it can be verified against the given decision table.

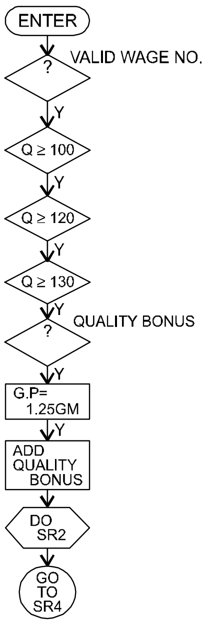


Fig.6.3.1

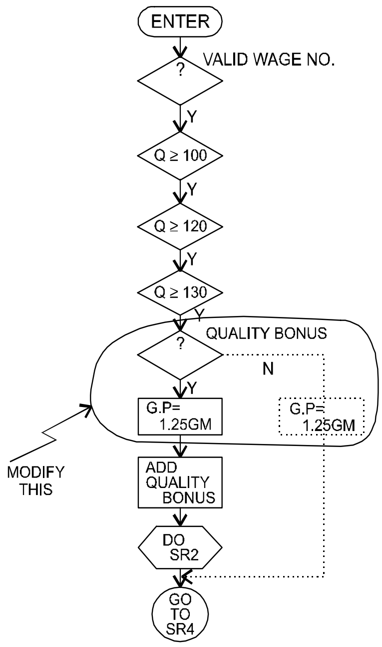


Fig.6.3.2

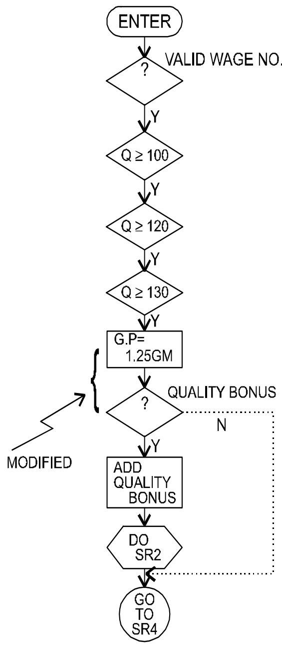


Fig.6.3.3

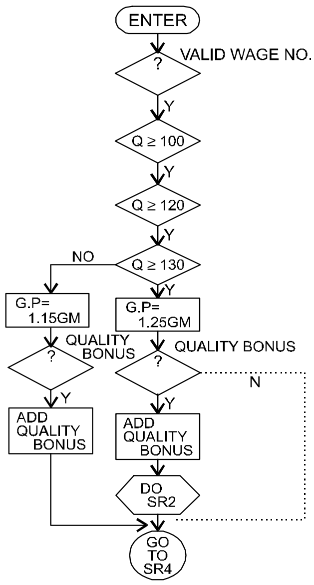


Fig. 6.3.4

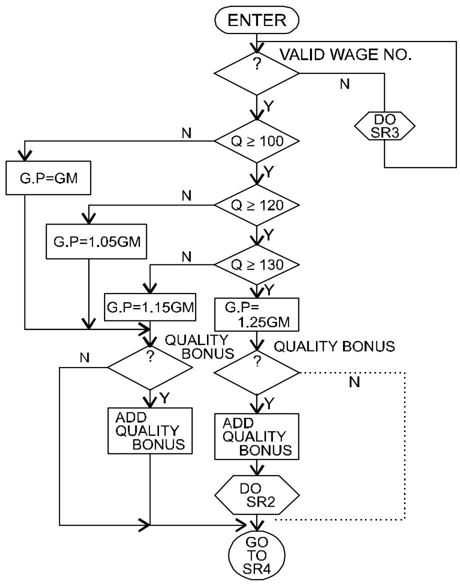


Fig. 6.3.5

6.4 ADVANTAGES AND DISADVANTAGES OF DECISION TABLES

A decision table has a number of ***advantages*** *which are stated below :*

(*i*) A decision table provides a framework for a complete and accurate statement of processing or decision logic. It forces a discipline on the programmer to think through all possible conditions.

(*ii*) A decision table may be easier to construct than a flow chart.

(*iii*) A decision table is compact and easily understood making it very effective for communication between analysts or programmers and non-technical users. Better documentation is provided by it.

(*iv*) Direct conversion of decision table into a computer program is possible. Software packages are available which take the statement specifying a decision table and compile it into a program.

(*v*) It is possible to check that all test combinations have been considered.

(*vi*) Alternatives are shown side by side to facilitate analysis of combinations.

(vii) The tables show cause and effect relationships.

(*viii*) They use standardised format.

(*ix*) Typists can copy tables with virtually no question or problems.

(*x*) Complex tables can easily be split into simpler tables.

(*xi*) Table users are not required to possess Computer knowledge.

Disadvantages of using decision tables are as follows :

(*i*) *Total sequence* - The total sequence is not clearly shown *i.e.,* no overall picture is given by decision tables as presented by flow charts.

(*ii*) *Logic* - Where the logic of a system is simple, flowcharts nearly always serve the purpose better than a decision table.

6.5 MISCELLANEOUS EXERCISES

Question 1

The details of procedure for dealing with delivery charges for goods bought from ABC Company is given below :

For calculating the delivery charges, customers are divided into two categories, those whose sales region code is 10 or above and those with the code of less than 10.

If the code is less than 10 and the invoice amount is less than Rs. 10,000, the delivery charge to be added to the invoice total is Rs. 200. But if the invoice value is for Rs. 10,000 or more, the delivery charge is Rs. 100.

If the code is equal to or greater than 10, the corresponding delivery charges are Rs. 250 and Rs. 150 respectively.

Required :

i. Prepare a decision table of the above procedure

ii. Prepare a program flowchart segment of the above procedure.

Question 2

While invoicing each customer, the invoice clerk has to work out the discounts allowable on each order. Any order over Rs. 20,000 attracts a "bulk" discount of 8%.

A customer within the trade is allowed 10%. There is also a special discount of 5% allowed for any customer who has been ordering regularly for over 5 years.

Construct :- (*i*) A Flow Chart (*ii*) A decision table; to illustrate the clerical procedure for working out this management policy.

Question 3

A hire-purchases scheme has adopted the following criterion for its customers. The customers will get the credit facility if they satisfy any of the following conditions :

(*i*) The customer must hold the present job for more than 5 years and reside in the same place at least for 3 years. In this case, the customer will get credit upto rupees three thousand.

(*ii*) The monthly salary of the customer must exceed rupees two thousand and must hold the present job for more than 5 years. In this case credit will be given upto rupees four thousand.

(*iii*) The monthly salary must exceed rupees two thousand and reside at the same place at least for 3 years. In this case credit will be given upto rupees four thousand.

(*iv*) In the case, the customer's monthly salary exceeds rupees two thousand, holds the present job for more than 5 years and also reside in the same place at least for the 3 years, the credit facility will be upto rupees five thousand.

The credit facility is rejected for all other customers. Prepare a decision table for this hire-purchase scheme.

Question 4

A. computer file has customer name, type, bill number, bill date, amount and the date of payment. If the customer is a dealer and pays his bills within 30 days, 10% discount is allowed. If it is 30 to 45 days, discount and surcharge is zero. If he pays after 45 days, he has to pay 10% surcharge. The corresponding percentages for a manufacturer are 12½%, 0, 12 ½%.

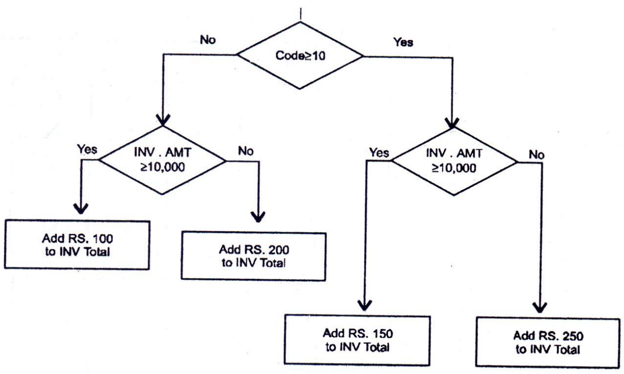
a. Write a decision table for the above problem.

b. Write a flowchart to calculate the discount, surcharge and net amount of each customer and print.

Answer 1: **Decision Table**

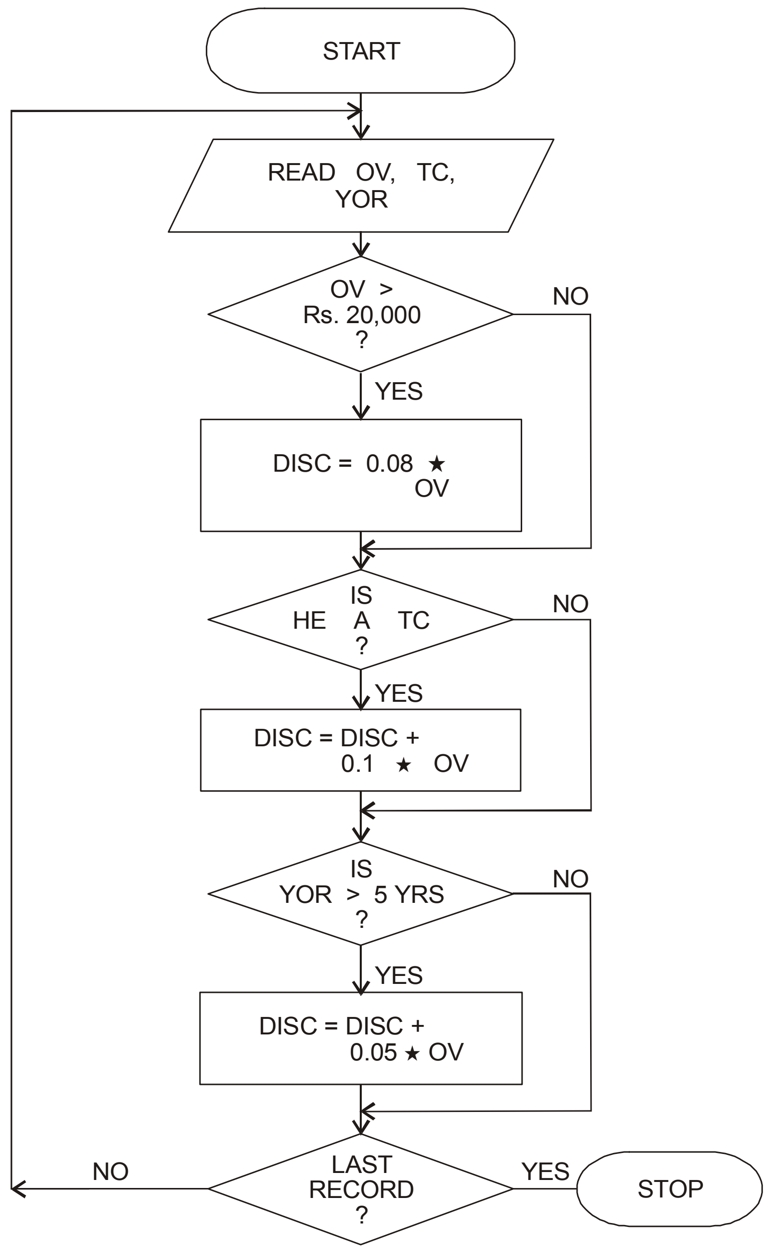
	Rules			
	1.	**2.**	**3.**	**4.**
Conditions	**Condition entries**			
Sales region code = 10.	Y	Y	N	N
Invoice amount < Rs. 10,000	Y	N	Y	N
Action Stub	**Action entry**			
Delivery charges				
Add Rs. 100 to invoice total			X	
Add Rs. 150 to invoice total	X			
Add Rs. 200 to invoice total				X
Add Rs. 250 to invoice total		X		

The flowchart is given below.



Answer 2 :

The flowchart is given below :



Decision Table is given below :

	RULES						
Conditions:	1	2	3	4	5	6	7
1. Order - Value Rs. 20,000	Y	Y	Y	Y	N	N	N
2. Trade - Customer	Y	Y	N	N	Y	Y	N
3. Year – Ordering Regularly > 5 Years	Y	N	Y	N	Y	N	Y
Actions :							
Nil Discount							X
5% "							X
8% "				X			
10% "						X	
13% "							
15% "			X		X		
18% "							
23% "	X	X					

KEY : Y = YES, N = NO, X = ACTION TO BE TAKEN

Answer 3 :

Hire Purchase Scheme	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**
1. Customer holds the present job for more than 5 years	Y	Y	Y	Y	N	N	N
2. Resides in the same place at least for 3 years	Y	Y	N	N	Y	N	N
3. Monthly salary of the customer exceeds Rs. 2000	Y	N	Y	N	Y	N	—

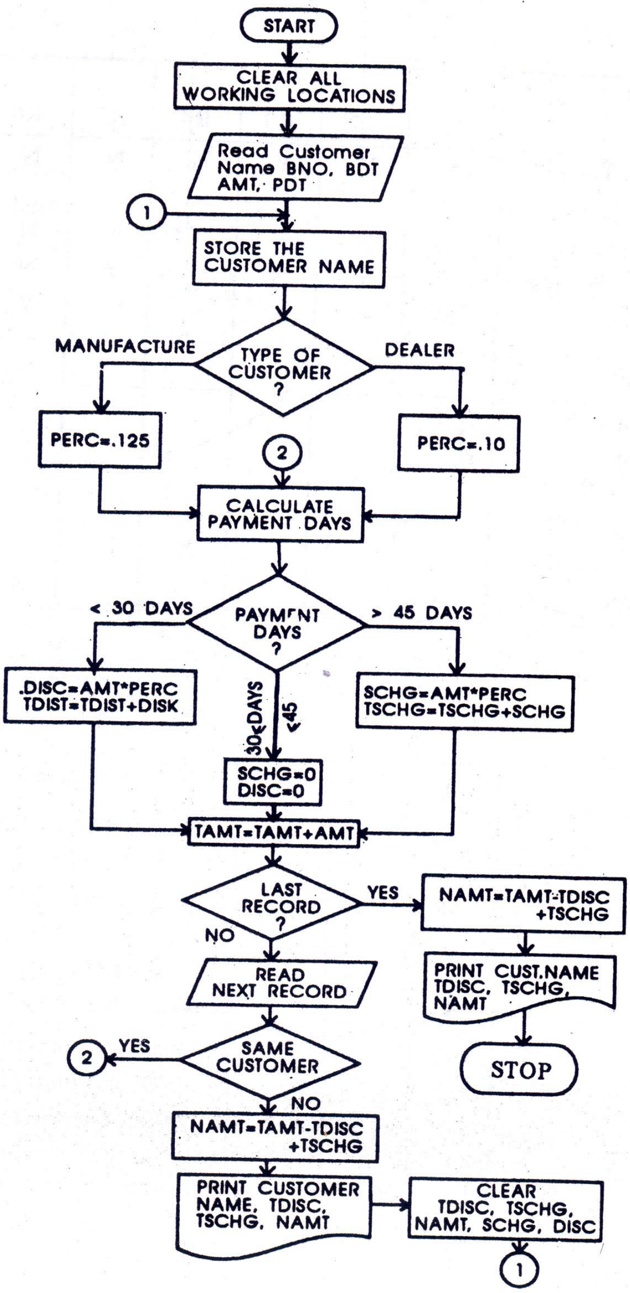
1. Give credit upto Rs. 3000			X				
2. Give credit upto Rs. 4000				X		X	
3. Give credit upto Rs. 5000		X					
4. Reject credit				X		X	X

Answer 4 (a) : The decision table is given below :—

Decision – table

RULES	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**
C_1 Customer Dealer	Y	Y	Y	N	N	N	Y	-
C_2 Payment Days >30 Days	Y	N	-	Y	N	N	Y	N
C_3 $\geq$30 & $\leq$45 days	-	Y	N	-	Y	N	Y	Y
C_4 > 45 days	N	-	Y	-	-	Y	Y	N
Actions								
A_1 Discount 10%	X							
A_2 Discount & Surcharge 0		X						
A_3 Surcharge 10%			X		X			
A_4 Discount 12½%				X				
A_5 Surcharge 12½%						X	X	X

(*b*) The flowchart is given below :


START
CLEAR ALL WORKING LOCATIONS
Read Customer Name BNO, BDT AMT, PDT
1
STORE THE CUSTOMER NAME
MANUFACTURE
TYPE OF CUSTOMER ?
DEALER
PERC=.125
PERC=.10
2
CALCULATE PAYMENT DAYS
< 30 DAYS
PAYMENT DAYS ?
> 45 DAYS
DISC=AMT*PERC TDIST=TDIST+DISK
30<DAYS <45
SCHG=AMT*PERC TSCHG=TSCHG+SCHG
SCHG=0 DISC=0
TAMT=TAMT+AMT
LAST RECORD ?
YES
NAMT=TAMT-TDISC +TSCHG
PRINT CUST.NAME TDISC, TSCHG, NAMT
STOP
NO
READ NEXT RECORD
2
YES
SAME CUSTOMER
NO
NAMT=TAMT-TDISC +TSCHG
PRINT CUSTOMER NAME, TDISC, TSCHG, NAMT
CLEAR TDISC, TSCHG, NAMT, SCHG, DISC
1

Self Examination Questions

Multiple Choice Questions

1. Which of the following is not a part of Decision table
   (a) Condition Stub
   (b) Action stub
   (c) Active stub
   (d) Action entries
2. ____ lists the comparisons or conditions.
   (a) Condition Stub
   (b) Action stub
   (c) Active stub
   (d) Action entries
3. ____ lists the various permutations of answer to the questions in the question stub.
   (a) Condition Stub
   (b) Action stub
   (c) Condition Entries
   (d) Action entries
4. ____ lists the actions to be taken along the various program branches.
   (a) Condition Stub
   (b) Action stub
   (c) Active stub
   (d) Action entries

5 which of the following is not a type of decision table.
   (a) Limited entry Tables
   (b) Extended Entry Table
   (c) Mixed Entry Table
   (d) Logical Entry Table.

Answers:

1	c	**2**	a	**3**	c	**4**	b	**5**	d

Short Type Questions

1. Discuss the various types of decision tables.
2. Discuss the components of any decision table.
3. What is the difference between the flowchart and decision table.

GLOSSARY 1

IMPORTANT COMPUTER TERMS

Access Time **-** The time interval between the instant when a computer or control unit calls for a transfer of data to or from a storage device and the instant when its operation is completed. Thus, access time is the sum of the waiting time and transfer time. Note: In some types of storage, such as disc, the access time depends upon the location specified and/or upon preceding events; in other types, such as core storage, the access time is essentially constant.

Acoustic Coupler **-** This is a portable version of a device called a modem which is used to convert the digital signals which a computer can understand into analog, or voice signals which can then be transmitted through a telephone system. At the receiving end, the analog signal is converted back into a digital format. Acoustic couplers have what appear to be two large rubber ears or suckers. The ear and mouth pieces of the telephone receiver are inserted into these 'ears' when transmitting or receiving computerised information. They can be battery operated and are, therefore, extensively used for electronic mail and similar communication links.

Address **-** A name, numeral, or other reference that designates a particular location in storage or some other data source or designation Note: Numerous types of addresses are employed in computer programming; for example; direct address, symbolic address.

ALGOL (Algorithmic Language) **-** A standard procedure oriented language for expressing computational algorithms developed as a result of international cooperation. ALGOL is designed to serve as a means for communicating computational procedures among humans, as well as to facilitate the preparation of such procedures for execution on any computer for which a suitable ALGOL compiler exists. Note: The basic elements of ALGOL are arithmetic expressions containing numbers, variables and functions. These are combined to form self-containing units called assignment statements. Declarations are non-computational instructions which inform the compiler of characteristics such as the dimensions of an array or the class of a variable. A sequence of declarations followed by a sequence of statements, all enclosed within "begin" "and" end instruction, constitutes an ALGOL program block. ALGOL is very popular in Europe.

Analog Transmission **-** There are two ways that 'Information' can travel along a telecommunications network: either as an analog or a digital signal. Analog signals are like the spoken word - the signal is continuous and carried by a changing wavelength (pitch) and amplitude (loudness). A digital signal, on the other hand, is like the binary information which is stored in a computer. The signal consists of discrete on-off (1 and 0) bits. Although analog and digital information cannot be changed in form, the electronic signal the network uses to transmit it can. Analog information can be transmitted directly or encoded into digital bits; digital information can be transmitted directly or modulated into analog form. The choice between transmission systems depends upon the relative volumes of analog and digital information, the relative costs of codes (analog to digital coders-decoders) and modems (digital to analog modulators - demodulators) and the relative efficiencies of digital and analog transmission.

Application Package - A computer routine or set of routines designed for a specific application *e.g.*, inventory control, on line savings accounting, linear programming, etc. Note: In most cases, the routines in the application packages are necessarily written in a generalized way and must be modified to meet each user's own needs.

Assemble - To prepare a machine language from a program written in symbolic coding by substituting absolute operation codes for symbolic operation codes and absolute or relocatable addresses for symbolic addresses. For example, the symbolic instruction ADD TAX might be assembled into the machine instruction 24 1365, where 24 is the operation code of addition and 1365 is the address of the storage location labeled TAX. Contrast with compile.

Assembler **-** A computer program that assembles programs written in symbolic coding to produce machine language programs. Note: Assemblers are an important part of the basic software for most computers and can greatly reduce the human effort required to prepare programs.

Asynchronous Communication - Transmission system in which the speed of operation is not related to any frequency in the system to which it is connected. In the transmission system each character is preceded by a start signal and succeeded by a stop signal. This means that 'asynch', as it is usually referred to, is rather slow.

Audit Trails - Means (such as a trail of documents, batch and processing references) for identifying the actions taken in processing input data or in preparing an output. By use of the audit trail, data on a source document can be traced to an output (such as a report), and an output can traced back to the source items from which it was derived.

Autodial **-** This is an automatic dialing facility now available on many telephones. A telephone number can be fed into a memory on the telephone and, by pressing a single or two keys, the telephone will automatically dial that number. This system is also used for view data systems and telex/teletex transmission.

Auxiliary Storage - Storage that supplements a computer's primary internal storage. Note, In general, that auxiliary storage has a much larger capacity but a longer access time than the primary storage. Synonymous with mass storage. Same as secondary storage.

Accumulator - A Storage area in memory used to develop totals of units or of amounts being computed.

American Standard Code for Information Interchange (ASCII) - Byte - oriented coding system based upon the use of seven-bit codes and used primarily as formats for data communication.

Background Communication - This means that while an operator is using a computer, terminal or word processor, the machine can, at the same time, receive a message from another source and store it for later access. No action is required by the operator to set up the machine to receive information. See also Foreground Communications.

Back-to-Back Communication - Direct communications link between two terminals.

***Basic (Beginner's All-purpose Symbolic Instruction Code)* -** A programming language developed in the mid - 1960's as an easy-to learn, easy-to-use language to teach students how to program. The language contains a limited set of powerful commands designed especially for use in a time sharing environment.

Backup - Pertaining to equipment or procedures that are available for use in the event of failure or overloading of the normally used equipment or procedures. Note: The provision of adequate backup facilities is an important factor in the design of all data processing systems and is especially vital in the design of real-time systems, where a system failure may bring the entire operation of a business to virtual standstill.

***Bar Codes* -** These are the vertical black lines you see on many goods in shops. They are called bar codes because they comprise 'bars' of different thickness. Each bar represent some kind of information, such as the price of the product, stock code number, etc. bar codes are read by a laser reader and many shops now use them as a point-of-sale transaction medium.

Batch file - It is like a mini program, a series of commands that are given to the personal computer to execute in sequence.

Batch processing - A technique in which items to be processed are collected into groups (batched) to permit convenient and efficient processing. Note: Most business applications are of the batch processing type; the records of all transactions affecting a particular master file are accumulated covering a period of time, (*e.g.*, one day); then they are arranged in sequence and processed against the master file.

Batch Total - A sum of a set of items in a batch of records which is used to check the accuracy of operations involving the batch.

BCD (Binary Coded Decimal) - Pertaining to a method of representing each of the decimal digits zero through 9 by a distinct group of binary digits. For example, in the "8-4-2-1" BCD notation, which is used in numerous digital computers, the decimal number39 is represented as 0011 1001 (whereas in pure binary notation it would be represented as 100111)

Bidirectional Printing - A printer types the first line from left to right and the second line from right to left and so on throughout the page. This speeds up the printing sequences.

Binary - Pertaining to the number system with a radix of 2, or to a characteristic or property involving choice or condition in which there are two possibilities. For example, the binary numeral 1101 means: $(1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$ which is equivalent to decimal 13. Note: The binary number system is widely used in digital computers because most computer components, *e.g.*, vacuum tubes, transistors, and integrated chips) are essentially binary in that they have two stable states.

Bit - A binary digit; a digit (0 or 1) in the representation of a number in binary notation.

Buffer - A storage device used to compensate for differences in the rates of flow of data or in the times of occurrence of events when transmitting data from one device to another. For example, a buffer holding the characters to print one line is associated with most line printers to compensate for the difference between the high speed at which the computer transmits data to the printer and the relatively low speed of the printing operation itself.

Buffer Memory - This is the internal memory of a microcomputer or word processor. Data is stored in this memory until transferred to its permanent store on a disk system. Buffer memories also hold the software used by the system.

***Bug* -** A mistake in the design of a program or a computer system, or an equipment fault.

Byte - A group of adjacent bits operated on as a unit and usually shorter than a word: Note in a number of important current computer systems, this term stands specifically for a group of eight adjacent bits that can represent one alphanumeric character or two decimal digits.

Cassette Storage - Many home computers use the conventional audio tape cassette system, which was developed by Philips for use on tape recorders and stereo systems, to both feed in the software and to store information.

Cathode Ray Tube - An electronic vacuum tube containing a screen on which information can be displayed. The abbreviation CRT is frequently used.

Central Processor - The unit of a computer system that includes the circuits which controls the interpretation and execution of instructions. Synonymous with CPU (Central Processing Units) and main frame.

***Check digit* -** A digit associated with a word for the purpose of checking for the absence of certain classes of errors. See residue check.

Channel - Magnetic track running along the length of tape that can be magnetized in bit patterns to represent data.

CIS development **-** The section of computer installation responsible for the analysis, design, and development of new systems and programs.

Chip - A miniature electronic package containing imprinted circuits and components.

Clipart - These are pre-prepared graphic images that one can incorporate into a document with a word processor or a desktop publishing program.

Cluster System - A number of word processor or computer workstations which have been linked together in some form to share central resources, such as storage, printers, telex access, etc.

Coding **-** The process of translating a set of computer processing specifications into a formal language for execution by a computer. A set of coded instructions.

Command Driven System - Describes the method of operation adopted by a computer or word processor. Each function or facility is activated by a command keyed into the system. Compare this with a menu-driven system where the functions are activated by calling up a menu on the screen to identify each facility available. An example of a command is to key in 'PRINT' which will activate the printer.

Computer-aided instruction (CAI) - Interactive use of a computer to deliver educational contents to individuals and to adjust presentations according to learner responses.

Computer information system (CIS) - A coordinated collection of hardware, software, people, data, and support resources to perform an integrated series of functions that can include input, processing, output, and storage.

Concurrent processing - The capability of a computer system to share memory among several programs and to execute the instructions provides by each during the same time frame.

Control break - Point during program processing at which some special processing event takes place. A control break is usually signaled by a change in the value of a control field within a data record.

Conversational program - A program that permits a dialogue to take place between a user and computer.

COBOL (Common Business Oriented Language) - A procedure-oriented language developed to facilitate the preparation and inter-change of programs which form business data processing functions. Note: Designed in 1959 by a committee representing the U.S. Government and several computer manufacturers, COBOL has evolved through several versions (*e.g*,, COBOL-60, COBOL-61, COBOL 61-Extended, COBOL-65). Every COBOL source program has four divisions, whose names and functions are as follows: (1) Identification Division, which identifies the source program and the output of a compilation, (2) Environment Division, which specifies those aspects of a data processing problem that are dependent upon the physical characteristics of a particular computer, (3) Data Division, which describes the data that the object program is to accept as input, manipulate, create, or produce as output, and (4) Procedure Division, which specifies the procedures to be performed by the object program, by means of English-like statements such as: "*Subtract tax from gross pay giving net pay*".

Compile **-** To prepare a machine language program (or a program expressed in symbolic coding) from a program written in another programming language (usually a procedure oriented language such as BASIC, COBOL or FORTRAN). The compilation process usually involves examining and making use of the overall structure of the program and/or generating more than one object program instruction for each source program statement. Contrast with assemble.

Compiler - A computer program that compiles. Compilers are an important part of the basic software for most computers permitting the use of procedure-oriented languages which can greatly reduce the human effort required to prepare computer programs.

Console **-** A portion of a computer that is used for communication between operators or maintenance engineers and the computer, usually by means of displays and manual control.

Control Program - A routine, usually contained within operating system, that aids in controlling the operations and managing the resources of a computer system.

CP/M Operating System - One of the most widely used microcomputer operating systems originally developed by Digital Research Inc., in USA. Computer users should be aware of the operating system of their machine to enable them to acquire the software capable of running on that system.

CP/M-86 Operating System - Another microcomputer operating system, a later and more sophisticated development of CP/M.

CR - Carriage Return - This is the most important key on a computer or word processor keyboard. It is used to activate most of the functions on the system. It is usually identified by a reverse L-symbol with an arrow on the end of the horizontal bar.

Cursor - A symbol that marks to current position of the mouse on the screen or the point of entry of data.

Data administration section - The group within the technical support area responsible for defining data requirements within an organization and setting up controls or managing the data.

Data Base **-** Data items that must be stored in order to meet the information processing and retrieval needs of an organization. The term implies an integrated file of data used by many processing applications in contrast to an individual data file for each separate application.

Data Base Administrator (DBA) - The person in charge of defining and managing the content of a data base.

Data Base Management System (DBMS) - Software to manage and control data resources.

Data Bus **-** The internal pathway in a computer on which data moves.

Data communications - The transmission of data between two or more separate physical sites through use of public and/or private communications channels or lines.

Data control section - The group within a computer installation responsible for meeting quality control standards for processing and for collecting inputs from and delivering outputs to computer users.

Data dictionary **-** A document listing and defining all items or processes represented in data flow diagrams or used within a system.

Data librarian - Person who maintains custody and control of tapes, disks, and procedures manuals by cataloging, checking out, and monitoring use of these data resources.

Data Management System - System software that supervises the handling of data required by programs during execution.

Debug **-** To trace and eliminate mistakes in a program or faults in equipment. The process is often assisted by a diagnostic routine.

Decision table - A table listing all the contingencies to be considered in description of a problem, together with the corresponding actions to be taken. Decision tables permit complex decision-making criteria to be expressed in a concise and logical format. They are sometimes used in place of flowcharts for problem definitions and documentation. Compilers have been written to convert decision tables into programs that can be executed by computers.

Desk checking - A manual checking process in which representative data items, used for detecting errors in program logic, are traced through the program before the latter is checked on the computer.

Dialog Box **-** A small window that opens up on the computer screen to the user request or put in information relating to a task (such as printing) or give the information to the user, such as when there is an error.

Digitize **-** The process of converting lines, drawings and pictures to digital form by scanning the drawings and pictures with a device that converts sensed highlights into numbers or horizontal and vertical coordinates.

Direct access device **-** A hardware unit that can read and write records from or to a file without processing all preceding records.

Direct data entry **-** Entry of data directly into the computer through machine-readable source documents or through use of on-line terminals. Direct entry is a by-product of source business transactions, without requiring manual transcription from original paper documents.

Down time **-** Time at which the computer is not available for processing.

Drag **-** To move something around the computer with the help of the mouse. This involves holding down one of the mouse buttons while user moves it.

Dynamic processing **-** The technique of swapping jobs in and out of computer memory according to their priorities and the number of time slices allocated to each task.

Dump **-** (1) To copy the contents of a set of storage locations, usually from an internal storage device (such as disk storage) to an external storage medium (such as magnetic tape or floppy disk), and usually for diagnostic or rerun purposes. (2) The data that results from the process defined in (1).

EBCDIC (Extended Binary Coded Decimal Interchange Code) **-** An 8-bit code that represents an extension of a 6-bit "BCD" code that was widely used in computers of the first and second generations. EBCDIC can represent upto 256 distinct characters and is the principal code used in many of the current computers.

Echo checks **-** A check upon the accuracy of a data transfer operation in which the data received (typically, by an output device) is transmitted back to the source (Typically, a control unit) and compared with the original data. An echo check on an output operation usually can only verify that, for example, the proper print hammers or punch pins were actuated at the proper instants, it cannot ensure that the proper marks were actually recorded on the output medium.

Electronic journal **-** A log file summarizing in chronological sequence, the processing activities performed by a system. The file is maintained on magnetic storage media.

Exception report **-** Management report produced by a management information system to highlight business conditions that are outside the range defined as normal.

Executive routine **-** A routine designed to organize and regulate the flow of work in a computer system by initiating and controlling execution of programs. A principal component of most operating systems. Synonymous with supervisory routine.

Facsimile Transmission System **-** Often abbreviated to 'Fax', this system is employed to relay alphanumeric and graphic data to other Fax machines at distant sites along a telephone or other telecommunications link. A fax device produces a facsimile copy of the original in the same manner as an office copier, except that the original is received electronically.

Field **-** (1) In a record, a group of characters represents one item. (2) A subdivision of a computer word or instruction; a group of bit positions within an instruction that hold an address. (3) A subdivision of a record; that is, an item.

File **-** A collection of related records, usually (but not necessarily) arranged in sequence according to key contained on each record. Note: A record, in turn, is a collection of related items; an item is an arbitrary quantity of data that is treated as a unit. In payroll processing, an employee's pay rate forms an item; a group of items relating to one employee form a record, and the complete set of employee records forms a file.

File label **-** A label identifying the file. Note: An internal table is recorded as the first or last record of a file and is machine-readable. An external label is attached to the outside of the file holder and is not machine-readable.

File maintenance **-** The updating of a file to reflect the effects of period changes by adding, altering data; *e.g.*, the addition of new programs to program library on magnetic disk.

File processing **-** The periodic updating of master files to reflect the effect of current data, often transaction data contained in detail files; *e.g.*, a weekly payroll run updating the payroll master file.

Fixed length record **-** A record that always contains the same number of characters. The restriction to a fixed length may be deliberate, in order to simplify and speed processing or it may be dictated by the characteristics of the equipment used. Contrast with variable-length record.

Fixed word length **-** Pertaining to a machine word or operand that always has the same number of bits or characters. Contrast with variable word length. Most scientific computers are of the fixed word length type for maximum computational speeds, while many business oriented computers have variable word length to permit efficient handling of items and records of varying sizes. Some computers types have both fixed and variable words.

Flowchart **-** A diagram that shows, by means of symbols and interconnecting lines, (1) the structure and general sequence of operations of a program or (2) a system of processing (system flow chart).

Foreground Communication **-** Where the transmission or receipt of massage requires action by the operator of the terminal. This can mean setting up the machine to communicate, making contact with the third party sending or receiving the message and activating the terminal to perform that function.

FORTRAN (Formula Translation) **-** A procedure oriented language designed to facilitate the preparation of computer programs that performs mathematical computations. It was designed by IBM in the 1950's to use symbols and expression similar to those of algebra, FORTRAN was not originally intended to be a common language. However, it has evolved through several basic versions (*e.g.* FORTRAN II, FORTRAN IV) plus numerous dialects, has become largely machine-independent and has been approved as a USA standard programming language in two versions (FORTRAN and basic FORTRAN). FORTRAN is widely used procedure-oriented language in the United States and is being effectively employed in certain business as well as scientific applications. The essential elements of the FORTRAN is the assignment statement; *e.g.* Z = X + Y causes the current value of the variables X and Y to be added together and their sum to replace the previous value of the variable Z.

***Font* -** A character set in a particular style and size of type, including all alphanumeric characters, punctuation marks and special symbols.

***Fourth Generation Languages* -** These are infact sophisticated software packages that permit users to query data bases and extract the information needed to solve problems and prepare reports. With these languages, very complex operations are accomplished by just pressing a few keystrokes. Some examples of fourth generation languages are dBASE, FRED and PC/FOCUS.

***Joystick* -** A vertical lever, usually in a ball socket, which can be titled in any direction and is used to move a cursor around the screen or display unit of a computer.

Generator A computer program designed to construct other programs for performing particular types of operations; *e.g.,* report program generator. Based upon parameters supplied to it, the generator typically selects from among various alternatives the most suitable method for performing the specified task, and adjusts the details of the selected method to produce a program attached to the characteristics of the data to be handled by the generated program.

***Hard Copy* -**Data stored on a more permanent medium, such as printing paper. Data stored on a floppy or hard disk can be overwritten.

Header label - A machine-readable record at the beginning of the file containing data identifying the file and data used in control.

Hollerith code - A widely used code for representing alphanumeric data on punched cards, named after Herman Hollerith, the originator of punched card tabulating. Each card column holds one character, and each decimal digit, letter, and special character is represented by one, two or three holes punched into designated row positions of the column.

IDP (Integrated Data Processing) - Data processing by a system that coordinates a number of previously unconnected processes in order to improve overall efficiency by reducing or eliminating redundant data entry or processing operations. An example of IDP is a system in which data describing orders, production, and purchases is entered into a single processing scheme that combines the functions of scheduling, invoicing, inventory control, etc.

Input/Output **-** A general term for the techniques, and media used to communicate with data processing equipments and for the data involved in these communications. Depending upon the context, the term may mean either "input and output" or "input or output". Synonymous with I/O.

Instruction **-** A set of characters that specifies an operation to be performed and, usually, the value of locations of one or more of its operands. In this context, the term instruction is preferable to the terms command and order, which are sometimes used synonymously.

Interblocked Gap **-** The distance on a magnetic tape between the end of one block and the beginning of the next. Within this distance, the tape can be stopped and brought up to the normal speed again. Since the tape speed is not constant when stopping, no reading or writing is permitted in the gap. Synonymous with inter-record gap and record gap, though the use of these two terms is not recommended because of the important distinction between blocks and records.

Item **-** An arbitrary quantity of data that is treated as a unit. A record, in turn, is a collection of related items, while a file is a collection of related records. Thus, in payroll processing an employee's pay rate forms an item, all of the items relating to one employee form a record, and the complete set of employee records forms a file.

Integrated Circuit (IC) **-** A device incorporating circuitry and semiconductor components within a single unit, usually a miniature chip. Circuit elements and components are created as part of the same manufacturing procedures.

Interpreter - Language translator that converts source code to machine code and executes it immediately, statement by statement.

Job scheduler - Person within a computer installation who monitors computer work loads and makes sure that all resources and materials necessary for running jobs are available to people who need them.

Key - One or more characters associated with a particular item or record and used to identify that item or record, especially in sorting or collating operations. The key may or may not be attached to the record or item it identifies. Contrast label and tag.

Label **-** A name attached to or written alongside the entity it identifies *e.g.* a key that is attached to the item or record it identifies, or a name written alongside a statement on a coding sheet.

Machine language **-** A language that is used directly by a computer. Thus, a "Machine language program" is a set of instructions which a computer can directly recognize and execute and which will cause it to perform a particular process. In Machine-oriented language there is a general (though not necessarily strict) one-to one correspondence between the statements of source program and the instructions of the object program (which will normally be a machine language program ready for executing on a particular computer). The input to an assembler is usually expressed in a machine-oriented language. Contrast with procedure-oriented language.

Marco Instruction - An instruction written in a machine-oriented language that has no equivalent operation in the computer and is replaced in the object program by a predetermined set of machine instructions. Macro instruction facilities can ease the task of coding in a machine-oriented language by precluding the need for detailed coding of input and output operations, blocking format control, checking for errors, etc.

Management information system - A system designed to supply the managers of a business with the information they need to keep informed of the current status of the business and to understand its implications; and to make and implement the appropriate operating decisions.

Maintenance (file) - Process of changing a master file through the addition of new records, the deletion of old records and changing the contents of existing records.

Mark sensing - A technique for detecting pencil marks entered by hand in prescribed places on some preprinted documents. The marked data may be converted into light patterns and transmitted directly to a computer.

Mass storage - Same as secondary storage or auxiliary storage.

Master file - A file containing relatively permanent information which is used as source of reference and is generally updated periodically. Contrast with detail file.

Merge - To form a single sequenced file by combining two or more similarly sequenced files. Merging may be performed manually, by a collator, or by a computer system for which a "merge routine" is available. Repeated merging, splitting and remerging of strings of records can be used to arrange the records in sequence; this process, called a "merging sort," is frequently used as the basis for sorting operations on computer systems.

Message Switching System - A facility which uses computer techniques to transmit and receive, and store and retrieve textual information. It is a means of communicating in a fast, cost-effective and reliable way, using modern technology. These systems allow immediate access to any person or office using the facilities and all massages are transmitted and received instantly whether addressee is in the next office or the other side of the world.

MICR (Magnetic Ink Character Recognition) - The automatic reading by machine of graphic characters printed with magnetic ink.

Module - In programming, a solution document representing a processing function that will be carried out by a computer.

Module N check - Same as residue check.

MS-DOS Operating System or Microsoft Disk Operating System - The operating system used by most of the major personal computer systems, especially the IBM Personal Computer 'look-likes'. IBM personal computers used a variation known as PC-DOS.

Multiprocessing **-** The simultaneous execution of two or more sequences of instructions in a single computer system. Frequently refers to simultaneous execution accomplished by the use of a system with more than one central processor.

Multi-programming - A technique for handling two or more independent programs simultaneously by overlapping or interleaving their execution. The overlapping or interleaving of the execution of the various programs is usually controlled by an operating system which attempts to optimize the performance of the computer system in accordance with the priority requirements of the various jobs.

Natural language processing - Use of command language that closely resembles English syntax and style to direct processing of a computer. Use of non structured commands.

Network - An integrated, communicating collection of computers and peripheral devices connected through communication facilities.

Object program - A program expressed in an object language (*e.g.*, a machine language program that can be directly executed by a particular computer).

OCR (Optical Character Recognition) - The automatic reading by machine of graphic characters through the use of light-sensitive devices.

***Offline (or Off-line*)** - Pertaining to equipments or devices that are not in direct communication with the central processor of a computer system. Offline devices cannot be controlled by a computer except through human intervention. Contrast with online.

Online (or On-line) **-** Pertaining to equipments or devices that are in direct communication with the central processor of a computer system. Online devices are usually under the direct control of the computer with which they are in communication. Contrast with offline.

Operating System - An organized collection of routines and procedures for operating a computer. These routines and procedures will normally perform some or all of the following functions - (1) Scheduling, loading, initiating and supervising the execution of programs; (2) allocating storage, input/output units and other facilities of the computer system; (3) initiating and controlling input/output operations; (4) handling errors and restarts; (5) coordinating communication between the human operator and the computer system; (6) maintaining a log of system operations, and (7) controlling operation in a multi-programming, multi-processing or time-sharing mode. Among the facilities frequently included within an operating system are an executive routine, a scheduler, an IOCS, utility routines, and monitor routines.

Overflow **-** In an arithmetic operation, the generation of a quantity beyond the capacity of the register or storage location which is to receive the result.

Overlay -To transfer segment of program from auxiliary storage into internal storage for execution, so that two or more segments occupy the same storage locations at different times. This technique makes it possible to execute programs which are too large to fit into the computer internal storage at one time, it is also important in multi-programming and time-sharing operations.

Pack **-** To store several short units of data in a single storage cell in such a way that the individual units can latter be recovered, *e.g.,* to store two 4—bit BCD digits in one 8 bit storage location.

Parallel Interface **-** Generally used to link a printer into a computer or word processor. This interface allows the printer to accept transmission of data which is sent in parallel bit sequences. See also Serial Interface.

Parity Bit **-** A bit (binary digit) appended to an array of bits to make the sum of all the1-bits in the array either always even ("even parity") or always odd ("odd parity"). For example,

	Even parity				*Odd parity*
	01	1	0	1	1
	01	0	0	1	0
	01	0	0	1	0
Data bits	01	1	0	1	1
	01	1	0	1	1
	11	0	1	1	0
Parity bits	10	1	0	1	0

Parity Checks **-** A check that tests whether the number of 1-bits in an array is either even ("even parity check") or odd ("odd parity check")

Peripheral equipment **-** The input/output units and secondary storage units of a computer system. Note : The central processor and its associated storage and control units are the only units of a computer system which are not considered peripheral equipment.

Programming language/1 **-** (PL/1) A general-purpose, high level language that is designed to combine business and scientific processing features and that can be easily learned by novice programmers, yet contains advanced features for experienced programmers.

Privacy - In connection with the use of computer-maintained files, the right of individuals to expect that any information kept about them will only be put to authorized use and to know about and challenge the appropriateness and accuracy of the information.

Programmable read-only memory (PROM) - Computer memory chips that can be programmed permanently, by burning the circuits in patterns, to carry out predefined process.

Problem-oriented language **-** A language whose design is oriented toward the specification of a particular class of problems, such as numerical control of machine tools. Sometimes used as a general term to describe both procedure and problem-oriented languages.

Procedure-oriented language - A language designed to permit convenient specification, in terms of procedural or algorithmic steps, of data processing or computational processes. Examples include ALGOL, COBOL and FORTRAN. Contrast with problem-oriented language and machine-oriented language.

Program - (1) A plan for solving a problem. (2) To devise a plan for solving a problem. (3) A computer routine, *i.e.*, a set of instructions arranged in proper sequence to cause a computer to perform a particular process. (4) To write a computer routine.

Program flowchart - A flowchart diagramming the processing steps and logic of a computer program. Contrast with system flowchart.

Programmer **-** A person who devices programs. The term “programmer” is most suitably applied to a person who is mainly involved in formulating programs, particularly at the level of flowchart preparation. A person mainly involved in the definition of problems is called an analyst, while a person mainly involved in converting programs into coding suitable for entry into a computer system is called a coder. In many organizations all three of these functions are performed by “programmers”.

Programming language - An unambiguous language used to express programs for a computer.

PROM - Programmable Read Only Memory - The program stored in a ROM (Read only Memory) can be read but not changed. A PROM, however, can be programmed in the field by suitably qualified personnel.

Protocol Translator - A peripheral device which converts the communications protocol of one system into the protocols of another system so that the two systems are compatible enabling data to be transferred between them.

Random access - Pertaining to a storage device whose access time is not significantly affected by the location of the data to be accessed, thus, any item of data which is stored online can be accessed within a relatively short time (usually in part of a second). Same as direct access. Contrast with serial access.

***Realtime (or Real-time)* -** (1) Pertaining to the actual time during which a physical process takes place. (2) pertaining to fast-response online computer processing, which obtains data from an activity or process, performs computations, and returns a response rapidly enough to control, direct or influence the outcome of the activity or process. For example, realtime operation is essential in computers associated with process control systems, message switching systems and reservation systems.

Record - A collection of related items of data. Note - In payroll processing, for example, an employee's pay rate forms an item, all of the items relating to one employee form a record, and the complete set of employee record forms a file. see also fixed-length record and variable-length record.

***Record gap* -** Same as interblock gap.

Recording density - The number of useful storage cell per unit of length or area; *e.g.,* the number of digits (or characters) per inch on a magnetic tape/floppy diskette, or the number of bits per inch on a single track of a tape. The most common recording densities in current use are 10 rows per inch for punched tape and 200, 556, 800 or 1600 bits per inch (bpi) for magnetic tape.

Redundancy check - A check based on the transfer of more bits or characters than the minimum number required to express the massage itself, the added bits or characters having been inserted systematically for checking purposes. The most common type of redundancy check is parity check.

Residue check - A check of numeric data or arithmetic operation in which each number A, is divided by the modulo, N, and the remainder, B, accompanies A as a check digits. For example, in modulo 4 checks, B will be either 0, 1, 2 or 3; if the remainder formed when A is divided by 4 does not equal B, an error is indicated. Synonymous with modulo N check.

Resolution - It indicates the degree of details—that can be perceived. The higher the resolution, the finer the detail.

RS-232-C Port - This is standard communications port on most microcomputers and word processors which is used as the link to a printer or the communications link to electronic mail, telex and other transmission systems. Also known as the V24 port.

Routine - A set of instructions arranged in correct sequence to cause a computer to perform a particular process. In this context, the term "routine" is somewhat more precise than the more general (and more commonly used) term "program".

Run - A performance of a specific process by a computer on a given set of data *i.e.,* the execution of one routine or of several routines which are linked to form one operating unit, during which little or no human intervention is required.

Run manual **-** A manual documenting the processing system, program logic, controls, program changes, and operating instructions associated with a computer run.

Scroll **-** To move a graphics image or the text on the monitor up, down, right, or left, in a smooth, usually continuous and reversible action.

Secondary storage **-** Storage that supplements a computer's primary internal storage. Synonymous with auxiliary storage.

Security program **-** Systems program that controls access to data in files and permits only authorized use of terminals and other equipments. Control is usually through various levels of pass words assigned on the basis of need to know.

Semiconductor - Material with electrical conducting qualities that fall between those of conductors and resistors. Also refers to electronic components and devices using semiconductor materials treated to impart special electrical properties.

Sequential processing **-** Same as batch processing.

Serial access **-** Pertaining to a storage device in which there is a sequential relationship between the access times to successive locations, as in the case of magnetic tape. Contrast with direct access or random access.

Serial Interface **-** Used to connect a printer to the input device, either a computer or word processor. Allows the printer to accept transmission of data which is sent serially, or one character at a time. See also Parallel Interface.

Software - A collection of programs and routines associated with a computer (including assemblers, compilers, utility routines, and operating systems) which facilitates the programming and operation of the computer. Contrast with hardware.

Source language - A language that is an input to a translation process. Contrast with object language.

Source Program - A program written in a source language (*e.g.,* written in COBOL, C, FORTRAN, or symbolic coding for input to a compiler or assembler).

Statement - In computer programming, a meaningful expression or generalized instruction.

Software package - A collection of programs, usually for specific applications, designed to solve common problems in selected industries or professions; offered as a means of reducing system development efforts and costs.

Spooling - Computer processing technique under which input and output files originating on and destined for slow-speed devices are written to high-speed storage devices prior to and following processing. Thus, processing can take place at high speeds while input and output can be handled separately at relatively slow speeds.

Status line - An area - a strip -at the bottom of the screen that tells the user about the operations of a program he/she is working in. For instance, a status line could tell that the file is now being saved, or that it is being printed.

Storage allocation - The assignment of specific programs, program segments, and or block of data to specific portions of a computer's storage.

Subroutine - A routine that can be part of another routine. A closed subroutine is stored in one place and connected to the program by means of linkages at one or more points in the program. An open subroutine is inserted directly into a program at each point where it is to be used. A great deal of coding effort can be saved through judicious use of subroutines to handle tasks which are encountered repetitively, such as the control of input operations, the evaluation of mathematical functions, and the handling of checking and error recovery procedures.

Supervisory routine - Same as executive routine.

Symbolic address - An address expressed in symbols convenient to the programmer, which must be translated into an absolute address (usually by an assembler) before it can be interpreted by a computer. For example, the storage location that holds an employee's gross pay might be assigned the symbolic address PAY.

Symbolic Coding - Coding that uses machine instruction with symbolic address. Contrast with absolute coding and relative coding. The input to most assemblers is expressed in symbolic coding. Mnemonic operation codes are usually employed along with the symbolic address to further simplify the coding process. For example, a two-address instruction that subtracts an employee's taxes from his gross pay might be written SUB TAX GPAY.

System **-** A set or arrangement of entities that forms, or is considered as an organized whole. This term is a very general one that is applied to both hardware and software entities; therefore it must be carefully qualified to be meaningful *e.g.,* computer system, management information system, number system, operating system.

System analysis - The examination of an activity, procedure, method, technique or business to determine what needs to be done and how it can best be accomplished.

System development life cycle (SDLC) **-** Activities required to develop, implement and install a new or revised system. Standard activity phases include investigation, analysis and general design, detailed design and implementation, installation, and review.

System flowchart - A flowchart diagramming the flow of work documents, and operations in a data processing application. Contrast with program flowchart.

Time sharing - (1) the use of given devices by a number of other devices, programs, or human users, one at a time and in rapid succession. (2) A technique or system for furnishing computing services to multiple users simultaneously, providing rapid responses to each of the users. Time sharing computer systems employ-multi programming and/or multiprocessing techniques and are often capable of serving users at remote locations *via* data communication network.

Toggle - A switch or control code that turns an event on or off by repeated action or use; to turn something on or off by repeating the same action.

Track - That part of a data storage medium that is influenced by (or influences) one head; *e.g.,* the ring-shaped portion of the surface of a disk, or one of several divisions (most commonly seven or nine) running parallel to the edges of a magnetic tape.

Trailer record - A record that follows another record or group of records and contains pertinent data related to that record or group of records.

Transaction Code - One or more characters that form part of a record and signify the type of transaction represented by the record (*e.g.,* in inventory control, the types of transactions would include deliveries to stock, disbursement from stock, orders, etc.)

Transaction file - Same as detail file.

Translator - A device or computer program that performs translation from one language or code to another - *e.g.,* an assembler or compiler.

UNIX Operating System - Computer operating system developed by the Bell Telephone Laboratories in the USA. Currently considered to be the system of the future with many manufacturers adopting UNIX for their new ranges of equipments. Office automation software is, on the whole, not very well represented in the UNIX area. There are some world processing packages, such as Q-One from Quadratronic, an offering from Interplex within an integrated package, Crystalwriter from Syntactics and UNIX-option Multimate which will be available shortly.

Unpack - To separate short units of data that have previously been packed *i.e.,* to reverse a packing operation.

Update - To incorporate into a master file the changes required to reflect recent transactions or other events.

Utility routine - A standard routine used to assist in the operation of a computer by performing some frequently required processes such as sorting, merging, report program generation, data transcription, file maintenance, etc. Utility routines are important components of the software supplied by the manufacturers of most computers.

Variable length record - A record that may contain a variable number of characters. Contrast with fixed-length record. In many cases where the equipment would permit the use of variable length records, the records are nonetheless held to a fixed length to facilitate both programming and processing.

Variable word length - Pertaining to a machine word or operand that may consist of a variable number of bits of characters. Contrast with fixed word length. Many business-oriented computers are of the variable word length type for efficient processing of items and records of varying size.

Very large scale integration (VLSI) - Design and production techniques to place thousands of electronic components within small integrated circuit chips to reduce their sizes and costs.

Word processing - Use of computers or specialized text-oriented equipments (including electronic typewriters) for the storage, editing, correction, and revision of textual files and for the printing of finished letters, reports and other documents from these files.

Word - A group of bits or characters treated as a unit capable of being stored in one storage location. Within a word, each location that may be occupied by a bit or characters is called a "position".

***Word Length* -** The number of bits or characters in a word.

***Word mark* -** A symbol (*e.g.,* a special character or a single bit) used in some variable word length computers to indicate the beginning or end of a word or item.

Working storage - A storage section set aside by the programmer for use in the development of processing results for storing constants, for temporarily storing results needed later in the program sequence, etc.

Workstation - A basic physical unit of a word processing or computer system which may comprise such hardware as a display unit, keyboard, storage system, and others, that enables an operator to perform computer functions, word processing and other tasks.

GLOSSARY 2

INTERNET RELATED TERMS

ARPA NET **- (Advanced Research Projects Agency Network) -** The precursor to the Internet. Developed in the late 60's and early 70's by the US Department of Defence as an experiment in wide-area networking that would survive a nuclear war.

Bandwidth - How much data one can send through a connection. Usually measured in bits-per-second. A full page of English text is about 16,000 bits. A fast modem can move about 15,000 bits in one second. Full-motion, full-screen video would require roughly 10,000,000 bits per second, depending on compression.

Baud **-** In common usage, the baud rate of a modem is how many bits it can send or receive per second. Technically, baud is the number of times per second that the carrier signal shifts value. For example, a 1200 bit-per-second modem actually runs at 300 baud, but it moves 4 bits per baud (4 × 300 = 1200 bits per second)

BBS **- (Bulletin Board System)** - A computerised meeting and announcement system that allows people to carry on discussion, upload an download files, and make announcements without the people being connected to the computer at the same time. There are many thousands (millions ?) of BBS's around the world, most are very small, running on a single IBM clone PC with 1 or 2 phone lines. Some are very large.

Bps **- (Bits-per-Second)** - A measurement of how data is moved from one place to another. A 28.8 modem can move 28,800 bits per second.

Browser **-** A Client program (software) that is used to look at various kinds of Internet resources. Mosaic, Netscape Nevigator and Internet Explorer are some of the commonly used browsers.

Client **-** A software program that is used to contact and obtain data from a Server software program on another computer, often across a great distance. Each Client program is designed to work with one or more specific kinds of Server programs and each Server requires a specific kind of Client. A Wed Browser is a specific kind of Client.

Cyberspace **-** Term originated by author William Gibson in his novel Neuromancer. The word Cyberspace is currently used to describe the whole range of information resources available through computer networks.

Domain Name **-** The unique name that identifies an Internet site. Domain Names always have 2 or more parts, separated by dots. The part on the left is the most specific, and the part on the right is the most general. A given machine may have more than one Domain Name but a given Domain Name points to only one machine. For example, the domain names :

matisse.net

mail.matisse.net

workshop.matisse.net

can all refer to the same machine, but each domain name can refer to no more than one machine.

***E-mail* - (Electronic Mail)** — Messages, usually text, sent from one person to another via computer. E-mail can also be sent automatically to a large number of addresses (Mailing List).

Ethernet - A very common method of networking computers in a LAN. Ethernet will handle about 10,000,000 bits-per-second and can be used with almost any kind of computer.

***FTP* - (File Transfer Protocol)** - A very common method of moving files between two Internet sites. FTP is a special way to login to another Internet site for the purposes of retrieving and/or sending files. There are many Internet sites that have established publicly accessible repositories of material that can be obtained using FTP.

Gigabyte - 1000 or 1024 Megabytes, depending on who is measuring.

Host - Any computer on a network that is a repository for services available to other computers on the network. It is quite common to have one host machine providing several services, such as WWW and USENET.

***HTML* - (Hyper Text Markup Language)** - The coding language used to create Hypertext documents for use on the World Wide Web.HTML looks a lot like old fashioned typesetting code, where you surround a block of text with codes that indicate how it should appear. Additionally, in HTML one can specify that a block of text, or a word, is linked to another file on the Internet. HTML files are meant to be viewed using a World Wide Web client Program, such as Netscape Nevigator, Internet Explorer or Mosaic.

Internet - (**Upper case I)** The vast collection of inter-connected networks that all use the TCP/IP protocols and that evolved from the ARPANET of the late 60's and early 70's. The Internet now connects more than 70,000 independent networks into a vast global internet.

***internet -* (Lower case i)** Any time when 2 or more networks are connected together, one has an internet - as in international or inter-state.

Intranet - A private network inside a company or organization that uses the same kind of software that one would find on the public Internet, but that is only for internal use.

As the Internet has become more popular, many of the tools used on the Internet are being used in private networks. For example, many companies have web servers that are available only to employees.

Note that an Intranet may not actually be an internet — it may simply be a network.

***ISP* - (Internet Service Provider**) - An institution that provides access to the Internet in some form, usually for money. For example, in India, VSNL (Videsh Sanchar Nigam Limited) is the Internet Service Provider.

***Java* -** Java is a network-oriented programming language invented by Sun Microsystems that is specifically designed for writing programs that can be safely downloaded to one's computer through the Internet and immediately run without fear of viruses or other harm to one's computer or files. Using small Java programs (called "Applets"), Web pages can include functions such as animations, calculations, and other fancy tricks.

One can expect to see a huge variety of features added to the Web using Java, since a Java program can be written to do almost anything a regular computer program can do, and then include that Java program in a Web page.

Leased-line - Refers to a phone line that is rented for exclusive 24-hour, 7 days-a-week use from one location to another location. The highest speed data connections require a leased line.

***Login* -** Noun or a verb. Noun : The account name used to gain access to a computer system. Not a secret (contrast with Password).

Verb : The act of entering into a computer system.

Maillist - (or Mailing List) A (usually automated) system that allows people to send e-mail to one address, whereupon their message is copied and sent to all of the other subscribers to the maillist. In this way, people who have many different kinds of e-mail access can participate in discussions together.

***Mosaic* -** The first WWW browser that was available for the Macintosh, Windows, and UNIX, all with the same interface. Mossaic really started the popularity of the Web. The source-code to Mosaic has been licensed by several companies and there are several other pieces of software as good or better than Mosaic, most notably, Netscape.

Netscape - A WWW Browser and the name of a company. The Netscape browser was originally based on the Mosaic program developed at the National Center for Supercompting Applications (NCSA).

Netscape has grown in features rapidly and is widely recognized as the best and most popular web browser. Netscape Corporation also produces web server software.

Netscape provided major improvements in speed and interface over other browsers.

Node - Any single computer connected to a network.

Packet Switching - The method used to move data around on the Internet. In packet switching, all the data coming out of a machine is broken up into chunks, each chunk has the address of where it came from and where it is going. This enables chunks of data from many different sources to co-mingle on the same lines, and be sorted and directed to different routes by special machines along the way. This way many people can use the same lines at the same time.

***PPP* - (Point to Point Protocol)** — Most well known as a protocol that allows a computer to use a regular telephone line and a modem to make TCP/IP connections and thus be really and truly on the Internet.

Router - A special purpose computer (or software package) that handles the connection between 2 or more networks. Routers spend all their time looking at the destination addresses of the packets passing through them and deciding which route to send them on.

Server - A computer, or a software package, that provides a specific kind of service to client software running on other computers. The term can refer to a particular piece of software, such as a WWW server, or to the machine on which the software is running *e.g.,* Our mail server is down today, that's why e-mail isn't getting out. A single server machine could have several different server software packages running on it, thus providing many different servers to clients on the network.

***SQL* - (Structured Query Language)** — A specialized programming language for sending queries to databases.

***TCP/IP* - (Transmission Control Protocol/Internet Protocol)** — This is the suite of protocols that defines the Internet. Originally designed for the UNIX operating system, TCP/IP software is now available for every major kind of computer operating system. To be truly on the Internet, your computer must have TCP/IP software.

***URL* - (Uniform Resource Locator)** — The standard way to give the address of any resource on the Internet that is part of the World Wide Web (WWW). A URL looks like this :

http://www.icai.org/seminars.html

or telnet://well.sf.ca.in

or news:new.newusers.questions etc.

The most common way to use a URL is to enter into a WWW browser program, such as Netscape, or Lynx.

APPENDIX 1

COMPUTER ABBREVIATIONS

ACC	Accumulator
ACK	Acknowledge character
A/D	Analog to Digital
ADCCP	Advanced Data Communication Control Procedure
ADP	Automatic Data Processing
ALGOL	ALGOrithmic Language
ALU	Arithmetic/Logic Unit
AM	Amplitude Modulation or Accounting Machine or Access Mechanism
ANSI	American National Standards Institute
APDOS	Apple DOS Operating System
AP	Attached Processor
APL	A Programming Language
ASCII	American Standard Code for Information Interchange
ASR	Automatic Send and Receive
ATM	Automatic Teller Machine
AU	Arithmetic Unit
BASIC	Beginner's All-purpose Symbolic Instruction Code
BCD	Binary Coded Decimal
BCS	British Computer Society
BDOS	Basic Disk Operating System
BIT	Binary digit
BIOS	Basic Input/Output System

BMC	Bubble Memory Control
bps	bits per second
BPI	Bytes per Inch
BROM	Bipolar Read Only Memory
BSAM	Basic Sequential Access Method
BSC	Binary Synchronous Communications
CAD	Computer–Aided (Assisted) Design
CAD/CAM	Computer-Aided Design/Computer-Aided Manufacturing
CAFS	Contents Addressable File Store
CAI	Computer–Aided (Assisted) Instruction
CAL	Computer–Aided (Assisted) Learning
CAM	Computer–Aided (Assisted) Manufacturing or
	Content Addressed Memory
CASE	Computer–Aided Software Engineering
CAT	1. Computer–Aided (Assisted) Training
	2. Computer–Aided (Axial) Topography
CCD	Charge Coupled Device
CGA	Colour Graphics Adapter
CDAC	Centre for Development of Advanced Computing
CDROM	Computer Disk–Read Only Memory
CICS	Computer Information Control System
CILP	Computer Language Information Processing
CIM	Computer Input Microfilm
CMI	Computer Managed Instruction
CMOS	Complementary Metal Oxide Semiconductor
CML	Computer Managed Learning
CNC	Computer Numerical Control
COBOL	Common Business Oriented Language
CODASYL	Conference on Data System Languages

COM	Computer Output (Originated) Microfilm
COMAL	Common Algorithmic language
CORAL	Class Oriented Ring Associated Language
Cps	Characters per second
CP/M	Control Program for Microprocessor
CPU	Central Processing Unit
CROM	Control Read Only Memory
CRT	Cathode Ray Tube
CSI	Computer Society of India
DS/HD	Double Sided, high density
DS/DD	Double Sided, double density
DAD	Direct Access Devices
DASD	Direct Access Storage Device
DBMS	Data Base Management System
DBTG	Data Base Task Group (of CODASYL)
DCE	Data Communications Equipment
DDL	Data Description (or Definition) Language
DDP	Distributed Data Processing
DOS	Disk (based) Operating System
DP	Data Processing
DPI	Dots per inch
DTP	Desktop Publishing
DPM	Data Processing Manager
DPS	Data Processing System
DRO	Destructive Read Out
DSS	Decision Support System
EBCDIC	Extended Binary Coded Decimal Interchange Code
ECMA	European Computer Manufacturers' Association
ECOM	Electronic computer oriented mail

EDI	Electronic Data Interchange
EDS	Exchangeable Disk Store
EEPROM	Electrically Erasable Programmed Read Only Memory
EDP	Electronic Data Processing (equivalent to DP)
EFTS	Electronic Funds Transfer System
ENIAC	Electronic Numerical Integrator and Calculator
EPROM	Erasable Programmable Read Only Memory
FGCS	Fifth Generation Computer System
FEP	Front-End Processor
FORTRAN	Formula Translation
G	Giga-one thousand million (usually called 1 billion)
GB	Giga Bytes
GIGO	Garbage In/Garbage Out
GUI	Graphical User Interface
HIPO	Hierarchical Input/process/Output
HLL	High Level Language
Hz	Hertz
IBG	Inter Block Gap
IC	Integrated Circuit
IDP	Integrated Data Processing
IFIP	International Federation for Information Processing
IMPLE	Initial Micro Program Load
I/O	Input/Output
IOCS	Input/Output Control System
IPS	Instructions per second
ISAM	Index(ed) Sequential Access method
ISDN	Integrated Services Digital Network
ISO	International Standards Organisation
ISR	Information Storage Retrieval

JCL	Job Control Language
K	Kilo-1000 in decimal; 1024 (2^{10}) in binary system
KBS	Kilo-Bytes per second
LAN	Local Area Network
LAP	Link Access protocol
LCD	Liquid crystal Display
LED	Light Emitting Diode
LISP	LIST Processing
LSI	Large Scale Integration
MB	Mega bytes–1 million in decimal; 1,048, 576 (2^{20}) in binary system
MAR	Memory Address Register
MCI	Magnetic Character Inscriber
MDR	Memory Data Register
MICR	Magnetic Ink Character Recognition
MIPS	Millions of instructions per second
MIS	Management Information System (or Services)
MOS Chips	Metal Oxide Semiconductor chips
MPU	Micro-Processor Unit
MSI	Medium Scale Integration
MVS	Multiple Virtual Storage
NCC	National Computing Centre
NMOS	N-Channel Metal Oxide Semiconductor
NS	Nano Second
OCR	Optical Character Recognition (Reading)
OMR	Optical Mark Recognition (Reading)
OOF	Office of the Future
OOP	Object Oriented Programming

OS	Operating Systems
OPS	Operating per second
OSI	Open systems Interconnection
PABX	Private Automatic Branch exchange
PBX	Private Branch Exchange
PCB	Printed Circuit Board
PC	Personal Computer
POS	Point-of–Sale
PIN	Personal Identification Number
PL/1	Programming Language/1
PMOS	P-Channel Metal Oxide Semiconductor
PROLOG	Programming in LOGic
PROM	Programmable Read Only Memory
PSE	Packet Switched System
PSTN	Public Switched Telephone network
QBE	Query By Example
RAM	Random Access Memory
RCS	Realtime Communication System
RJE	Remote Job Entry
ROM	Read Only Memory
RPG	Report Program Generator
RTL	Real Time language
RDBMS	Relational Data Base Management Systems
SOP	Standard Operating Procedure
SIMULA	Simulation Language-an extension of ALGOL for Simulation LANGUAGE PROBLEMS
SNOBL	String Oriented Symbolic Languages
SNA	Systems Network Architecture
SQL	Structured Query Language

SSI	Small Scale Integration
TDM	Time Division Multiplexing
TPI	Tracks Per inch
TRS	Tandy Radio Shack
T/S	Time Sharing
TSS	Time Sharing System
TTY	Tele Typewriter
UG	User Group
UNIVAC	Universal automatic computer
VDU	Visual Display Unit
VAN	Value Added Network
VLDB	Very Large Data Base
VMOS	V-Channel Metal Oxide Semiconductor
VGA	Video Graphics Adapter
VLSI	Very Large Scale Integration
WAN	Wide Area Network
WORM	Write Once, Read Memory
WP	Word Processing

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SECTION : B

STRATEGIC MANAGEMENT

CHAPTER 1

BUSINESS ENVIRONMENT

LEARNING OBJECTIVES

- Understand the term business and its objectives.
- Know what are the factors that influence a business.
- Understand what is environmental analysis and why is it needed.
- Have a basic knowledge of various types of environment.
- Have an understanding of different micro-economic factors that are affecting business.
- Know the various macro-economic factors and how they are related to business.
- Understand the various components of the competitive environment.

Awareness of the environment is not a special project to be undertaken only when warning of change becomes deafening...

Kenneth R. Andrews

It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change.

Charles Darwin

1. INTRODUCTION

Each business organization operates in its unique environment. Environment influence businesses and also gets influenced by it. No business can function free of interacting and influencing forces that are outside its periphery. In the new economy the facets of business are rapidly changing as compared to earlier years. The development in technology and faster communication have lead to evolvement of newer kinds of businesses. The concept of businesses such as e-bay, rediff were non-existent in yesteryears. Businesses are conducted through internet and has lead to virtual shrinking of physical boundaries between nations.

2. BUSINESS

Etymologically the term business refers to the state of being busy for an individual, group, organization or society. The term is also interpreted as one's regular occupation or profession. In another sense, the term refers to a particular entity, company or corporation. It is also interpreted as a particular market sector such as the computer business. Thus the term is wide and amenable to different usages. A business for our purposes can be any activity consisting of purchase, sale, manufacture, processing, and/or marketing of products and/or services.

It is said that a business exists for profits. Profit, as a surplus of business, accrues to the owners. It is their share, just as wages are the share of workers. People invest in business for getting a return. It is a reward for risk taking, so far as the owners are concerned. As a motive, profit serves as a stimulant for business effort.

For business enterprises, profit is often regarded as the overall measure of performance. It is treated as a financial yardstick for measuring business efficiency and for evaluating managerial competence – how well the decisions and actions of managers turn out to be effective; how well they are able to combine and utilise resources and to sustain the enterprise as a going and a growing concern. Other things being equal, the higher the efficiency the greater is the level and volume of profit. Business efficiency is often expressed in terms of percentage of profit to sales volume, to capital employed, to market value of corporate shares and so on. Outside investors also equate profit with the degree of business efficiency and managerial competence and commit their funds in light of such equation and other related assessments.

Peter F Drucker has drawn two important conclusions about what is a business that are useful for an understanding of the term business.

- The first thing about a business is that it is created and managed by people. There will be a group of people who will take decisions that will determine whether an organization is going to prosper or decline, whether it will survive or will eventually perish. This is true of every business.
- The second conclusion drawn is that the business cannot be explained in terms of profit. The economic criterion of maximising profits for a firm has little relevance in the present times. Profit maximization, in simple terms is selling at a higher price than the cost. Profit maximization has been qualified with the long-term perspective and has been modified to include development of wealth, to include several non-financial factors such as goodwill, societal factors, relations and so on.

3. OBJECTIVES OF A BUSINESS

A business has some purpose. A valid purpose of business is to create customers. It is for the businesses to create a customer or market. A purpose of business is that business exists to create customers. It is the customer who determines what a business is. The customer is the foundation of business and keeps it in existence. A still broader view of business purpose is that business exists and functions for catering to the material needs and requirements of society, within the framework of general considerations of social interest. Business is society's organ of economic expansion, growth and change.

Enterprises pursue multiple objectives rather than a single objective. In general, we may identify a set of business objectives pursued by a large cross-section of enterprises. These relate to profitability, productive efficiency, growth, technological dynamism, stability, self-reliance, survival, competitive strength, customer service, financial solvency, product quality, diversification, employee satisfaction and welfare, and so on. Enterprises seek to balance these objectives in some appropriate manner. We may now elaborate some of the more important objectives of business

- **Survival:** Survival is the will and anxiety to perpetuate into the feature as long as possible. It is a basic, implicit objective of most organizations. While survival is an obvious objective, it gains more value and prominence during the initial stage of the establishment of the enterprise and during general economic adversity. The ability to survive is a function of the nature of ownership, nature of business competence of management, general and industry conditions, financial strength of the enterprise and so on. However, business and other enterprises are interested in more than mere survival.

- **Stability:** One of the most important of objectives of business enterprises is stability. It is a cautious, conservative objective. In a sense, stability is a least expensive and risky objective in terms of managerial time and talent and other resources. A stable and steady enterprise minimises managerial tensions and demands less dynamism from managers. It is a strategy of least resistance in a hostile external environment.

- **Growth:** This is a promising and popular objective which is equated with dynamism, vigour, promise and success. Enterprise growth may take one or more of the forms like increase in assets, manufacturing facilities, increase in sales volume in existing products or through new products, improvement in profits and market share, increase in manpower employment, acquisition of other enterprises and so on. Growth may take the enterprise along relatively unknown and risky paths, full of promises and pitfalls.

- **Efficiency:** Business enterprise seek efficiency in rationally choosing appropriate means to achieve their goals, doing things in the best possible manner and utilising resources in a most suitable combination to get highest productivity. In a sense, efficiency is an economic version of the technical objective of productivity – designing and achieving suitable input output ratios of funds, resources, facilities and efforts. Efficiency is a very useful operational objective.

- **Profitability:** It is generally asserted that private enterprises are primarily motivated by the objective of profit. Some may go even further and emphasise that profit is the sole motive of business enterprises. All other objectives are facilitative objectives and are meant to be subservient to the profit motive. It is pointed out that private business enterprises are operated on behalf of and for the benefit of the owners who have assumed the business risk of investing their funds.

4. ENVIRONMENTAL INFLUENCES ON BUSINESS

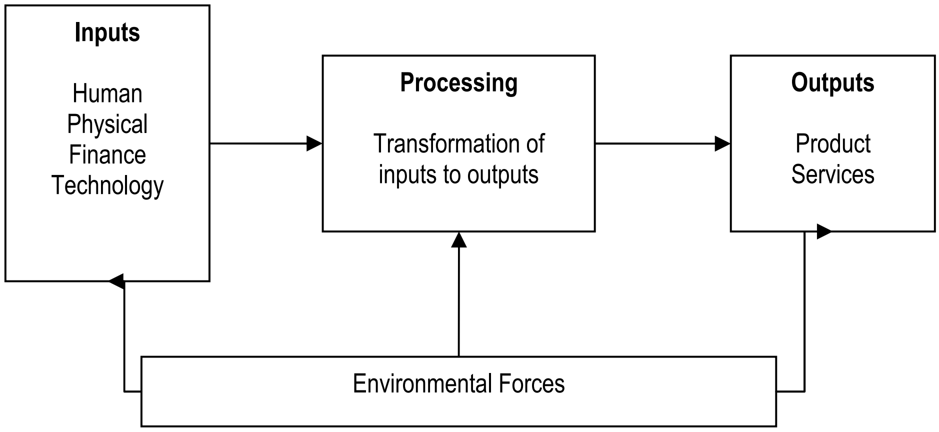
All living creatures including human beings live within an environment. Apart from the natural environment, environment of humans include family, friends, peers and neighbours. It also includes man-made structures such as buildings, furniture, roads and other physical infrastructure. The individuals do not live in a vacuum. They continuously interact with their environment to live their lives.

Just like human beings, business also does not function in an isolated vacuum. Businesses function within a whole gambit of relevant environment and have to negotiate their way through it. The extent to which the business thrives depends on the manner in which it interacts with its environment. A business which continually remains passive to the relevant changes in the environment is destined to gradually fade-away in oblivion. To be successful business has to not only recognise different elements of the environment but also respect, adapt to or have to manage and influence them. The business must continuously monitor and adapt to the environment if it is to survive and prosper. Disturbances in the environment may spell extreme threats or open up new opportunities for the firm. A successful business has to identify, appraise, and respond to the various opportunities and threats in its environment.

Environment is sum of several external and internal forces that affect the functioning of business. According to Barry M. Richman and Melvyn Copen "Environment factors or constraint are largely if not totally, external and beyond the control of individual industrial enterprises and their managements. These are essentially the 'givers' within which firms and their managements must operate in a specific country and they vary, often greatly, from country to country." A strategist looks on the environment as posing threats to a firm or offering immense opportunities for exploitation. Stressing this aspect, Glueck and Jauch wrote: "The environment includes factors outside the firm which can lead to opportunities for or threats to the firm. Although there are many factors, the most important of the sectors are socio-economic, technological, supplier, competitors, and government. "

Business functions as a part of broader environment. The inputs in the form of human, physical, financial and other related resources are drawn from the environment. The business converts these resources through various processes into outputs of products and/or services. The latter are partly exchanged with the external client groups, say customers. The exchange process brings in some surplus (or profits, reputation, good public image and so on) to the business, which could be stored and used for further development and growth.

Different organizations use different inputs, adopt different processes and produce different outputs. For example, an educational institution produces literate people. A hospital provides health and medical services. Organizations depend on the external environment for the inputs required by them and for disposing of their outputs in a mutually beneficial manner. The input-output exchange activity is a continuous process and calls for an active interaction with the external environment.



4.1 Problems in understanding the environmental influences

In trying to understand the environment, managers face different problems as follows:

- The environment encapsulates many different influences; the difficulty is in making sense of this diversity in a way which can contribute to strategic decision-making. Listing all conceivable environmental influences may be possible, but it may not be of much use because no overall picture emerges of really important influences on the organization.
- The second difficulty is that of uncertainty. Managers typically claim that the pace of technological change and the speed of global communications mean more and faster change now than ever before. Whether or not change is in fact faster now than hitherto, and whether or not the changes are more unpredictable, it remains the case that, while it is important to try to understand future external influences on an organization, it is very difficult to do so.
- Managers are no different from other individuals in the way they cope with complexity. They tend to simplify such complexity by focusing on aspects of the environment, which, perhaps, have been historically important, or confirm prior views. These are not perverse managerial behaviours; they are the natural behaviour of everyone faced with complexity. Arguably, one of the tasks of the strategic manager is to find ways & means to break out

of oversimplification or bias in the understanding of their environment, while still achieving a useful and usable level of analysis.

4.2 Framework to understand the environmental influences

In spite of the problems in understanding business environment, organizations can not ignore it. We will make an attempt to identify a framework for understanding the environment of organizations. This will help in identifying key issues, find ways of coping with complexity and also assist in challenging managerial thinking.

- Firstly, it is useful to take an initial view of the nature of the organizations environment in terms of how uncertain it is. Is it relatively static or does it show signs of change, and in what ways? Is it simple or complex to comprehend? This helps in deciding what focus the rest of the analysis is to take.
- The next step might be the auditing of environmental influences. Here the aim is to identify which of the many different environmental influences are likely to affect the organization's development or performance. This is done by considering the way in which political, economic, social and technological influences have a bearing on organizations. It is increasingly useful to relate such influences to growing trends towards globalization of industries. It may also be helpful to construct pictures - or scenarios - of possible futures, to consider the extent to which strategies might need to change.
- The final step is to focus more towards an explicit consideration of the immediate environment of the organization - for example, the competitive arena in which the organization operates. In competitive environment we will study five forces analysis *(discussed later in the chapter)* that aims to identify the key forces at work in the immediate or competitive environment and why they are significant. There should be an attempt to understand why the forces are of strategic significance. It is also required to analyse the organization's competitive position: that is, how it stands in relation to those other organizations competing for the same resources, or customers, as itself.

5. WHY ENVIRONMENTAL ANALYSIS?

When the company ceases to adjust the environment to its strategy or does not react to the demands of the environment by changing its strategy, the result is reduced achievement of corporate objectives. From environmental analysis strategists get time to anticipate opportunities and to plan to take optional responses to these opportunities. It also helps strategists to develop an early warning system to prevent threats or to develop strategies which can turn a threat to the firm's advantage. It is clear that because of the difficulty to assessing the future, not all future events can be anticipated. But some can and are. To the extent that some or most are anticipated by this analysis and diagnosis, managerial decisions are likely to be better. And the process reduces the time pressures on the few which are not anticipated. Thus, the managers can concentrate on these few instead of having to deal with all the environmental influences.

In general, environmental analysis has three basic goals as follows:

- *First,* the analysis should provide an understanding of current and potential changes taking place in the environment. It is important that one must be aware of the existing environment. At the same time one must have a long term perspective about the future too.
- *Second,* environmental analysis should provide inputs for strategic decision making. Mere collection of data is not enough. The information collected must be useful for and used in strategic decision making.
- *Third,* environment analysis should facilitate and foster strategic thinking in organizations-typically a rich source of ideas and understanding of the context within which a firm operates. It should challenge the current wisdom by bringing fresh viewpoints into the organization.

"Positive trends in the environment breed complacency. That underscores a basic point: in change there is both opportunity and challenge". - Clifton Garvin

6. CHARACTERISTICS OF BUSINESS ENVIRONMENT

Business environment exhibits many characteristics. Some of the important – and obvious – characteristics are briefly described here.

- **Environment is complex:** the environment consists of a number of factors, events, conditions and influences arising from different sources. All these do not exist in isolation but interact with each other to create entirely new sets of influences. It is difficult to comprehend at once the factors constituting a given environment. All in all, environment is a complex that is somewhat easier to understand in parts but difficult to grasp in totality.
- **Environment is dynamic:** the environment is constantly changing in nature. Due to the many and varied influences operating, there is dynamism in the environment causing it to continuously change its shape and character.
- **Environment is multi-faceted:** What shape and character an environment assumes depends on the perception of the observer. A particular change in the environment, or a new development, may be viewed differently by different observers. This is frequently seen when the same development is welcomed as an opportunity by one company while another company perceives it as a threat.
- **Environment has a far reaching impact:** The environment has a far reaching impact on organizations. The growth and profitability of an organization depends critically on the environment in which it exists. Any environment change has an impact on the organization in several different ways.

7. COMPONENTS OF BUSINESS ENVIRONMENT

The environment in which an organization exists could be broadly divided into two parts *the external* and *the internal* environment. Since the environment is complex, dynamic, multi-faceted and has a far reaching impact, dividing it into external and internal components enables us to understand it better. Here we deal with the appraisal of the external environment. This is done through a description of important characteristics of the environment, dividing the environment into its external and internal parts, observing how a systematic approach can help in environmental appraisal, and classifying the external environment into two parts, the general and the relevant environment. Next, we see how the external environment can be divided into different components.

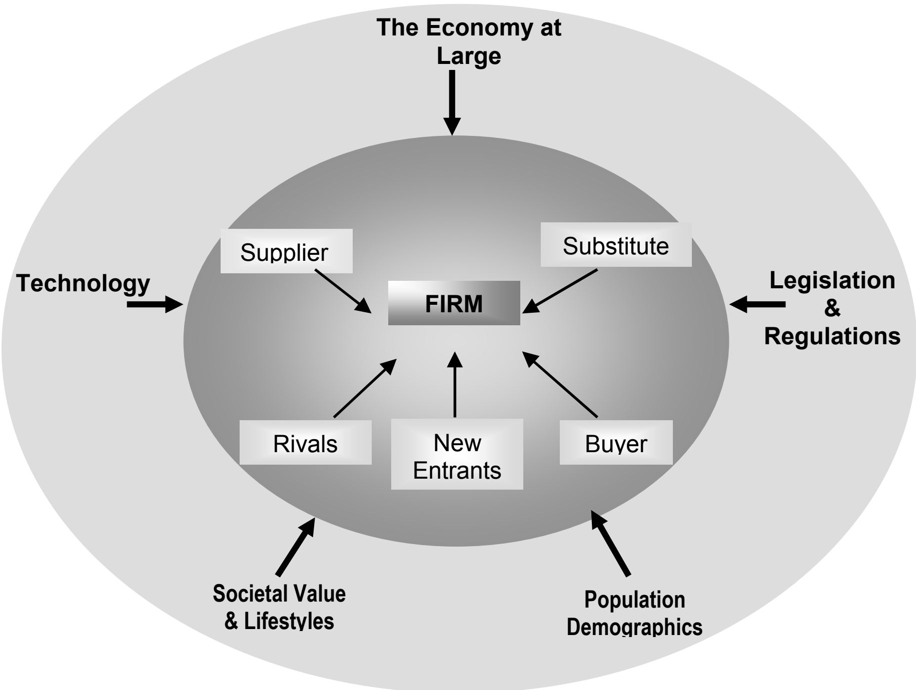


*Figure: A Company's Business Environment*The *external environment* (Macro Environment) includes all the factors outside the organization which provide opportunity or pose threats to the organization. The *internal environment* (Micro Environment) refers to all the factors within an organization which impart strengths or cause weaknesses of a strategic nature.

The environment in which an organization exists can, therefore, be described in terms of the opportunities and threats operating in the external environment apart from the strengths and weaknesses existing in the internal environment. The four environmental influences could be described as follows:

- *An opportunity* is a favourable condition in the organization's environment which enables it to consolidate and strengthen its position. An example of an opportunity is growing demand for the products or services that a company provides.
- *A threat* is an unfavourable condition in the organization's environment which creates a risk for, or causes damage to, the organization. An example of a threat is the emergence of strong new competitors who are likely to offer stiff competition to the existing companies in an industry.
- *A strength* is an inherent capacity which an organization can use to gain strategic advantage over its competitors. An example of a strength is superior research and development skills which can be used for new product development so that the company gains competitive advantage.
- *A weakness* is an inherent limitation or constraint which creates a strategic disadvantage. An example of a weakness is over dependence on a single product line, which is potentially risky for a company in times of crisis.

An understanding of the external environment, in terms of the opportunities and threats, and the internal environment, in terms of the strengths and weaknesses, is crucial for the existence, growth and profitability of any organization.

A systematic approach to understanding the environment is the SWOT analysis. Business firms undertake *SWOT analysis* to understand the external and internal environment. SWOT, which is the acronym for *strengths, weaknesses, opportunities and threats.* Through such an analysis, the strengths and *weaknesses* existing within an organization can be matched with the opportunities and threats operating in the environment so that an effective strategy can be formulated. An effective organizational strategy, therefore, is one that capitalises on the opportunities through the use of strengths and neutralises the threats by minimizing the impact of weaknesses. The process of strategy formulation starts with, and critically depends on, the appraisal of the external and internal environment of an organization. We will learn more about SWOT analysis in the third chapter.

8. RELATIONSHIP BETWEEN ORGANIZATION AND ITS ENVIRONMENT

In relation to the individual corporate enterprise, the external environment offers a range of opportunities, constraints, threats and pressures and thereby influences the structure and functioning of the enterprise. As a sub-system, the corporate enterprise draws certain inputs of resources, information and values from the larger environmental system, transforms them into outputs of products, services, goals and satisfactions and exchanges with or transmits them into the external environment. In the process, it generates energy and sustains itself.

The relationship between the organization and its environment may be discussed in terms of interactions between them in several major areas which are outlined below:

- *Exchange of information*: The organization scans the external environmental variables, their behaviour and changes, generates important information and uses it for its planning, decision-making and control purposes. Much of the organizational structure and functioning is attuned to the external environmental information. Information generation is one way to get over the problems of uncertainty and complexity of the external environment. Information is to be generated on economic activity and market conditions, technological developments, social and demographic factors political-governmental policies and postures, the activities of other organizations and so on. Both current and projected information is important for the organization.

  Apart from gathering information, the organization itself transmits information to several external agencies either voluntarily, inadvertently or legally. Other organizations and individuals may be interested in the organization and its functioning and hence approach the organization for information. It is also possible to glean information from the behaviour of the organization itself, from its occasional advertisements, and from annual reports. Also, the organization may be legally or otherwise bound to supply information on its activities to governmental agencies, investors, employees, trade unions, professional bodies and the like.

- *Exchange of resources*: The organization receives inputs—finance, materials, manpower, equipment etc., from the external environment through contractual and other arrangements. It sustains itself by employing the above inputs for involving or producing output of products and services. The organization interacts with the factor markets for purposes of getting its inputs; it competes sometimes and collaborates sometimes with other organizations in the process of ensuring a consistent supply of inputs.

  The organization is dependent on the external environment for disposal of its output of products and services to a wide range of clientele. This is also an interaction process—perceiving the needs of the external environment and catering to them, satisfying the expectations and demands of the clientele groups, such as customers, employees, shareholders, creditors, suppliers, local community, general public and so on. These groups tend to press on the organization for meeting their expectations, needs and demands and for upholding their values and interests.

- *Exchange of influence and power*: Another area of organizational-environmental interaction is in the exchange of power and influence. The external environment holds considerable power over the organization both by virtue of its being more inclusive as also by virtue of its command over resources, information and other inputs. It offers a range of opportunities, incentives and rewards on the one hand and a set of constraints, threats and restrictions on the other. In both ways, the organization is conditioned and constrained. The external environment is also in a position to impose its will over the organization and can force it to fall in line. Governmental control over the organization is one such power relationship. Other organizations, competitors, markets, customers, suppliers, investors etc., also exercise considerable collective power and influence over the planning and decision making processes of the organization.

In turn, the organization itself is sometimes in a position to wield considerable power and influence over some of the elements of the external environment by virtue of its command over resources and information. The same elements which exercise power over the organization are also subject to the influence and power of the organization in some respects. To the extent that the organization is able to hold power over the environment it increases its autonomy and freedom of action. It can dictate terms to the external forces and mould them to its will.

In delineating the relationship between the organization and the environment, one has to be clear on the diversity of both these entities. On the one hand, the nature of relationship depends on the size of the organization, its age, the nature of business, the nature of ownership, degree of professionalization of management, etc. On the other hand, the relationship depends on the fact whether the external environmental elements behave in a random or structured manner (uncertainty *v.* predictability), whether such elements are placid or turbulent, whether they are slow-changing or fast changing, whether they are simple or complex, and so forth. The degree of interaction between the organization and the external environment is set by the above characteristics. It follows therefore that all organizations do not behave in the same way in relation to their external environment. Their structures and functions are shaped in tune with the demands of the external environment.

9. THE MICRO AND MACRO ENVIRONMENT

The environment of business can be categorised into two broad categories micro-environment and macro-environment. Micro-environment is related to small area or immediate periphery of an organization. Micro-environment influences an organization regularly and directly. Within the micro or the immediate environment in which a firm operates we need to address the following issues:

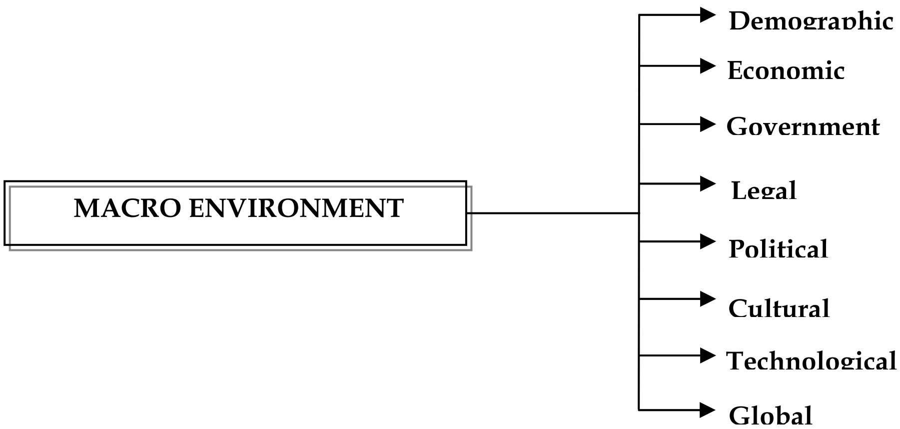
- The employees of the firm, their characteristics and how they are organised.
- The customer base on which the firm relies for business.
- The ways in which the firm can raise its finance.
- Who are the firms suppliers and how are the links between the two being developed?
- The local community within which the firm operates.
- The direct competition and how they perform.

This last point might act as a convenient linking point as we move towards the macro issues influencing the way a firm reacts in the market place. Macro environment has broader dimensions. It mainly consist of economic, technological, political legal and socio-cultural. The issues concerning an organization are:

- Who are their threats in the competitive world in which they operate and why?
- Which areas of technology might pose a threat to their current product range and why?
- The bargaining power of suppliers and customers?
- The type of competition they are facing and their perceived threats and weaknesses?

The classification of the relevant environment into components or sectors helps an organization to cope with its complexity, comprehend the different influences operating, and relating the environmental changes to its strategic management process. Different bases for classification have been adopted. As already discussed earlier there are two types of environmental forces, which influences an organizations business operation. Some of these forces are external to the firm and the organization has little control over them. Whereas the other types of forces which comes from within the organization and can be controlled by it. Hence, the business environment can be divided into two major components:

Macro Environment: consists of demographics and economic conditions, socio-cultural factors, political and legal systems, technological developments, etc. These constitute the general environment, which affects the working of all the firms.



Micro environment: consist of suppliers, consumers, marketing intermediaries, etc. These are specific to the said business or firm and affects it's working on short term basis.

MICRO ENVIRONMENT

- Consumer/Customer
- Competitors
- Organization
- Market
- Suppliers
- Intermediaries

Environmental Scanning

Environmental scanning also known as Environmental Monitoring is the process of gathering information regarding company's environment, analysing it and forecasting the impact of all predictable environmental changes. Successful marketing depends largely on how a company can synchronise its marketing programmes with its environmental changes.

10. ELEMENTS OF MICRO ENVIRONMENT

This is also known as the task environment and affects business and marketing in the daily operating level. When the changes in the macro environment affect business in the long run, the effect micro environmental changes are noticed immediately. Organizations have to closely analyse and monitor all the elements of micro environment in order to stay competitive.

10.1 Consumers/Customers

According to Peter Drucker the aim of business is to create and retain customer. Customers are the people who pay money to acquire an organization's products. The products may be both in form of goods or services. The organizations cannot survive without customers. They will cease to exist. Customers may or may not be a consumer. Consumer is the one who ultimately consumes or uses the product or service. A father may buy a product as a customer for his daughter who will be a consumer. A consumer occupies the central position in the marketing environment. The marketer has to closely monitor and analyse changes in consumer tastes and preferences and their buying habits.

- Who are the customers/consumers?
- What benefits are they looking for?
- What are their buying patterns?

10.2 Competitors

Competitors are the other business entities that compete for resources as well as markets. Competition shapes business. A study of the competitive scenario is essential for the marketer, particularly threats from competition. Following are a few of major questions that may be addressed for analysing competitions:

- Who are the competitors?
- What are their present strategy and business objective?
- Who are the most aggressive and powerful competitors?

Competition may be direct or indirect. Direct competition is between organizations, which are in same business activity. At the same time competition can also be indirect. For example, competition between a holiday resort and car manufacturing company for available discretionary income of affluent customers is indirect competition.

10.3 Organization

Individuals occupying different positions or working in different capacities in organizations consists of individuals who come from outside. They have different and varied interests. In micro environment analysis, nothing is important as self-analysis by the organization itself. Understanding its own strengths and capabilities in a particular business, i.e., understanding a business in depth should be the goal of firm's internal analysis. The objectives, goals and resource availabilities of a firm occupy a critical position in the micro environment.

"*We have met the enemy and he is us*" - Pogo.

An organization has several non-specific elements of the organization's surroundings that may affect its activities. These consists of specific organizations or groups that are likely to influence an organization. These are:

- *Owners:* They are individuals, shareholders, groups, or organizations who have a major stake in the organization. They have a vested interest in the well-being of the company.
- *Board of directors:* Board of directors are found in companies formed under the Companies Act, 1956. The board of directors is elected by the shareholders and is charged with overseeing the general management of the organization to ensure that it is being run in a way that best serves the shareholders' interests.
- *Employees:* Employees are the people who actually do the work in an organization. Employees are the major force within an organization. It is important for an organization that employees embrace the same values and goals as the organization. However, they differ in beliefs, education, attitudes, and capabilities. When managers and employees work toward different goals everyone suffers.

10.4 Market

The market is larger that customers. The market is to be studied in terms of its actual and potential size, its growth prospect and also its attractiveness. The marketer should study the trends and development and the key success factors of the market he is operating. Important issues are :

- Cost structure of the market.
- The price sensitivity of the market.
- Technological structure of the market.
- The existing distribution system of the market.
- Is the market mature?

10.5 Suppliers

Suppliers form an important component of the micro environment. The suppliers provide raw materials, equipment, services and so on. Large companies rely on hundreds of suppliers to maintain their production. Suppliers with their own bargaining power affect the cost structure of the industry. They constitute a major force, which shapes competition in the industry. Also organizations have to take a major decision on "outsourcing" or "in-house" production depending on this supplier environment.

10.6 Intermediaries

Intermediaries exert a considerable influence on the business organizations. They can also be considered as the major determining force in the business. In many cases the consumers are not aware of the manufacturer of the products they buy. They buy product from the local retailers or big departmental stores such as Big bazaars, Subhiksha and Vishal Mega Mart that are increasingly becoming popular in some big cities.

11. ELEMENTS OF MACRO ENVIRONMENT

Macro environment is explained as one which is largely external to the enterprise and thus beyond the direct influence and control of the organization, but which exerts powerful influence over its functioning. The external environment of the enterprise consists of individuals, groups, agencies, organizations, events, conditions and forces with which the organization comes into frequent contact in the course of its functioning. It establishes interacting and interdependent relations, conducts transactions, designs and administers appropriate strategies and policies to cope with fluctuations therein and otherwise negotiates its way into the future.

11.1 Demographic environment

The term demographics denotes characteristics of population in a area, district, country or in world. It includes factors such as race, age, income, educational attainment, asset ownership, home ownership, employment status and location. Data with respect to these factors within a demographic variable, and across households, are of interest, to businessmen in addition to economist. Marketers and other social scientists often group populations into categories based on demographic variables. Some of the demographic factors have great impact on the business. Factors such as general age profile, sex ratio, education, growth rate affect the business with different magnitude. India has relatively younger population as compared to some countries. China on the other hand is having an aging population. Many multinationals are interested in India considering its population size. With having approximately sixteen percent of the world's population, the country holds huge potential for overseas companies.

Business Organizations need to study different demographic factors. Particularly, they need to address following issues:

- What demographic trends will affect the market size of the industry?
- What demographic trends represent opportunities or threats?

The business, as such, is concerned with a population's size, age structure, geographic distribution, ethnic make-up, and distribution of income. While each of the major elements of discussed below, the challenge for strategists is to determine what the changes, that have been identified in the demographic characteristics or elements of a population, imply for the future strategic competitiveness of the company. We will briefly discuss a few factors that are of interest to a business.

(i) *Population Size:* While population size itself, large or small, may be important to companies that require a "critical mass" of potential customers, changes in the specific make-up of a population's size may have even more critical implications. Among the most important changes in a population's size are:

- Changes in a nation's birth rate and/or family size;
- Increases or declines in the total population;
- Effects of rapid population growth on natural resources or food supplies.

Changes in a nation's population growth rate and life expectancy can have important implications for companies. Are people living longer? What is the life expectancy of infants? There will be implications for the health care system (for companies serving that segment) and for the development of products and services targeted at older (or younger) population.

(ii) *Geographic Distribution:* Population shifts from one region of a nation to another or from non-metropolitan to metropolitan areas may have an impact on a company's strategic competitiveness. Issues that should be considered include:

- The attractiveness of a company's location may be influenced by governmental support.
- Companies may have to consider relocation if population shifts have a significant impact on the availability of a qualified workforce.
- The concepts of working-at-home and commuting electronically on the information highway have also started in India in an very small level. These may imply changes in recruiting and managing the workforce.

(iii) *Ethnic Mix:* This reflects the changes in the ethnic make-up of a population and has implications both for a company's potential customers and for the workforce. Issues that should be addressed include:

- What do changes in the ethnic mix of the population imply for product and service design and delivery?
- Will new products and services be demanded or can existing ones be modified?
- Managers prepared to manage a more culturally diverse workforce?
- How can the company position itself to take advantage of increased workforce heterogeneity?

(iv) Income Distribution: Changes in income distribution are important because changes in the levels of individual and group purchasing power and discretionary income often result in changes in spending (consumption) and savings patterns. Tracking, forecasting, and assessing changes in income patterns may identify new opportunities for companies

11.2 Economic environment

The economic environment refers to the nature and direction of the economy in which a company competes or may compete. The economic environment includes general economic situation in the region and the nation, conditions in resource markets (money market, manpower market, raw material components, services, supply markets and so on) which influence the supply of inputs to the enterprise, their costs, quality, availability and reliability of supplies.

Economic environment determines the strength and size of the market. The purchasing power in an economy depends on current income, prices, savings, circulation of money, debt and credit availability. Income distribution pattern determines the marketing possibilities. The important point to consider is to find out the effect of economic prospect and inflation on the operations of the firms. Strategists must scan, monitor, forecast, and assess a number of key economic factors mentioned in the table below for both domestic and key international markets.

Key Economic Factors

♦ Shift to a service economy	♦ Availability of credit
♦ Level of disposable income	♦ Propensity of people to spend
♦ Interest rates	♦ Inflation rates
♦ Tax rates	♦ Money market rates
♦ Government budget deficits	♦ Gross national product trend
♦ Consumption patterns	♦ Trade Block Formations
♦ Demand shifts for different categories of goods and services	♦ Income differences by region and consumer groups
♦ Price fluctuations	♦ Worker productivity levels
♦ Global movement of labour and capital	♦ Monetary & Fiscal policies
♦ Stock market trends	♦ Foreign countries' economic conditions
♦ Import/export factors	♦ Company of Petroleum Exporting Countries (OPEC) policies
♦ Coalitions of Countries/ Regional blocks	♦ Unemployment trends

11.3 Political-Legal Environment

This is partly general to all similar enterprises and partly specific to an individual enterprise. It includes such factors as the general state of political development, the degree of politicalization of business and economic issues, the level of political morality, the law and order situation, political stability, the political ideology and practices of the ruling party, the purposefulness and efficiency of governmental agencies, the extent and nature of governmental intervention in the economy and the industry, Government policies (fiscal, monetary, industrial, labour and export-import policies), specific legal enactments and framework in which the enterprise has to function and the degree of effectiveness with which they are implemented, public attitude towards business in general and the enterprise in particular and so on. There are three important elements in political-legal environment.

(i) **Government**: Business is highly guided and controlled by government policies. Hence the type of government running a country is a powerful influence on business: A strategist has to consider the changes in the regulatory framework and their impact on the business.

Taxes and duties are other critical area that may be levied and affect the business. For example, introduction of Fringe benefits Tax has major impact on the business.

(ii) **Legal:** Business Organizations prefer to operate in a country where there is a sound legal system. However, in any country businesses must have a good working knowledge of the major laws protecting consumers, competitions and organizations. Businesses must understand the relevant laws relating to companies, competition, intellectual property, foreign exchange, labour and so on.

(iii) **Political:** Political pressure groups influence and limit organizations. Apart from sporadic movements against certain products, service and organizations, politics has deeply seeped into unions. Also special interest groups and political action committees put pressure on business organizations to pay more attention to consumer's rights, minority rights, and women rights.

11.4 Socio-Cultural environment

This is too general an entity which influence almost all enterprises in a similar manner. It is a complex of factors such as social traditions, values and beliefs, level and standards of literacy and education, the ethical standards and state of society, the extent of social stratification, conflict and cohesiveness and so forth.

Socio-cultural environment consist of factors related to human relationships and the impact of social attitudes and cultural values which has bearing on the business of the organization. The beliefs, values and norms of a society determine how individuals and organizations should be interrelated. The core beliefs of a particular society tend to be persistent. It is difficult for businesses to change these core values, which becomes a determinant of its functioning.

Some of the important factors and influences operating in this environment are:

- Social concerns, such as the role of business in society, environmental pollution, corruption, use of mass media, and consumerism.
- Social attitudes and values, such as expectations of society from business, social customs, beliefs, rituals and practices, changing lifestyle patterns, and materialism.
- Family structure and changes in it, attitude towards and within the family, and family values.
- Role of women in society, position of children and adolescents in family and society.
- Educational levels, awareness and consciousness of rights, and work ethics of members of society.

The social environment primarily affects the strategic management process within the organization in the areas of mission and objective setting, and decisions related to products and markets.

11.5 Technological environment

The most important factor, which is controlling and changing people's life, is technology. Technology has literally created wonder. Man could realise its dream of walking in the moon, traveling in spaceships, and go to the other side of the globe within few hours. They have already started dreaming of living of very extended life of hundreds years with the latest development of genetic sciences and technology.

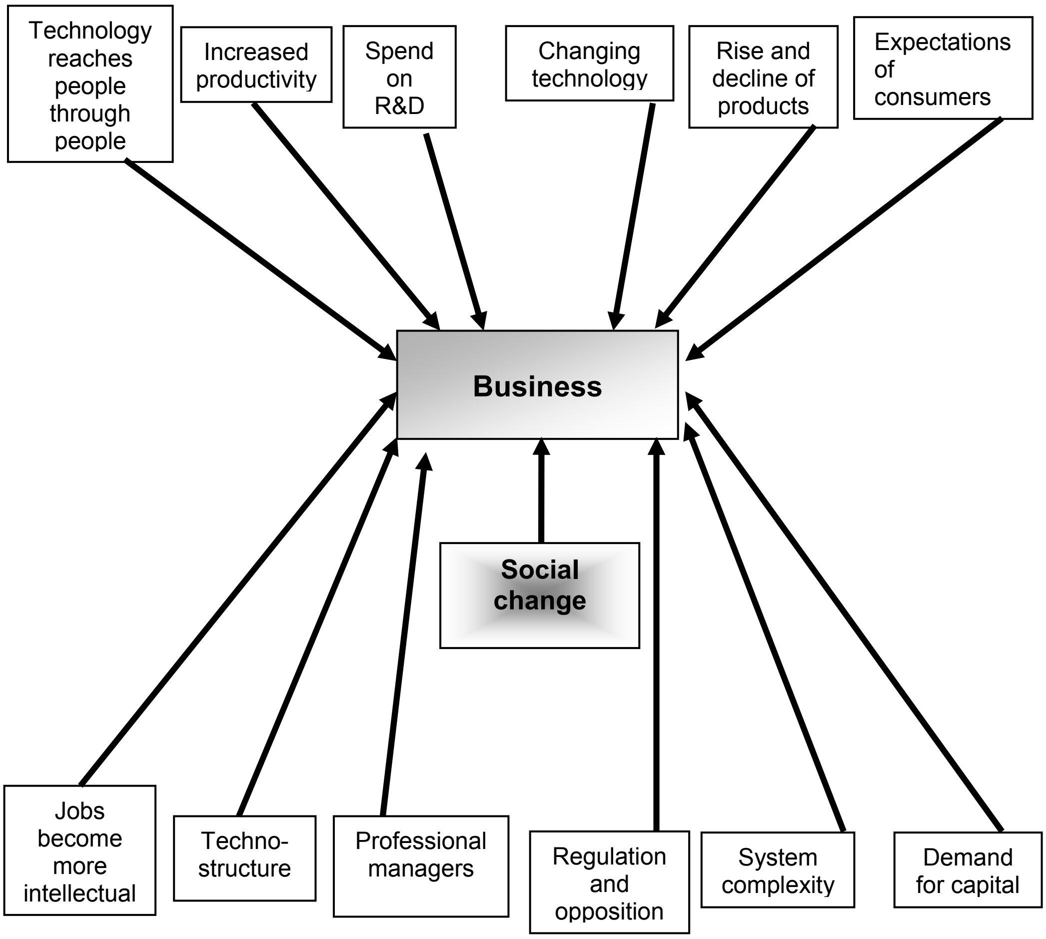


Figure: Interference between Business & Technology

Technology has changed the way people communicate with the advent of Internet and telecommunication system. Technology has changed the ways of how business operates now. This is leading to many new business opportunities as well as making obsolete many existing systems. The following factors are to be considered for the technological environment:

- The pull of technological change.
- Opportunities arising out of technological innovation.
- Risk and uncertainty of technological development.
- Role of R&D in a country and government's R&D budget.

Technology can act as both opportunity and threat to a business. It can act as opportunity as business can take advantage of adopting technological innovations to their strategic advantage. However, at the same time technology can act as threat if organisations are not able to adopt it to their advantage. For example, an innovative and modern production system can act as threat if the business is not able to change their production system. New entrants can always use availability of technological improvements in products or production methods that can be a threat to a business.

Technological opportunities and threats are not limited to the product or production. Technology permeates whole gambit of business. It can transform how a business acts and functions.

The technology and business are highly interrelated and interdependent also. The fruits of technological research and development are available to society through business only and this also improves the quality of life of the society. Hence, technology is patronized by business. Then again technology also drives business and makes a total change on how it is carried out. The interface between business and technology is explained in the figure: Interface between Business & Technology. Important technology-related issues that might affect a broad variety of companies include:

- Access to the "information highway" through the Internet which may enable large numbers of employees to work from home or provide strategists with access to richer sources of information,
- Business-to-business sales and exchanges,
- Providing customers with access to online shopping through the Internet.

For example, Dell Computer Corporation reduces its paperwork flow, schedules its payments more efficiently, and is able to coordinate its inventories efficiently and effectively by using the capabilities of the Internet. This helps to eliminate/reduce paperwork, flatten companies, and shrink time and distance, thus capturing a competitive premium for the company. Because the technological aspects are so important, some of the key questions that can be asked in assessing the technological environment are given below.

- What are the technologies {both manufacturing and information technologies} used by the company?
- Which technologies are utilised in the company's business, products, or their parts?
- How critical is each technology to each of these products and businesses?
- Which external technologies might become critical and why? Will they remain available outside the company?
- What has been the investment in the product and in the process side of these technologies? For the company and for its competitors? Design? Production? Implementation and service?
- What are the other applications of the company's technologies? In which applications does the company currently participate and why? In which applicating does the company does not participate and why?
- Which technological investments should be curtailed or eliminated?
- What additional technologies will be required in order to achieve the current corporate business objectives? .
- What are the implications of the technology and business portfolios for corporate strategy?

11.6 Global environment

Today's competitive landscape requires that companies must analyse global environment as it is also rapidly changing. The new concept of global village has changed how individuals and organizations relate to each other. Further, new migratory habits of the workforce as well as increased offshore operation are changing the dynamics of business operation. Among the global environmental factors that should be assessed are:

- Potential positive and negative impact of significant international events such as a sport meet or a terrorist attack.
- Identification of both important emerging global markets and global markets that are changing. This includes shifts in the newly industrialised countries in Asia that may imply the opening of new markets for products or increased competition from emerging globally competitive companies in countries such as South Korea and China.

- Differences between cultural and institutional attributes of individual global markets.

Due to economic reforms, Indian businessmen are also out to see beyond the physical boundaries of the country. The Indian companies are acquiring business in different countries. The need to think and act from global perspective is universal. For a long time businessmen everywhere believed that home markets were adequate and safe. They never felt the need to explore the overseas markets in a big way. "If they could pick up some extra sales through exporting, these businessmen were more than satisfied. The scenario is different now. The companies are increasingly interested in globalising.

Nature of Globalization

Globalization means several things for several people. For some it is a new paradigm - a set of fresh beliefs, working methods, and economic, political and socio-cultural realities in which the previous assumptions are no longer valid. For developing countries, it means integration with the world economy. In simple economic terms, globalization refers to the process of integration of the world into one huge market. Such unification calls for removal of all trade barriers among countries. Even political and geographical barriers become irrelevant

At the company level, globalization means two things: (a) the company commits itself heavily with several manufacturing locations around the world and offers products in several diversified industries, and (b) it also means ability to compete in domestic markets with foreign competitors.

A company which has gone global is called a multinational (MNC) or a transnational (TNC). An MNC is, therefore, one that, by operating in more than one country gains *R&D,* production, marketing and financial advantages in its costs and reputation that are not available to purely domestic competitors. The global company views the world as one market, minimises the importance of national boundaries, sources, raises capital and markets wherever it can do the job best.

To be specific, a global company has three characteristics:

- It is a conglomerate of multiple units (located in different parts of the globe) but all linked by common ownership.
- Multiple units draw on a common pool of resources, such as money, credit, information, patents, trade names and control systems.
- The units respond to some common strategy. Nestle International is an example of an enterprise that has become multinational. It sells its products in most countries and manufactures in many. Besides, its managers and shareholders are also based in different nations.

A further development, perhaps, will be the *super-national enterprise.* It is a worldwide enterprise chartered by a substantially non-political international body such as IMF or World Bank. It operates as a private business without direct obligations. Its function is international business service, and it remains viable only by performing that service adequately for nations which permit its entry. With its integrative view, it should be able to draw the economic world closer together. It could serve all nations without being especially attached to anyone of them.

Why do companies go global?

There are several reasons why companies go global. These are discussed as follows:

- One reason could be the rapid shrinking of time and distance across the globe thanks to faster communication, speedier transportation, growing financial flows and rapid technological changes.
- It is being realised that the domestic markets are no longer adequate and rich. Japanese have flooded the U.S. market with automobiles and electronics because the home market was not large enough to absorb whatever was produced. Some European companies have gone global for similar reason.
- According to Raymond Vernon companies that develop attractive new products sell them first in their home markets. Sooner or later, foreigners may learn about these products. At this stage, most companies would export the product or service rather than produce it abroad. But as foreign demand grows, the economics of foreign production change. Eventually, the foreign market becomes large enough to justify foreign investment.
- Another reason for going overseas may also vary by industry. Petroleum and mining companies often go global to secure a reliable or cheaper source of raw-materials. Some manufacturing companies, by contrast, have often ventured overseas to protect old markets or to seek new ones. For example cheap labour in India lure foreign investors.
- Companies often set up overseas plants to reduce high transportation costs. The higher the ratio of the unit cost to the selling price per unit, the more significant the transportation factor becomes.
- The motivation to go global in high-tech industries is slightly different. Companies in electronics and telecommunications must spend large sums on research and development for new products and thus may be compelled to seek ways to improve sales volume to support high overhead expenses. If domestic sales and exports do not generate sufficient cash flow, the companies naturally might look to overseas manufacturing plants and sales branches to generate higher sales and better cash flow.

The following developments are also responsible for transnational operation of companies.

- Increasing emphasis on market forces and a growing role for the private sector in nearly all developing countries;

- Rapidly changing technologies that are transforming the nature, organization, an location of international production;
- The globalization of firms and industries;
- The rise of services to constitute the largest single sector in the world economy; and regional economic integration, which has involved both the world's largest economies as well as select developing countries.

Manifestation of globalization

Globalization manifests itself in many ways. important of them are:

- **Configuring anywhere in the world:** An MNC can locate its different operations in different countries on the basis of raw material availability, consumer markets and low-cost labour.
- **Interlinked and independent economies:** In terms of economic-welfare, globalization refers to the unique economically interdependent international environment. Each country's prosperity is interlinked with the rest of the world. No nation can any longer hope to lead an existence of solitude and isolation in which only domestic industries can function.
- **Lowering of trade and tariff barriers:** The apparent and real collapse of international trade barriers proposes a new global cooperative arrangement and a redefinition of roles of state and industry. The trend is towards increased privatization of manufacturing and services sectors, less government interference in business decisions and more dependence on the value-added sector to gain market place competitiveness. World over, governments are pulling out from commercial business. The trade tariffs and custom barriers are getting lowered, resulting in cheaper and abundant supply of goods.
- **Infrastructural resources and inputs at International prices:** Infrastructural inputs must be ensured at competitive prices, if the companies were to compete globally. The advantages of cheap labour (and other inputs) evaporate in the face of continuous inflation and high infrastructural costs.
- **Increasing trend towards privatization:** Governments are everywhere withdrawing from owning and running business enterprises. Private entrepreneurs are given greater access and freedom to run business units. The role of government is reduced to the provider of infrastructure for private business to prosper.

- **Entrepreneur and his unit have a central economic role:** In the emerging world order, the entrepreneur and his unit become central figures in the process of economic growth and development of a nation. Given the right environment, businesses are able to innovate, bring in new products, and contribute to nation's wealth. For the risk he takes and efforts he puts in, the businesses are rewarded with profits. Related to this is the viability of the business unit. Only firms which are cost effective and quality oriented survive and prosper. Weak and marginal firms die their natural death.

- **Mobility of skilled resources:** Skilled labour was once considered to be the decisive factor in plant location and even in determining comparative advantage of a nation. Not any more. Skilled labour is highly mobile. Modern factories use highly skilled labour which is freely mobile. Where labour is unskilled, managements are spending vast sums of money to train workers become skilled in their jobs. Besides labour, other factors of production (land and capital) are also mobile. A developing country which is long on land and short on capital can invite foreign investment and make good the deficiency. Similarly, a developed country which is long on capital and short on land can use a developing country as a base for its manufacturing operations.

  Thus, the traditional factors of production, viz., land, labour and capital, are no more immobile or restricted for usage with. They are transferable from any part of the world to any other part of the globe. The entire world has become a global village.

- **Market-side efficiency:** Integration of global markets implies that costs, quality processing time, and terms of business become dominant competition drivers. Customers can make a genuine choice of products and services on the basis of maximum value for money. The exclusive markets which were once enjoyed are no longer available to a firm. The inexorable pressure of technology and need for its integration means that customers no longer have to be satisfied with shoddy products and services provided by the state monopolies.

- **Formation of regional blocks:** A final corollary to globalization is the formation of trade blocks. The reasons for forming such blocks are obvious. Countries, like corporations, have to form strategic alliances to ward off economic and technological threats and leverage their respective comparative and competitive advantages. The signing of NAFTA (North American Free Trade Area) among N. America, Canada, and Mexico creates new markets and manufacturing opportunities for these countries and threatens to disrupt the plans and strategies of world powers such as Japan. Similarly formation of European Union and ASEAN affects the World trade balance.

India is part of South Asian Association for Regional cooperation (SAARC). SAARC consist of seven South Asian Countries with Bangladesh, Bhutan, Maldives, Nepal, Pakistan and Sri Lanka as its members in addition of India. SAARC endevours to accelerate economic growth in the Region. It also strives for social progress and cultural development in the region, promotion of active collaboration and mutual assistance in the economic, social, cultural, technical and scientific fields and strengthening of cooperation among the member states in the International forums on matters of common interest.

12. STRATEGIC RESPONSES TO THE ENVIRONMENT

The business organization and its many environments have innumerous interrelationship that at times, it becomes difficult to determine exactly where the organization ends and where its environment begins. It is also difficult to determine exactly what business should do in response to a particular situation in the environment. Strategically, the businesses should make efforts to exploit the opportunity ad thought the threats.

In this context following approaches may be noted:

(i) **Least resistance:** Some businesses just manage to survive by way of coping with their changing external environments. They are simple goal-maintaining units. They are very passive in their behaviour and are solely guided by the signals of the external environment. They are not ambitious but are content with taking simple paths of least resistance in their goal-seeking and resource transforming behaviour.

(ii) **Proceed with caution:** At the next level, are the businesses that take an intelligent interest to adapt with the changing external environment. They seek to monitor the changes in that environment, analyse their impact on their own goals and activities and translate their assessment in terms of specific strategies for survival, stability and strength. They regard that the pervasive complexity and turbulence of the external environmental elements as 'given' within the framework of which they have to function as adaptive-organic sub-systems. This is an admittedly sophisticated strategy than to wait for changes to occur and then take corrective-adaptive action.

(iii) **Dynamic response:** At a still higher sophisticated level, are those businesses that regard the external environmental forces as partially manageable and controllable by their actions. Their feedback systems are highly dynamic and powerful. They not merely recognise and ward off threats; they convert threats into opportunities. They are highly conscious and confident of their own strengths and the weaknesses of their external environmental 'adversaries'. They generate a contingent set of alternative courses of action to be picked up in tune with the changing environment.

Shaping external environment

How far is it possible for organizations to actively shape their relevant environments is an critical question? Can human organizations ever become such super-powerful entities? Is total environmental control and command worth the cost? What are the self-defeating elements in such an approach? Admittedly, the very dominating behaviour of command organizations may generate powerful countervailing pressures and forces in the environment. It should be remembered that the external environment in larger and more inclusive than the individual organization; presumably the former commands more resources and its interests and values are much broader than those of the latter.

A innovative and autonomous organization generates its own constraints. It is not above the rule of law and logic of the external environment. Within certain limits, such an organization can shape part of its relevant external environment on a reciprocal basis.

13. COMPETITIVE ENVIRONMENT

The essence of strategy formulation is coping with competition. Although competition makes organizational working difficult, intense competition is neither a coincidence nor bad luck. All organizations have competition. Multinationals and large organizations clash directly on every level of product and service. Mid-sized and small business also chase same customers and find that prices and product quality are bounded by the moves of their competitors. Even large public sector monopolies are gradually getting privatised and facing competition. The monopolies enjoyed by the Bharat Sanchar Nigam Ltd and Mahanagar Telephone Nigam Ltd have faded away after entry of private players. For a single business organization the competition spells out freedom of entry and exit in the market and affects its prices and scale of operations

The benefit of competition are also enjoyed by the society and the markets in which organisations operate. The customers are able to get products at lower costs and better quality. They get better value of their money because of competition.

The nature and extent of competition that a business is facing in the market is one of the major factors affecting the rate of growth, income distribution and consumer welfare. Businesses have to consider competitors' strategies, profits levels, costs, products and services when preparing and implementing their business plans.

While formulating strategies, organizations have to separately identify and concentrate on the competitors who are significantly affecting the business. Lesser attention may be given to smaller competitors who have little or no impact the business. There can be several competitors vying to satisfy same needs of customers. Competition is not necessarily restricted to same product or services. Coke and Pepsi may be obvious competitors. At the same time they have to compete with other companies such as Hindustan Lever Ltd whose Kisan squashes will be directed towards same needs. They have to also compete with natural juices such as Real.

A better understanding of the nature and extent of competition may be reached by answering the following questions:

(i) Who are the competitors?

(ii) What are their product and services?

(iii) What are their market shares?

(iv) What are their financial positions?

(v) What gives them cost and price advantage?

(vi) What are they likely to do next?

(vii) Who are the potential competitors?

Cooperation in a Competitive Environment: In economics we study oligopoly, wherein a small number of only manufactures/sellers of a product may join together to have monopolistic behaviour. An example of oligopoly can be Organization of the Oil Exporting Countries (OPEC), which is collective group of nations extracting and exporting oil. Its aim according to its Statute, is 'the coordination and unification of the petroleum policies of member countries and the determination of the best means for safeguarding their interests, individually and collectively; ways and means of ensuring the stabilization of prices in international oil markets with a view to eliminating harmful and unnecessary fluctuations. The cooperation in organizations forming *cartels* (a term used to define the groups in oligopoly) may be in form of deciding market shares, prices and profits. It is not necessary that the organizations form explicit cartels as they may have tacit arrangements not known to general public.

The cooperation may also be witnessed in highly competitive business environment. Tata and Fiat have arrangements in relations to cars. Such cooperation is not necessarily restricted to the organizations producing or dealing in same product or services. They may identify some common interest for cooperation between them. A cold drink manufacture may enter into arrangement with a chain of restaurants to offer its beverages to the clients of restaurants. Lately, various credit card companies are entering into arrangements with other businesses to launch co-branded credit cards. Such arrangements help in reaching greater number of customers.

The benefits of cooperation are also seen in Japan, where large cooperative networks of businesses are known as *kieretsus*. These are formed in order to enhance the abilities of individual member businesses to compete in their respective industries. A *kieretsu* is a loosely-coupled group of companies, usually in related industries. *Kieretsu* members are peers and may own significant amounts of each other's stock and have many board members in common. However, they are different from conglomerates (Common in western countries and also found in India) wherein all members are lineated through ownership pattern. A *kieretsu* also differs from a consortium or an association, as the primary purpose of a *kieretsu* is not to share information or agree industry standards, but to share purchasing, distribution or any other functions. In *Kieretsu* members remain independent companies in their own right: the only strategy they have in common is to prefer to do business with other *kieretsu* members, both when buying and when selling.

Cooperation on account of family ownership: Theoretically, cooperation generates automatically in businesses owned by a same family. The ownership, groups are engaged in the management of their enterprise in a direct manner. Commonly, the ownership group is nothing but a family and its kith and kin. In India, a very large number of business enterprises, big, medium and small, are family-managed enterprises. These include large business houses such as Tata, Birla, Godrej, Reliance, Modi, Escorts and *et al*. Major decisions and sometimes even minor decisions are made by members of the family who manage the enterprise. The interests of the family largely influence the managerial decisions and activities of the enterprise. There is a total identity between the needs and goals of the family and of the enterprise.

Sometimes, quarrels and conflicts among the managing members of the family on family matters tend to distort their behaviour in managing the enterprise also and thereby damage its functioning. Succession remains a tricky and conflicting issue in businesses. Be it the Ambanis of Reliance Industries, the Bajajs of Bajaj Auto, the Nandas of Escorts, or the Modis of Modi Rubber - each family has, in the recent past, faced succession and ownership issues and found them tough to resolve. However, one can count several counter examples of family-run businesses that have resolved these issues amicably. The Murugappa Group in the South, the Burmans of Dabur India and the Thapars have settled succession issues without coming into the public eye.

14. PORTER'S FIVE FORCES MODEL - COMPETITIVE ANALYSIS

To gain a deep understanding of a company's industry and competitive environment, managers do not need to gather all the information they can find and waste a lot of time digesting it. Rather, the task is much more focused. Thinking strategically about a company's competitive environment entails using some well defined concepts and analytical tools.

The character, mix, and subtleties of competitive forces are never the same from one industry to another. A powerful and widely used tool for systematically diagnosing the significant competitive pressures in a market and assessing the strength and importance of each is the *five-forces model of competition.(see figure)* This model holds that the state of competition in an industry is a composite of competitive pressures operating in five areas of the overall market:

- Competitive pressures associated with the market manoeuvring and jockeying for buyer patronage that goes on among *rival sellers* in the industry.
- Competitive pressures associated with the threat of *new entrants* into the market.
- Competitive pressures coming from the attempts of companies in other industries to win buyers over to their own *substitute products.*
- Competitive pressures stemming from *supplier* bargaining power and supplier-seller collaboration.

♦ Competitive pressures stemming from *buyer* bargaining power and seller-buyer Collaboration.

The way one uses the five-forces model to determine what competition is like in a given industry is to build the picture of competition in three steps:

Step 1: Identify the specific competitive pressures associated with each of the five forces.

Step 2: Evaluate how strong the pressures comprising each of the five forces are (fierce, strong, moderate to normal, or weak).

Step 3: Determine whether the collective strength of the five competitive forces is conducive to earning attractive profits.

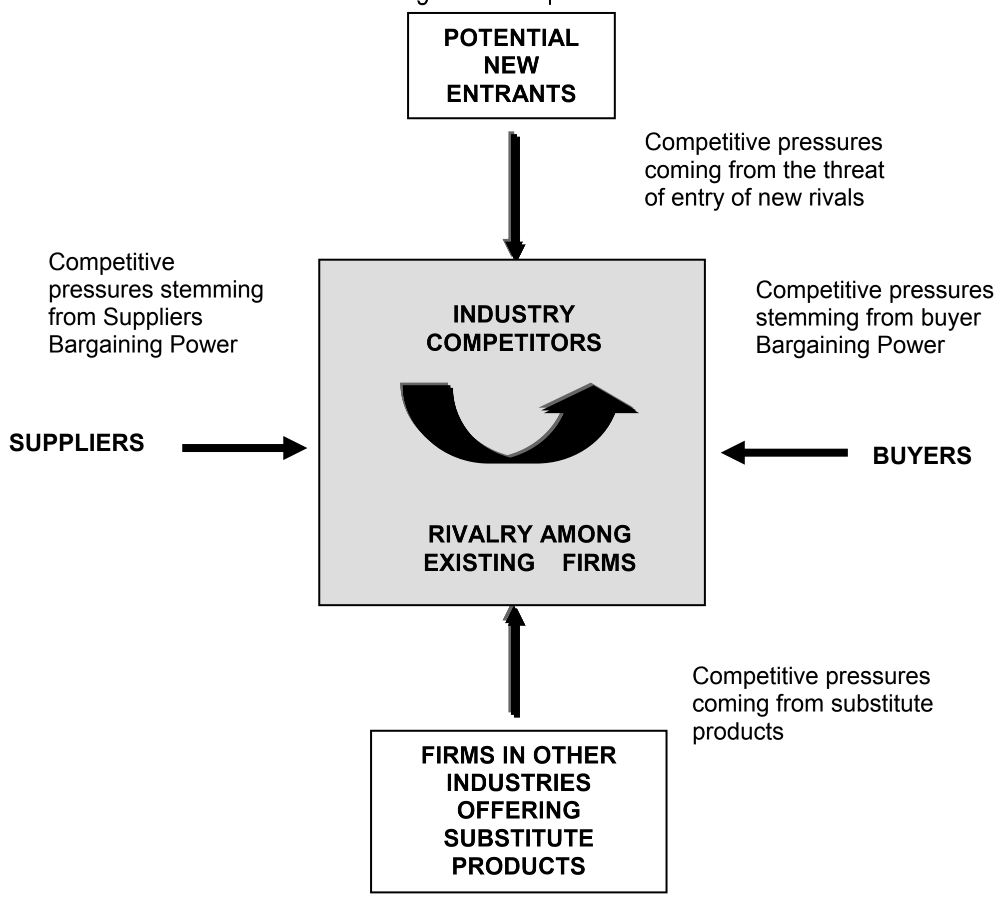


Figure: The Five Force model of Competition

Threat of new entrants: New entrants are always a powerful source of competition. The new capacity and product range they bring in throw up new competitive pressure. And the bigger the new entrant, the more severe the competitive effect. New entrants also place a limit on prices and affect the profitability of existing players.

Bargaining power of customers: This is another force that influences the competitive condition of the industry. This force will become heavier depending on the possibilities of the buyers forming groups or cartels. Mostly, this is a phenomenon seen in industrial products. Quite often, users of industrial products come together formally or informally and exert pressure on the producer in matters such as price, quality and delivery. Two top CDMA service providers Reliance and Tata Teleservices had put a simultaneous pressure on Qualcomm to reduce the royalties on the CDMA based handsets.

Such a collusion on the part of buyers can be a major force in some industries. The bargaining power of the buyers influences not only the prices that the producer can charge but also influences in many cases, costs and investments of the producer because powerful buyers usually bargain for better services which involve costs and investment on the part of the producer.

Bargaining power of suppliers: Quite often suppliers, too, exercise considerable bargaining power over companies. The more specialised the offering from the supplier, greater is his clout. And, if the suppliers are also limited in number they stand a still better chance to exhibit their bargaining power. The bargaining power of suppliers determines the cost of raw materials and other inputs of the industry and, therefore, industry attractiveness and profitability.

Rivalry among current players: The rivalry among existing players is an idea that can be easily understood. This is what is normally understood as competition. And it is obvious that for any player, the competitors influence prices as well as the costs of competing in the industry, in production facilities product development, advertising, sales force, etc.

Threats from substitutes: Substitute products are a latent source of competition in an industry. In many cases they become a major constituent of competition. Substitute products offering a price advantage and/or performance improvement to the consumer can drastically alter the competitive character of an industry. And they can bring it about all of a sudden. For example, coir suffered at the hands of synthetic fibre. Wherever substantial investment in R&D is taking place, threats from substitute products can be expected. Substitutes, too, usually limit the prices and profits in an industry.

So, in addition to existing rivals or competitors proper, forces such as new entrants, customers, suppliers, and substitutes have all to be viewed as forces governing competition in the industry. A firm has to give due weightage to each of these forces as a fight can emerge from any quarter.

The five forces together determine industry attractiveness/profitability. This is so because these forces influence the causes that underlie industry attractiveness/profitability. For example, elements such as cost and investment needed for being a player in the industry decide industry profitability, and all such elements are governed by these forces. The collective strength *of* these five competitive forces determines the scope to earn attractive profits. The strength *of* the forces may vary from industry to industry as also within a given

SELF-EXAMINATION QUESTIONS

Multiple Choice Questions

1. All are elements of micro environment except:
   - (a) Consumer.
   - (b) Suppliers.
   - (c) Competitors.
   - (d) Society.
2. All are elements of macro environment except:
   - (a) Society.
   - (b) Government.
   - (c) Competitors.
   - (d) Technology.
3. Select the correct statement out of the following:
   - (a) Environmental factors are totally beyond the control of a single industrial enterprise.
   - (b) Environmental factors are largely beyond the control of a single industrial enterprise.
   - (c) Environmental factors are totally within the control of a single industrial enterprise.
   - (d) None of the above.

4. In response to the changes in the environment organizations in general should:

   (a) Understand the impact of changes on the strategy and make appropriate modifications.

   (b) Make efforts that changes are reverted back so that organizations can function smoothly.

   (c) Ignore the changes.

   (d) None of the above.

5. Read the following three statements:

   (i) The environment is constantly changing in nature

   (ii) Various environmental constituents exist in isolation and do not interact with each other.

   (iii) The environment has a far reaching impact on organizations.

   From the combinations given below select an alternative that represent statements that are true:

   (a) (i) and (ii).

   (b) (ii) and (iii)

   (c) (i) and (iii)

   (d) (i), (ii) and (iii)

6. Under Porters five forces new entrants are ________ source of competition.

   (a) Significant

   (b) Marginal

   (c) Insignificant

   (d) Infinite

7. Which environmental factor regulates the values and beliefs, traditions and customs of society?

   (a) Political-legal factor

   (b) Technological factor

   (c) Economic factor

   (d) Socio-cultural factor

Objective Type Questions

State with reasons which of the following statements are correct/incorrect:

(a) According to Peter F Drucker businesses exist for making profits.

(b) Society within which a company operates is part of its micro environment.

(c) Competitors are part of macro environment of an organisation.

(d) The environment is constantly changing.

(e) Various environmental constituents exist in isolation and do not interact with each other.

(f) Businesses function in an isolated manner.

(g) Under porters five forces new entrants are insignificant source of competition.

Short answer Questions

1. What is a kieretsus?
2. What is demographic environment of business?
3. Write a short note on micro environment.

Essay type Questions

1. Do you advocate that organizations should concern themselves with the elements of its outside world? Why?
2. Discuss the relations between organizations and their external environment? How organizations strategically respond to their environment?
3. What do you mean by micro and macro environment?
4. Briefly discuss various elements of macro environment.
5. What is competitive environment? Discuss the five forces driving industry competition as given by Porter.

Case Study

Information technology (IT) exports from the Software Technology Park in Sohanpur in Uttar Pradesh has increased from Rs 1005 crore to Rs 1455 crore in the last five years. To further this growth and discuss the common issues various IT professionals of different companies assembled for a meeting. Their agenda included discussion on the issues relevant for the development of the technology park and available opportunities in IT industry for companies planning to set up IT and processing businesses in Sohanpur.

It was felt by a few persons that the absence of an airport and availability of uninterrupted round the clock power supply were major hurdles towards the development of the park. The nearest airport is 600 km away in New Delhi.

One of the participant highlighted the importance of world-class telecommunication facilities in the area. He felt that the telecommunications technology in the region is primitive and is not able to meet the present needs of the region. He also spoke at length about the problems of frequent job changes by present youth. He highlighted that a major problem is lack of patience in the young generation of IT professionals. He said retention was a major problem in Sohanpur as professional also preferred bigger cities. He suggested that the IT businesses should get together to create a conducive working climate for retention as well as growth.

Read the above case and answer the following questions:

(1) List out different environmental factors for a new entrepreneur who wants to start a new IT project in the Technology park. Segregate them as positive and negative.

(2) What is importance of an Airport in the city? Discuss.

(3) Suggest how manpower issues can be dealt by the businesses in the park.

Answers – Multiple Choice Questions

1. (d), **2.** (c), **3.** (b), **4.** (a), **5.** (c), **6.** (c), **7.** (d)

CHAPTER 2

BUSINESS POLICY AND STRATEGIC MANAGEMENT

LEARNING OBJECTIVES

- Learn what business policy and strategy is all about.
- Know the framework and importance of strategic management.
- Know the strategic management process.
- Have an understanding of corporate vision and mission.
- Learn how strategy operates at different levels of the organization.

Without a strategy the organization is like a ship without a rudder.

Joel Ross and Michael Kami

Strategic management is not a box of tricks or a bundle of techniques. It is analytical thinking and commitment of resources to action.

Peter Drucker

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1. INTRODUCTION

This chapter introduces the concept of business policy and strategic management. With the increased competition, the management of business has acquired strategic dimension. All professionals, including the chartered accountants, working towards growth of their businesses must possess sound knowledge of strategic management. Business policy and strategic management are highly intertwined.

2. BUSINESS POLICY AS A DISCIPLINE

The origins of business policy can be traced back to 1911, when Harvard Business School introduced an integrative course in management aimed at the creation of general management capability. This course was based on interactive case studies which had been in use at the school for instructional purposes since 1908. The course was intended to enhance general managerial capability of students. However, the introduction of business policy in the curriculum of business schools / management institutes came much later. In 1969, the American Assembly of Collegiate Schools of Business, a regulatory body for business schools, made the course of business policy, a mandatory requirement for the purpose of recognition. During the next few decades, business policy as a course spread to different management institutes across different nations and become an integral part of management curriculum. Basically, business policy is considered as a capstone, integrative course offered to students who have previously been through a set of core functional area courses. The term 'Business Policy' has been traditionally used though new titles for the course have begun to be introduced in recent years.

According to Glueck, development in business policy arose from the use of planning techniques by managers. Starting from day-to-day planning in earlier times, managers tried to anticipate the future through preparation of budgets and using control systems like capital budgeting and management by objectives. With the inability of these techniques to adequately emphasize the role of future, long-range planning came to be used. Soon, long-range planning was replaced by strategic planning, and later by strategic management:, a term that is currently used to describe the process of strategic decision making.

Business policy, as defined by Christensen and others, is "the study of the functions and responsibilities of senior management, the crucial problems that affect success in the total enterprise, and the decisions that determine the direction of the organization and shape its future. The problems of policy in business, like those of policy in public affairs, have to do with the choice of purposes, the moulding of organizational identity and character, the continuous definition of what needs to be done, and the mobilization of resources for the attainment of goals in the face of competition or adverse circumstance.

Business Policy tends to emphasise on the rational-analytical aspect of strategic management. It presents a framework for understanding strategic decision making. Such a framework enables a person to make preparations for handling general management responsibilities.

3. MEANING AND THE NATURE OF MANAGEMENT

To understand strategic management to be studied later, we need to have a basic understanding of the term management The term ‘management’ can be used in two major contexts.

(a) It is used with reference to a key up-group in an organisation. In relation to an organisation, management is the chief organ entrusted with the task of making it a purposeful and productive entity, by undertaking the task of bringing together and integrating the disorganised resources of manpower, money, materials, and technology into a functioning whole. An organisation becomes a unified functioning system when management systematically mobilises and utilises the diverse resources.

Management is a critical variable and a vital sub-system in an organisation. The survival and success of an organisation depend to a large extent on the competence and character of management. Management has to also facilitate organisational change and adaptation. It has to also work for resolution of organisational conflicts.

(b) It is also used with reference to a set of interrelated functions and processes, to a field of study or discipline in social sciences and to a vocation or profession. The functions and processes of management are wide-ranging but closely inter-related. They range all the way from design of the organisation, determination of the goals and activities, mobilisation and acquisition of resources, allocation of tasks and resources among the personnel and activity units. They also include adoption of certain techniques, tools and methods for carrying on activities, through articulation of skills and efforts of organisational personnel in a unified manner and installation of communication and control systems to ensure that what is planned is achieved.

Management refers to an integrated set of functions and processes designed to initiate and unify group effort in a meaningful manner directed towards pursuing certain goals. It is in this context we will study strategic management later. Management involves mobilisation and utilisation of physical human and other needed resources in judicious manner through certain skills, techniques, and activities.

A wide range of definitions of management exist in the literature on management. Here we shall cite the definitions of a few theorists :

Peter Drucker: Management is a function, a discipline, a task to be done, and managers practise this discipline, carry out the functions and discharge these tasks.

Dalton McFarland: Management is the process by which managers create, direct, maintain and operate purposive organisations through systematic, co-ordinated an co-operative human effort.

Management is an influence process to make things happen, to gain command over phenomena, to induce and direct events and people in a particular manner. Influence is backed by power, competence, knowledge and resources. Influence is not unilateral but multilateral. Managers formulate their goals, values and strategies, partly autonomously, to cope with, to adapt and to adjust themselves with the behaviour and changes of the environment.

4. WHAT IS A STRATEGY

A typical dictionary will define the word strategy as something that has to do with war and deception of an enemy. In business organizational context the term is not much different. Businesses have to respond to a dynamic and often hostile environment for pursuit of their mission. Strategy seeks to relate the goals of the organization to the means of achieving them. A company's strategy is the game plan management is using to stake out market position, conduct its operations, attract and please customers, compete successfully, and achieve organizational objectives.

A company's strategy consists of the combination of competitive moves and business approaches that managers employ to please customers, compete successfully and achieve organizational objectives. We may define 'strategy' as a long range blueprint of an organization's desired image, direction and destination what it wants to be, what it wants to do and where it wants to go. Following other definitions are also important to understand the term:

Igor H. Ansoff	:	The common thread among the organization's activities and product-markets that defines the essential nature of business that the organization was or planned to be in future.
William F. Glueck	:	A unified, comprehensive and integrated plan designed to assure that the basic objectives of the enterprise are achieved.

Strategy is consciously considered and flexibly designed scheme of corporate intent and action to achieve effectiveness, to mobilise resources, to direct effort and behaviour, to handle events and problems, to perceive and utilise opportunities, and to meet challenges and threats to corporate survival and success. In corporate strategy, the set of goals has a system of priorities; the combination, the sequence and the timing of the moves, means and approaches are determined in advance, the initiative and responses have a cogent rationale behind them, are highly integrated and pragmatic; the implications of decisions and action programmes are corporate wide, flexible and contingent.

The very injection of the idea of strategy into business organizations is intended to unravel complexity and to reduce uncertainty of the environment. To the extent the term strategy is associated with unified design and action for achieving major goals, gaining command over the situation with a long-range perspective and securing a critically advantageous position. Its implications for corporate functioning are obvious.

Strategy is meant to fill in the need of organizations for a sense of dynamic direction, focus and cohesiveness. Objectives and goals alone do not fill in the need. Strategy provides an integrated framework for the top management to search for, evaluate and exploit beneficial opportunities, to perceive and meet potential threats and crises, to make full use of resources and strengths, to offset corporate weaknesses and to make major decisions in general. Top management operates in an environment of partial ignorance and uncertainty.

In general, a corporate strategy has the following characteristics:

- It is generally long-range in nature, though it is valid for short-range situations also and has short-range implications.
- It is action oriented and is more specific than objectives.
- It is multipronged and integrated.
- It is flexible and dynamic.
- It is formulated at the top management level, though middle and lower level managers are associated in their formulation and in designing sub-strategies.
- It is generally meant to cope with a competitive and complex setting.
- It flows out of the goals and objectives of the enterprise and is meant to translate them into realities.
- It is concerned with perceiving opportunities and threats and seizing initiatives to cope with them. It is also concerned with deployment of limited organizational resources in the best possible manner.
- It gives importance to combination, sequence, timing, direction and depth of various moves and action initiatives taken by managers to handle environmental uncertainties and complexities.
- It provides unified criteria for managers in function of decision making.

Strategies are meant to fill in the need of enterprises for a sense of direction, focus and coherent functioning. Strategies provide an integral framework for management to negotiate its way through a complex and turbulent external environment. They provide a systematic basis for the enterprise to stand its ground in the face of challenge and change as also quickly adjust to them. They obviate the occasions for impulsive and crisis decisions, false starts, misdirected moves, wasted resource uses and the like. Without a network of well designed strategies, followed up by policies, corporate objectives and goals tend to remain as mere aspirations and good intentions. Even if they get off the ground, they will be lacking drive and direction. The role of strategies thus stems from the fact that achievement of organizational objectives is best with uncertainties and pitfalls.

Strategies are formulated at the corporate, divisional and functional level. Corporate strategies are formulated by the top managers. They include the determination of the business lines, expansion and growth, vertical and horizontal integration, diversification, takeovers and mergers, new investment and divestment areas, R & D projects, and so on. These corporate wide strategies need to be operationalized by divisional and functional strategies regarding product lines, production volumes, quality ranges, prices, product promotion, market penetration, purchasing sources, personnel development and like.

However, strategy is no substitute for sound, alert and responsible management. Strategy can never be perfect, flawless and optimal. It is in the very nature of strategy that it is flexible and pragmatic; it is art of the possible; it does not preclude second-best choices, trade-offs, sudden emergencies, pervasive pressures, failures and frustrations. However, in a sound strategy, allowances are made for possible miscalculations and unanticipated events.

5. GENERIC STRATEGIC ALTERNATIVES

According to William F Glueck and Lawrence R Jauch there are four generic ways in which strategic alternatives can be considered. These are stability, expansion, retrenchment and combinations.

5.1 Stability strategies: One of the important goals of a business enterprise is stability – to safeguard its existing interests and strengths, to pursue well established and tested objectives, to continue in the chosen business path, to maintain operational efficiency on a sustained basis, to consolidate the commanding position already reached, and to optimise returns on the resources committed in the business.

A stability strategy is pursued by a firm when:

- It continues to serve in the same or similar markets and deals in same products and services.
- The strategic decisions focus on incremental improvement of functional performance

Stability strategies are implemented by approaches wherein few functional changes are made in the products or markets. It is not a 'do nothing' strategy. It involves keeping track of new developments to ensure that the strategy continues to make sense. This strategy is typical for mature business organizations. Some small organizations will also frequently use stability as a strategic focus to maintain comfortable market or profit position.

5.2 Expansion Strategy: Expansion strategy is implemented by redefining the business by adding the scope of business substantially increasing the efforts of the current business. Expansion is a promising and popular strategy that tends to be equated with dynamism, vigor, promise and success. An enterprise on the move is a more agreeable stereotype than a steady-state enterprise. It is often characterised by significant reformulation of goals and directions, major initiatives and moves involving investments, exploration and onslaught into new products, new technology and new markets, innovative decisions and action programmes and so on. Expansion also includes diversifying, acquiring and merging businesses. The strategy may take the enterprise along relatively unknown and risky paths, full of promises and pitfalls.

Expansion through diversification: Diversification is defined as entry into new products or product lines, new services or new markets, involving substantially different skills, technology and knowledge. When an established firm introduces a new product which has little or no affinity with its present product line and which is meant for a new class of customers different from the firm's existing customer groups, the process is known as conglomerate diversification. Both the technology of the product and of the market are different from the firm's present experience.

Innovative and creative firms always look for opportunities and challenges to grow, to venture into new areas of activity and to break new frontiers with the zeal of entrepreneurship. They feel that diversification offers greater prospects of growth and profitability than expansion.

For some firms, diversification is a means of utilising their existing facilities and capabilities in a more effective and efficient manner. They may have excess capacity or capability in manufacturing facilities, investible funds, marketing channels, competitive standing, market prestige, managerial and other manpower, research and development, raw material sources and so forth. Another reason for diversification lies in its synergistic advantage. It may be possible to improve the sales and profits of existing products by adding suitably related or new products, because of linkages in technology and/or in markets.

Expansion through acquisitions and mergers: Acquisition of or merger with an existing concern is an instant means of achieving the expansion. It is an attractive and tempting proposition in the sense that it circumvents the time, risks and skills involved in screening internal growth opportunities, seizing them and building up the necessary resource base required to materialise growth. Organizations consider merger and acquisition proposals in a systematic manner, so that the marriage will be mutually beneficial, a happy and lasting affair.

Apart from the urge to grow, acquisitions and mergers are resorted to for purposes of achieving a measure of synergy between the parent and the acquired enterprises. Synergy may result from such bases as physical facilities, technical and managerial skills, distribution channels, general administration, research and development and so on. Only positive synergistic effects are relevant in this connection which denote that the positive effects of the merged resources are greater than the some of the effects of the individual resources before merger or acquisition.

5.3 Retrenchment Strategy: A business organization can redefine its business by divesting a major product line or market. Retrenchment or retreat becomes necessary or expedient for coping with particularly hostile and adverse situations in the environment and when any other strategy is likely to be suicidal–'Strategic retreat' is often resorted to in military engagements. In business parlance also, retreat is not always a bad proposition to save the enterprise's vital interests, to minimise the adverse effects of advancing forces, or even to regroup and recoup the resources before a fresh assault and ascent on the growth ladder is launched.

The nature, extent and timing of retrenchment are matters to be carefully decided by management, depending upon each contingency. The enterprise has several options open to it in designing and acting upon its strategy. In cases of temporary and partial setbacks, the enterprise can endeavour to cut back on its capital and revenue expenditures-new administrative blocks, replacement of worn-out machinery, advertising, R & D activities, employee welfare subsidies, community development projects, executives perks, and so on. In somewhat more serious cases of hard times, inventory levels, manufacturing level, manpower, plant maintenance, dividend to shareholders and interest on deposits, are some of the areas for slashing or postponement as the case may be. In the next stage, the enterprise may think of withdrawing from some marginal markets, withdrawal of some brands and sizes of products, withdrawal of even some slow moving products, winding up some branch offices, abolition of some executive positions and so on. In the fourth stage, the enterprise may resort to sale of some manufacturing facilities and individual product divisions which are a drag on the enterprise's resources. It may also seek retirement either from the production or the marketing stage. It is also possible to think of offering itself for take-over by another more viable enterprise. As a last option an enterprise may seek liquidation which means corporate death. This is the difficult solution, an answer to all problems of existence and a liberation from the fetters of frustration.

5.4 Combination Strategies: The above strategies are not mutually exclusive. It is possible to adopt a mix of the above to suit particular situations. An enterprise may seek stability in some areas of activity, expansion in some and retrenchment in the others. Retrenchment of ailing products followed by stability and capped by expansion in some situations may be thought of. For some organizations, a strategy by diversification and/or acquisition may call for a retrenchment in some obsolete product lines, production facilities and plant locations.

6. THE DYNAMICS OF COMPETITIVE STRATEGY

Strategic thinking involves orientation of the firm's internal environment with the changes of the external environment. The competitive strategy evolves out of consideration of several factors that are external to the firm as shown in the figure - Context in which competitive strategy is formulated

The economic and technical component of the external environment are considered as major factors leading to new opportunities for the organization and also closing threats. Similarly the broader expectation of the society in which the organization operates is again an important factor to determine the competitive strategy. The strengths and weaknesses of organizations are the internal factors, which determine the corporate strategy. It is to be analysed and find out in which functional area such as marketing, R & D, operations, etc. the organization has superiority over the competitors. The strength is to considered in the context of the opportunities arising in the external environment. The personal values of the key implementers also play major roles in formulating the competitive strategy.

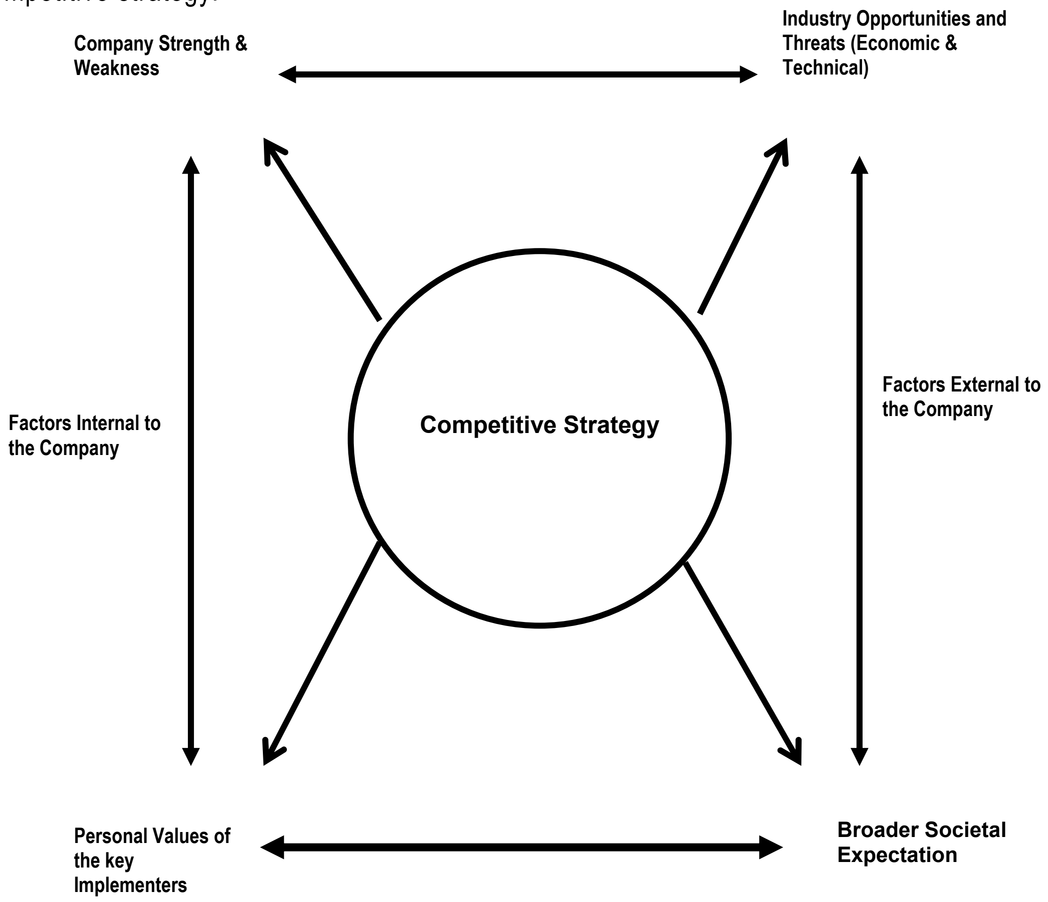

Figure: Context in which Competitive Strategy is Formulated

7. STRATEGIC MANAGEMENT

In a hyper competitive marketplace, companies can operate successfully by creating and delivering superior value to target customers and also learning how to adapt to a continuously changing business environment. So to meet changing conditions in their industries, companies need to be farsighted and visionary, and must develop long-term strategies. Strategic planning, an important component of strategic management, involves developing a strategy to meet competition and ensure long-term survival and growth. The overall objective of strategic management is two fold:

- To create competitive advantage, so that the company can outperform the competitors in order to have dominance over the market.
- To guide the company successfully through all changes in the environment.

The present organizational operations are highly influenced by the increasing rate of change in the environment and the ripple effect created on the organization. Changes can be external to the firm or it may be change introduced to the firms by the managers. It may manifest in the blurring of industry and firm boundaries, driven by technology, deregulation, or, through globalization. The tasks of crafting, implementing and executing company strategies are the heart and soul of managing a business enterprise.

Strategic management starts with developing a company mission (to give it direction), objectives and goals (to give it means and methods for accomplishing its mission), business portfolio (to allow management to utilize all facets of the organization), and functional plans (plans to carry out daily operations from the different functional disciplines).

No matter how well the strategic processes have been designed and implemented, success depends on how well each department performs its customer-value-adding activities and how well the departments work together to serve the customer. Value chains and value delivery networks have become popular with organizations that are sensitive to the wants and needs of consumers. Ultimately the aim of strategic management is to save the company's business products, services and communications so that they achieve targeted profits and growth.

The term strategic management refers to the managerial process of forming a strategic vision, setting objectives, crafting a strategy, implementing and executing the strategy, and then overtimes initiating whatever corrective adjustments in the vision, objectives, strategy, and execution are deemed appropriate.

7.1 Framework

The basic framework of strategic process can be described in a sequence of five stages as shown in the figure - *Framework of strategic management*: The five stages are as follows:

Stage one - Where are we Now? (Beginning): This is the starting point of strategic planning and consists of doing a situational analysis of the firm in the environmental context. Here the firm must find out its relative market position, corporate image, its strength and weakness and also environmental threats and opportunities. This is also known as SWOT (Strength, Weakness, Opportunity, Threat) analysis. You may refer third chapter for a detailed discussion on SWOT analysis.

Stage two: - Where are we Want to Be? (Ends): This is a process of goal setting for the organization after it has finalised its vision and mission. A strategic vision is a roadmap of the company's future – providing specifics about technology and customer focus, the geographic and product markets to be pursued, the capabilities it plans to develop, and the kind of company that management is trying to create.

An organization's Mission states what customers it serves, what need it satisfies, and what type of product it offers.

Stage three - How Might we Get There? (Means): Here the organization deals with the various strategic alternatives it has.

Stage four - Which Way is Best? (Evaluation): Out of all the alternatives generated in the earlier stage the organization selects the best suitable alternative in line with its SWOT analysis.

Stage five - How Can we Ensure Arrival? (Control): This is a implementation and control stage of a suitable strategy. Here again the organization continuously does situational analysis and repeats the stages again.

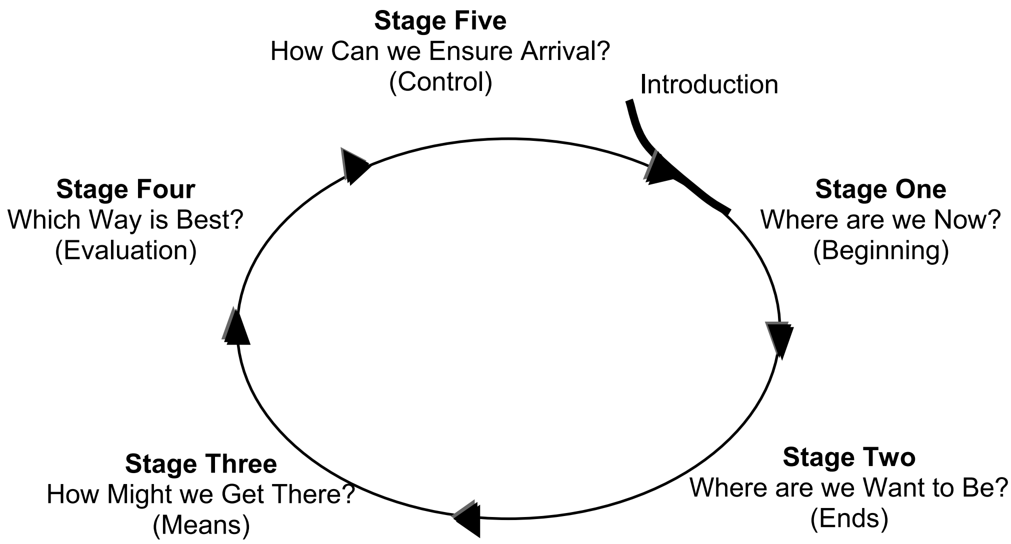

Figure - Framework of strategic management

7.2 Importance of Strategic Management

Strategic planning and implementation have become a must for all organizations for their survival and growth in the present turbulent business environment. 'Survival of fittest 'as propagated by Darwin is the only principle of survival for organization, where 'fittest' are not the 'largest' or 'strongest' organization but those who can change and adapt successfully to the changes in business environment. Many organizational giants have also followed the path of extinction failing to manage drastic changes in the business environment. Also business follows the war principle of 'win or lose', and not necessarily win-win situation arises in business world. Hence the organization has to build its competitive advantage over the competitors in the business warfare in order to win. This can be done only by following process of strategic management - strategic analysis, formulation and implementation. The major benefits of strategic management are:

- ♦ Strategic management helps organisations to be more proactive instead of reactive in shaping its future. Organisations are able to analyse and take actions instead of being mere spectators. Thereby they are able to control there own destiny in a better manner. It helps them in working within vagaries of environment and shaping it, instead of getting carried away by its turbulence or uncertainties.
- ♦ Strategic management provides framework for all the major business decisions of an enterprise such as decisions on businesses, products, markets, manufacturing facilities, investments and organisational structure. It provides better guidance to entire organisation on the crucial point - what it is trying to do.
- ♦ Strategic management is concerned with ensuring a good future for the firm. It seeks to prepare the corporation to face the future and act as pathfinder to various business opportunities. Organisations are able to identify the available opportunities and identify ways and means as how to reach them.
- ♦ Strategic management serves as a corporate defence mechanism against mistakes and pitfalls. It help organisations to avoid costly mistakes in product market choices or investments.
- ♦ Over a period of time strategic management helps organisation to evolve certain core competencies and competitive advantages that assist in its fight for survival and growth.

8. STRATEGIC DECISION MAKING

Decision making is a managerial process and function of choosing a particular course of action out of several alternative courses for the purpose of accomplishment of the organizational goals. Decisions may relate to general day to day operations. They may be major or minor. They may also be strategic in nature. Strategic decisions are different in nature than all other decisions which are taken at various levels of the organization during day-to-day working of the organizations. The major dimensions of strategic decisions are given below:

- ♦ *Strategic issues require top-management decisions*: Strategic issues involve thinking in totality of the organizations and also there is lot of risk involved. Hence, problems calling for strategic decisions require to be considered by top management.

- *Strategic issues involve the allocation of large amounts of company resources*: It may require huge financial investment to venture into a new area of business or the organization may require huge number of manpower with new set of skills in them.
- *Strategic issues are likely to have a significant impact on the long term prosperity of the firm*: Generally the results of strategic implementation are seen on a long term basis and not immediately.
- *Strategic issues are future oriented*: Strategic thinking involves predicting the future environmental conditions and how to orient for the changed conditions.
- *Strategic issues usually have major multifunctional or multi-business consequences:* As they involve organization in totality they affect different sections of the organization with varying degree.
- *Strategic issues necessitate consideration of factors in the firm's external environment: Strategic focus in organization involves orienting its internal environment to the changes of external environment.*

9. THE TASK OF STRATEGIC MANAGEMENT

The strategy-making/strategy-implementing process consists of five interrelated managerial tasks. These are

- *Setting vision and mission:* Forming a strategic vision of where the organization is headed, so as to provide long-term direction, delineate what kind of enterprise the company is trying to become and infuse the organization with a sense of purpose.
- *Setting objectives:* Converting the strategic vision into specific performance outcomes for the company to achieve.
- Crafting a strategy to achieve the desired outcomes.
- Implementing and executing the chosen strategy efficiently and effectively.
- Evaluating performance and initiating corrective adjustments in vision, long-term direction, objectives, strategy, or execution in light of actual experience, changing conditions, new ideas, and new opportunities.

Strategic management model

The strategic management process can best be studied and applied using a model. Every model represents some kind of process. The model illustrated in the *Figure: Strategic management model* is a widely accepted, comprehensive. This model like any other model of management does not guarantee sure-shot success, but it does represent a clear and practical approach for formulating, implementing, and evaluating strategies. Relationships among major components of the strategic management process are shown in the model.

Identifying an organization's existing vision, mission, objectives, and strategies is the starting point for any strategic management process because an organization present situation and condition may preclude certain strategies and may even dictate a particular course of action. Every organization has a vision, mission, objectives, and strategy, even if these elements are not consciously designed, written, or communicated. The answer to where an organization is going can be determined largely by where the organization has been.

The strategic management process is dynamic and continuous. A change in any one of the major components in the model can necessitate a change in any or all of the other components. For instance, a shift in the economy could represent a major opportunity and require a change in long-term objectives and strategies; a failure to accomplish annual objectives could require a change in policy; or a major competitor's change in strategy could require a change in the firm's mission. Therefore, strategy formulation, implementation, and evaluation activities should be performed on a continual basis, not just at the end of the year or semi-annually. The strategic management process never really ends.

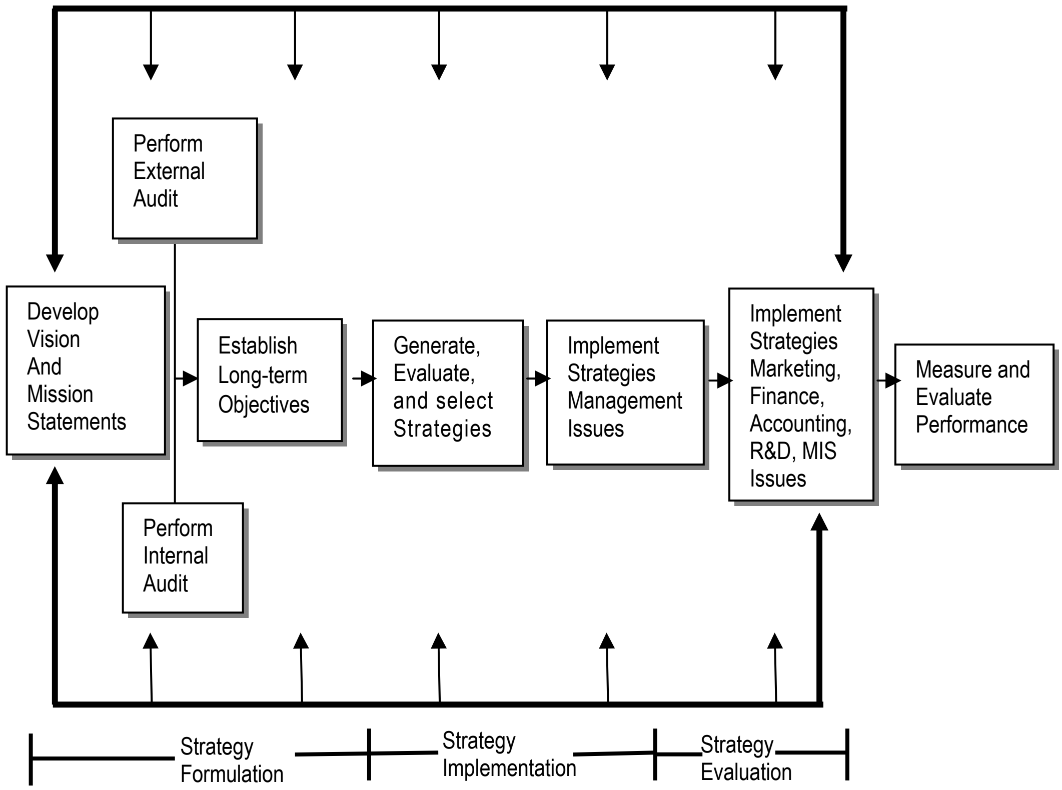

Figure Strategic Management Model

The strategic management process is not as cleanly divided and neatly performed in practice as the strategic management model suggests. Strategists do not go through the process in lockstep fashion. Generally, there is give-and-take among hierarchical levels of an organization. Many organizations conduct formal meetings semi-annually to discuss and update the firm's vision/mission, opportunities/threats, strengths/weaknesses, strategies, objectives, policies, and performance. Creativity and candour from participants are encouraged in meeting. Good communication and feedback are needed throughout the strategic management process.

Application of the strategic management process is typically more formal in larger and well-established organizations. Formality refers to the extent that participants, responsibilities, authority, duties, and approach are specified. Smaller businesses tend to be less formal. Firms that compete in complex, rapidly changing environments, such as technology companies, tend to be more formal in strategic planning. Firms that have many divisions, products, markets, and technologies also tend to be more formal in applying strategic-management concepts. Greater formality in applying the strategic management process is usually positively associated with the cost, comprehensiveness, accuracy, and success of planning across all types and sizes of organizations.

10. VISION, MISSION AND OBJECTIVES

Amongst the various steps in the strategic management model we will restrict discussion to vision, mission and objectives in this chapter.

How can you lead if you do not know where are you going?

George Newman, The Conference Board

Management's job is not to see the company as it is ……but as it can become.

- John W Teets, CEO, Greyhound Corporation

10.1 The Vision

Very early in the strategy making process, a company's senior managers must wrestle with the issue of what directional path the company should take and what changes in the company's product-market-customer-technology focus would improve its current market position and future prospects. Deciding to commit the company to one path versus another pushes managers to draw some carefully reasoned conclusions about how to try to modify the company's business makeup and the market position it should stake out.

Top management's views and conclusions about the company's direction and the product-customer-market-technology focus constitute a strategic vision for the company. A strategic vision delineates management's aspirations for the business, providing a panoramic view of the "where we are going" and a convincing rationale for why this makes good business sense for the company. A strategic vision thus points an organization in a particular direction, charts a strategic path for it to follow in preparing for the future, and molds organizational identity. A clearly articulated strategic vision communicates management's aspirations to stakeholders and helps steer the energies of company personnel in a common direction. For instance, Henry Ford's vision of a car in every garage had power because it captured the imagination of others, aided internal efforts to mobilize the Ford Motor Company's resources, and served as a reference point for gauging the merits of the company's strategic actions.

*A **Strategic vision** is a road map of a company's future – providing specifics about technology and customer focus, the geographic and product markets to be pursued, the capabilities it plans to develop, and the kind of company that management is trying to create.*

The three elements of a strategic vision:

1. Coming up with a mission statement that defines what business the company is presently in and conveys the essence of "Who we are and where we are now?"
2. Using the mission statement as basis for deciding on a long-term course making choices about "Where we are going?"
3. Communicating the strategic vision in clear, exciting terms that arouse organization wide commitment.

How to develop a strategic vision

- The entrepreneurial challenge in developing a strategic vision is to think creatively about how to prepare a company for the future.
- Forming a strategic vision is an exercise in intelligent entrepreneurship.
- Many successful organizations need to change direction not in order to survive but in order to maintain their success.
- A well-articulated strategic vision creates enthusiasm for the course management has charted and engages members of the organization.
- The best-worded vision statement clearly and crisply illuminate the direction in which organization is headed.

10.2 Mission

According to Glueck & Jauch mission is answer to the question 'what business are we in' that is faced by corporate-level strategist. Analysis shows that in actual practice many business firms fail to conceptualise and articulate the mission and business definition with the required clarity. And such firms are seen to fumble in the selection of opportunities and the choice of strategies. Firms wedded to the idea of strategic management of their enterprise cannot afford to be lax in the matter of mission and business definition, as the two ideas are absolutely central to strategic planning.

Why organization should have mission?

- To ensure unanimity of purpose within the organization.
- To provide a basis for motivating the use of the organization's resources.
- To develop a basis, or standard, for allocating organizational resources.
- To establish a general tone or organizational climate, for example, to suggest a businesslike operation.
- To serve as a focal point for those who can identify with the organization's purpose and direction, and to deter those who cannot form participating further in the organization's activities.
- To facilitate the translation of objective and goals into a work structure involving the assignment of tasks to responsible elements within the organization.
- To specify organizational purposes and the translation of these purposes into goals in such a way that cost, time, and performance parameters can be assessed and controlled.

*A company's **Mission statement** is typically focused on its present business scope – "who we are and what we do"; mission statements broadly describe an organizations present capabilities, customer focus, activities, and business makeup.*

Mission should contain elements of long-term strategy as well as desired outcomes they often basic values and the philosophy of the organizations that is perceived by the senior managers at the senior level who write them. A good mission statement should be of precise, clear, feasible, distinctive and motivating. It should indicate major components of strategy. Following points are useful while writing mission of a company :

- The mission is not to make a profit.
- One of the roles of a mission statement is to give the organization its own special identity, business emphasis and path for development – one that typically sets it apart form other similarly situated companies.
- A company's business is defined by what needs it trying to satisfy, by which customer groups it is targeting and by the technologies and competencies it uses and the activities it performs.

- Technology, competencies and activities are important in defining a company's business because they indicate the boundaries on its operation.
- Good mission statements are highly personalized – unique to the organization for which they are developed.

What is our mission? And what business are we in?

The well-known management experts, Peter Drucker and Theodore Levitt were among the first to agitate this issue through their writings. They emphasised that as the first step in the business planning endeavour every business firm must clarify the corporate mission and define accurately the business the firm is engaged in. They also explained that towards facilitating this task, the firm should raise and answer certain basic questions concerning its business, such as:

- What is our mission?
- What is our ultimate purpose?
- What do we want to become?
- What kind of growth do we seek?
- What business are we in?
- Do we understand our business correctly and define it accurately in its broadest connotation?
- Do we know our customer?
- Whom do we intend to serve?
- What human need do we intend to serve through our offer?
- What brings us to this particular business?
- What would be the nature of this business in the future?
- In what business would we like to be in, in the future?

At the time these two experts raised this issue, the business managers of the world did not fully appreciate the import of these questions; those were days when business management was still a relatively simple process even in industrially advanced countries like the US. It was only in subsequent years that captains of industry all over the world understood the significance of the seemingly simple questions raised by Drucker and Levitt.

The corporate mission is an expression of the growth ambition of the firm. It is, in fact, the firm's future visualised. It provides a dramatic picture of what the company wants to become. It is the corporation's dream crystallised. It is a colourful sketch of how the firm wants its future to look, irrespective of the current position. In other words, the mission is a grand design of the firm's future.

Mission amplifies what brings the firm to this business or why it is there, what existence it seeks and what purpose it seeks to achieve as a business firm. In other words, the mission serves as a justification for the firm's very presence and existence; it legitimises the firm's presence.

Mission is also an expression of the vision of the corporation, its founder/ leader. To make the vision come alive and become relevant, it needs to be spelt out. It is through the mission that the firm spells out its vision.

It represents the common purpose, which the entire firm shares and pursues. A mission is not a confidential affair to be confined at the top; it has to be open to the entire company. All people are supposed to draw meaning and direction from it. It adds zeal to the firm and its people. A mission is not a fad-it is a tool to build and sustain commitment of the people to the corporation's policies. A mission is not rhetoric - it is the corporation's guiding principle.

A mission does not represent a specific target. At the same time it is not all euphoria either. It represents the whole thrust of the firm. To quote Thomas Watson, Jr., former chairman of IBM, "The basic philosophy, spirit, and drive of an organization have far more to do with its relative achievements than technological or economic resources, organizational structure, innovation and timing. It also expresses the core values and beliefs of the firm".

Every organization functions through a network of aims. Mission is the foundation from which the network of aims is built. The mission serves as a proclamation to insiders and outsiders on what the corporation stands for. A mission, however, is not a PR document; while it legitimises the corporation's existence and role in society, its main purpose is to give internal direction for the future of the corporation.

According to Peter Drucker, every organization must ask an important question *"What business are we in*?" and get the correct and meaningful answer. The answer should have marketing or external perspective and should not be restated to the production or generic activities of business. The table given below will clarify and highlight the importance of external perspective.

What Business Are We In?

Company	Production-oriented answer	Marketing-oriented answer
AT&T	We operate a long-distance telephone company.	We provide multiple forms of reliable, efficient and inexpensive telecommunication services
Indian Oil	We produce oil and gasoline products	We provide various types of safe and cost-effective energy.
Indian Railways	We run a railroad	We offer a transportation and material-handling system
Eastman Kodak	We make cameras and film.	We help preserve beautiful memories
Revlon	In the factory, we make cosmetics.	In the drugstore, we sell hope

Understanding Mission and Purpose

The mission is a statement which defines the role that an organization plays in the society. The organisations also have some purpose that is anything that an organization strives for. Organizations relate their existence to satisfying a particular need of the society. They do this in terms of their mission and purpose. We can described mission as "a statement which defines the role that an organization plays in the society", and purpose as "anything which an organization strives for." In business policy, both these terms are either used jointly or singly. Since both mission and purpose go hand in hand, they can be used together while maintaining the basic difference between them. Mission strictly refers to the particular needs of the society, for instance, its information needs. Purpose relates to what the organization strives to achieve in order to fulfil its mission to the society. A book publisher and a magazine editor are both engaged in satisfying the information needs of society but they do it through different means. A book publisher may aim at producing excellent reading material while a magazine editor may strive to present news analysis in a balanced and unbiased manner. Both have different purposes but an identical mission:

Some examples of vision, mission and objectives

Mission and vision of the Institute of Chartered Accountants of India

Mission	The Indian Chartered Accountancy Profession will be the valued Trustees of World Class Financial Competencies, Good Governance and Competitiveness.

Vision	Recognise the changes in Economy/Business Environment such as focus on value, dynamic business and organization structures, developments in Information Technology and Telecommunication, new Government policies, globalization of business and competitive pressures. Recognise the path to success by adapting to the changes, knowledge management and acquiring skills to work with future environment influenced by technological and other changes. Recognise the opportunities for Chartered Accountants in the emerging areas such as new audit and assurance needs, performance measurement services, change management services, strategy management, general practice specialization and servicing global organizations. Recognise the Institute's role as a proactive, innovative and flexible organization, in equipping Chartered Accountants with top quality education and values. Recognise the need to be known as World Class Advisor.

Mission of Unilever: "The mission of our company, as William Hasketh Lever saw it, is to make cleanliness commonplace, to lessen work for women, to foster health, and to contribute to personal attractiveness that life may be more enjoyable for the people who use our products."

Mission of Mckinsey & Co: "To help business corporation and governments to be more successful".

Mission of Cadbury India: "To attain leadership position in the confectionary market and achieve a strong presence in the food drinks sector."

Mission of Reliance Industries: "To become a major player in the global chemicals business and simultaneously grow in other growth industries like infrastructure."

Mission of Ranbaxy: "To become a $1 billion research-based global pharmaceuticals company."

10.3 Objectives and Goals

Business organization translate their vision and mission into objectives. As such the term objectives is synonymous with goals, however, we will make an attempt to distinguish the two. Objectives are open-ended attributes that denote the future states or outcomes. Goals are close-ended attributes which are precise and expressed in specific terms. Thus the goals are more specific and translate the objectives to short term perspective.

However, this distinction is not made by several theorists on the subject. Accordingly, we will also use the term interchangeably.

Objectives *are organizations performance targets – the results and outcomes it wants to achieve. They function as yardstick for tracking an organizations performance and progress.*

All organizations have objectives. The pursuit of objectives is an unending process such that organizations sustain themselves. They provide meaning and sense of direction to organizational endeavour. Organizational structure and activities are designed and resources are allocated around the objectives to facilitate their achievement. They also act as benchmarks for guiding organizational activity and for evaluating how the organization is performing.

Objectives with strategic focus relate to outcomes that strengthen an organizations overall business position and competitive vitality. Objective to be meaningful to serve the intended role must possess following characteristics:

- Objectives should define the organization's relationship with its environment.
- They should be facilitative towards achievement of mission and purpose.
- They should provide the basis for strategic decision-making
- They should provide standards for performance appraisal.
- Objectives should be understandable.
- Objectives should be concrete and specific
- Objectives should be related to a time frame
- Objectives should be measurable and controllable
- Objectives should be challenging
- Different objectives should correlate with each other
- Objectives should be set within constraints

11. STRATEGIC LEVELS IN ORGANISATIONS

In most companies, there are two main types of managers: *general managers*, who bear responsibility for the overall performance of the company or for one of its major self-contained subunits or divisions, and *functional managers*, who are responsible for supervising a particular function, that is, a task, activity, or operation. Like finance and accounting, production, marketing, R&D, information technology, or materials management.

An organization is divided into several functions and departments that work together to bring a particular product or service to the market. If a company provides several different kinds of products or services, it often duplicates these functions and creates a series of self-contained divisions (each of which contain its own set of functions) to manage each different product or service. The general managers of these divisions then become responsible for their particular product line. The overriding concern of general managers is for the health of the whole company or division under their direction; they are responsible for deciding how to create a competitive advantage and achieve high profitability with the resources and capital they have at their disposal. Figure 'levels of strategic management' shows the organization of a multidivisional company that is, a company that competes in several different businesses and has created a separate self-contained division to manage each of these. As you can see, there are three main levels of management: corporate, business, and functional. General managers are found at the first two of these levels, but their strategic roles differ depending on their sphere of responsibility.

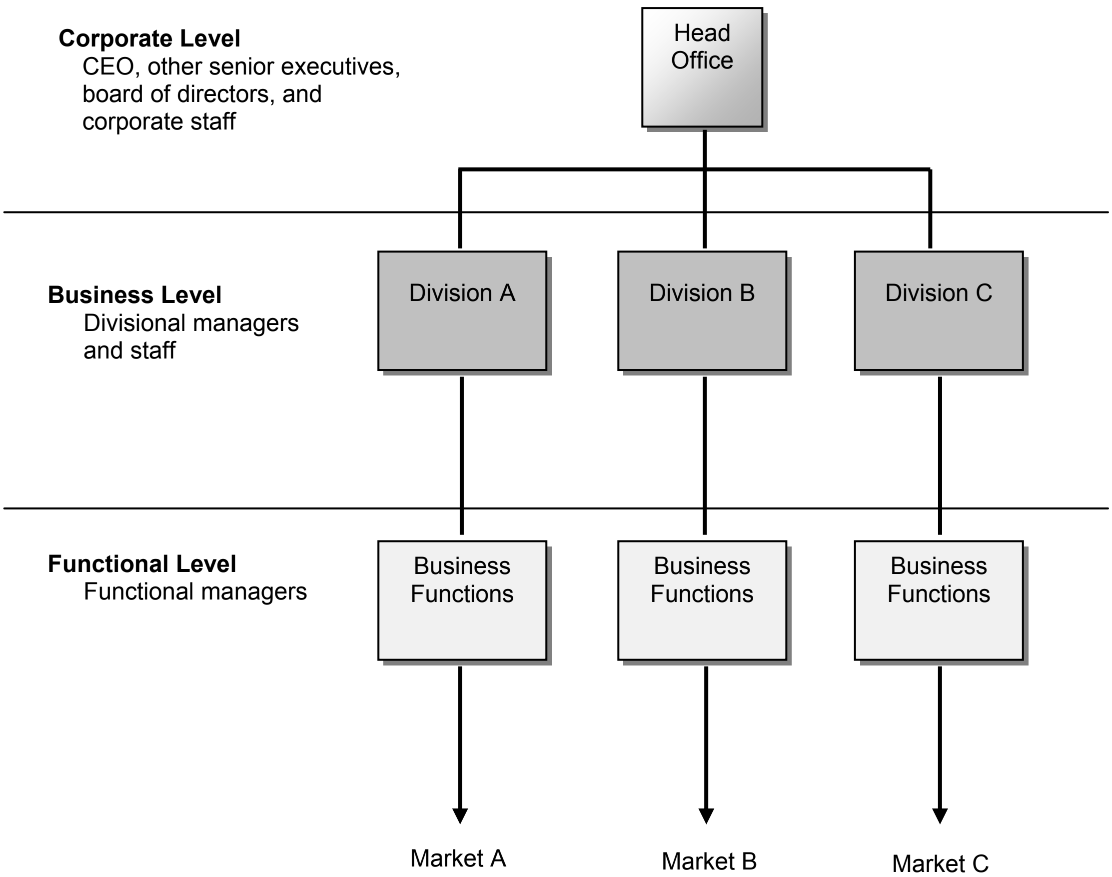

Figure : Level of Strategic Management

The corporate level of management consists of the chief executive officer (CEO), other senior executives, the board of directors, and corporate staff. These individuals occupy the apex of decision making within the organization. The CEO is the principal general manager. In consultation with other senior executives, the role of **corporate-level managers** is to oversee the development of strategies for the whole organization. This role includes defining the mission and goals of the organization, determining what businesses it should be in, allocating resources among the different businesses, formulating and implementing strategies that span individual businesses, and providing leadership for the organization.

Consider General Electric (GE) as an example. GE is active in a wide range of businesses, including lighting equipment, major appliances, motor and transportation equipment, turbine generators, construction and engineering services, industrial electronics, medical systems, aerospace, aircraft engines, and financial services. The main strategic responsibilities of its CEO, Jeffrey Immelt, are setting overall strategic objectives, allocating resources among the different business areas, deciding whether the firm should divest itself of any of its businesses, and determining whether it should acquire any new ones. In other words, it is up to Immelt to develop strategies that span individual businesses; his concern is with building and managing the corporate portfolio of businesses to maximize corporate profitability.

It is *not* his specific responsibility to develop strategies for competing in the individual business areas, such as financial services. The development of such strategies is the responsibility of the general managers in these different businesses or *business level managers.* However, it is Immelt's responsibility to probe the strategic thinking of business-level managers to make sure that they are pursuing robust strategies that will contribute toward the maximization of GE's long-run profitability and to hold them into account for their performance.

Besides overseeing resource allocation and managing the divestment and acquisition processes, corporate-level managers provide a link between the people who oversee the strategic development of a firm and those who own it (the shareholders). Corporate-level managers, and particularly the CEO, can be viewed as the guardians of shareholder welfare. It is their responsibility to ensure that the corporate and business strategies that the company pursues are consistent with maximizing shareholder wealth. If they are not, then ultimately the CEO is likely to be called to account by the shareholders.

A business unit is a self-contained division (with its own functions-for example, finance, purchasing, production, and marketing departments) that provides a product or service for a particular market. The principal general manager at the business level, or the business-level manager, is the head of the division. The strategic role of these managers is to translate the general statements of direction and intent that come from the corporate level into concrete strategies for individual businesses. Thus, whereas corporate-level general managers are concerned with strategies that span individual businesses, business-level general managers are concerned with strategies that are specific to a particular business. At GE, a major corporate goal is to be first or second in every business in which the corporation competes. Then the general managers in each division work out for their business the details of a strategy that is consistent with this objective.

Functional-level managers are responsible for the specific business functions or operations (human resources, purchasing, product development, customer service, and so on) that constitute a company or one of its divisions. Thus, a functional manager's sphere of responsibility is generally confined to *one* organizational activity, whereas general managers oversee the operation of a *whole* company or division. Although they are not responsible for the overall performance of the organization, functional managers nevertheless have a major strategic role: to develop functional strategies in their area that help fulfil the strategic objectives set by business- and corporate-level general managers.

In GE's aerospace business, for instance, manufacturing managers are responsible for developing manufacturing strategies consistent with the corporate objective of being first or second in that industry. Moreover, functional managers provide most of the information that makes it possible for business- and corporate-level general managers to, formulate realistic and attainable strategies. Indeed, because they are closer to the customer than the typical general manager is, functional managers themselves may generate important ideas that subsequently may become major strategies for the company. Thus, it is important for general managers to listen closely to the ideas of their functional managers. An equally great responsibility for managers at the operational level is strategy implementation: the execution of corporate and business-level plans.

Characteristics of strategic management decisions at different levels

Characteristic	Level of Strategy		
	Corporate	Business	Functional
Type	Conceptual	Mixed	Operational
Measurability	Value judgments dominant	Semi quantifiable	Usually Quantifiable
Frequency	Periodic or Sporadic	Periodic or Sporadic	Periodic
Relation to present activities	Innovative	Mixed	Supplementary

Risk	Wide Range	Moderate	Low
Profit Potential	Large	Medium	Small
Cost	Major	Medium	Modest
Time horizon	Long Range	Medium Range	Short Range
Flexibility	High	Medium	Low
Cooperation Required	Considerable	Moderate	Little

SELF EXAMINATION QUESTIONS

Multiple Choice Questions

1. Read the following three statements:

   (i) Strategies have short-range implications.

   (ii) Strategies are action oriented.

   (iii) Strategies are rigidly defined.

   From the combinations given below select an alternative that represent statements that are true:

   (a) (i) and (ii)

   (b) (i) and (iii)

   (c) (ii) and (iii)

   (d) (i), (ii) and (iii)

2. Retrenchment strategy in the organization can be explained as

   (a) Reducing trenches (gaps) created between individuals.

   (b) Divesting a major product line or market.

   (c) Removal of employees from job through the process of reorganization.

   (d) Removal of employees from job in one business to relocate them in other business.

3. The three stages of strategic management are:

   (a) Stratify assessment, strategy execution, and strategy evaluation.

   (b) Strategy formulation, strategy implementation, and strategy evaluation.

(c) Strategy formulation, strategy implementation, and strategy execution.

(d) Strategy formulation, strategy execution, and strategy assessment.

4. The four generic strategic alternatives propounded by Glueck and Jauch are:

(a) retirement, combination, stability and expansion

(b) retrenchment, combination, stability and expansion

(c) retrenchment, termination, retirement and stability

(d) retirement, expansion, termination and growth

5. The first step of strategy formulation in strategic management model is:

(a) Undertake internal analysis.

(b) Undertake external analysis.

(c) Set major objectives.

(d) Determine vision and mission.

6. Select the correct statement:

(a) In general corporate level decisions are costly to take, involve high risk and have large profit potential.

(b) In general corporate level decisions are costly to take, involve low risk and have large profit potential.

(c) In general corporate level decisions are costly to take, involve high risk and have low profit potential.

(d) In general corporate level decisions are cheaper to take, involve low risk and have large profit potential.

Objective Type Questions

State with reasons which of the following statements are correct/incorrect:

(a) Strategies have short-range implications

(b) Functional level managers are responsible for the specific business functions.

(c) Vision and Mission are translated into objectives.

Short answer questions

1. Write a short note on business policy.

2. Explain diversification as strategy.

Essay type questions

1. What do you understand by Strategy? What are major strategic alternatives available to a business organisation?
2. Discuss different strategic levels in organizations.
3. Discuss the process of strategic management.

Case Study

Delhi-based Ace International is close to acquiring popular household brands Yummy and Tasty from Beetroot Ltd. The deal, at rupees thirty-five crores was announced at a joint press conference.

It was sometime back that Beetroot felt the need to restructure its unwieldy product portfolio and exit brands which had low business potential for the company. Beetroot had put these brands on sale late last year. Ace has emerged as the highest bidder for them. The company, stated in the press release that Ace is buying the brands but not their manufacturing facility at Noida (near Delhi), because the plant also makes other food products which are Beetroot's core food brands.

While Yummy and Tasty are marginal businesses for Beetroot, (around Rs 20 crore per annum) management consultants felt that they are a good fit in Ace's product portfolio. The company makes the same genre of products and can grow the brands without additional input or distribution costs. Tasty and Yummy are food brands that Ace can manufacture in its existing plants spread across seven locations in Punjab and Maharashtra. The company can also use the same set of distributors to place these brands in shops. Financial Analysts expect them to add 8-10% to Alpha's Rs 250 crore turnover in the first year.

(a) Discuss the business strategy for Ace

(b) Discuss the business strategy for Beetroot.

Answers - Multiple Choice Questions

1. (a), **2.** (b), **3.** (b), **4.** (b), **5.** (d), **6.** (a)

CHAPTER 3

STRATEGIC ANALYSIS

LEARNING OBJECTIVES

- Know the importance of strategic analysis in the formulation of strategy.
- Learn some of the methods of competitive analysis that are used in business organizations.
- Know what is SWOT and TOWS analysis.
- Have an understanding of some of the methods used in portfolio analysis.

Analysis is the critical starting point of strategic thinking.

Kenichi Ohmae

If you're not faster than your competitor, you're in a tenuous position, and if you're only half as fast, you're terminal.

George Salk

The idea is to concentrate our strength against our competitor's relative weakness.

Bruce Henderson

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1. INTRODUCTION

The strategic management process, after deciding the vision, mission, goals and objectives of the organization, turns its focus to scanning of environment in which all organizations work as sub-systems. That is environmental scanning covers both scanning of external environment and internal environment. The scanning of external environment leads to the identification of the opportunities and threats thrown open to organizations while the internal analysis leads to the study of strengths and weaknesses which will decide as to what extent each company is going to capitalize the opportunities and threats thrown open.

2. STRATEGIC ANALYSES

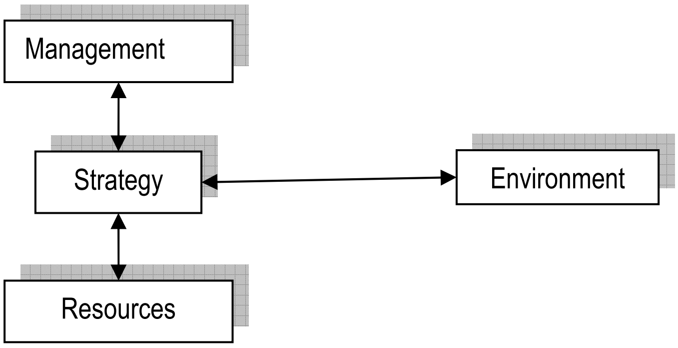
Strategy formulation is not a task in which managers can get by with opinions, good instincts, and creative thinking. Judgments about what strategy to pursue need to flow directly from *solid analysis* of a company's external environment and internal situation. The two most important situational considerations are (1) industry and competitive conditions and (2) a company's own competitive capabilities, resources, internal strengths and weaknesses, and market position.

What is involved in sizing up a company's overall situation and deciding on a strategy? The analytical sequence is from strategic appraisal of the company's external and internal situation, to evaluation of alternatives, to choice of strategy. Accurate diagnosis of the company's situation is necessary managerial preparation for deciding on a sound long-term direction, setting appropriate objectives, and crafting a winning strategy. Without perceptive understanding of the strategic aspects of a company's external and internal environments, the chances are greatly increased that managers will concoct a strategic game plan that doesn't fit the situation well, that holds little prospect for building competitive advantage, and that is unlikely to boost company performance.

Issues to consider for strategic analyses

Strategy evolves over a period of time: There are different forces that drive and constrain strategy and that must be balanced in any strategic decision. An important aspect of strategic analyses is to consider the possible implications of routine decisions. Strategy of a business, at a particular point of time, is result of a series of small decisions taken over an extended period of time. A manager who makes an effort to increase the growth momentum of an organization is materially changing strategy.

Balance: The process of strategy formulation is often described as one of the matching the internal potential of the organization with the environmental opportunities. In reality, as perfect match between the two may not be feasible, strategic analyses involve a workable balance between diverse and conflicting considerations. A manager working on a strategic decision has to balance opportunities, influences and constraints. There are pressures that are driving towards a particular choice such as entering a new market. Simultaneously there are constraints that limit the choice such as existence of a big competitor. These constraining forces will be producing an impact that will vary in nature, degree, magnitude and importance. Some of these factors can be managed to some extent, however, there will be several others that are beyond the control of a manager.



Risk: In the strategic analyses the principle of maintaining balance is important. However, the complexity and intermingling of variables in the environment reduces the strategic balance in the organization. The lives that we lead is uncertain and the business is no exception. Competitive markets, liberalization, globalization, booms, recessions, technological advancements, inter-country relationships all affect businesses and pose risk at varying degree. An important aspect of strategic analysis is to identify potential imbalances or risks and assess their consequences. A broad classification of the strategic risk that requires consideration in strategic analyses is given below:

		Time	
		Short-term	***Long-term***
Strategic Risks	***External***	Errors in interpreting the environment cause strategic failure.	Changes in the environment lead to obsolescence of strategy.
	Internal	Organizational capacity is unable to cope up with strategic demands.	Inconsistencies with the strategy are developed on account of changes in internal capacities and preferences

External risk is on account of inconsistencies between strategies and the forces in the environment. Internal risk occurs on account of forces that are either within the organization or are directly interacting with the organization on an routine basis.

3. SITUATIONAL ANALYSIS

All companies operate in a "macro environment" shaped by influences emanating from the economy at large, population demographics, societal values and lifestyles, governmental legislation and regulation, technological factors. These factors have been discussed in chapter 1. Strictly speaking, a company's macro environment includes all relevant factors and influences outside the company's boundaries; by relevant, we mean important enough to have a bearing on the decisions the company ultimately makes about its direction, objectives, strategy, and business model. For the most part, influences coming from the outer ring of the macro environment have a low impact on a company's business situation and shape only the edges of the company's direction and strategy. There are notable exceptions, though. There are enough strategically relevant trends and developments in the macro environment to justify a watchful eye. As company managers scan the external environment, they must watch for potentially important environmental forces, assess their impact and influence, and adapt the company's direction and strategy as needed.

However, the factors and forces in a company's macro environment having the biggest strategy-shaping impact almost always pertain to the company's immediate industry and competitive environment.

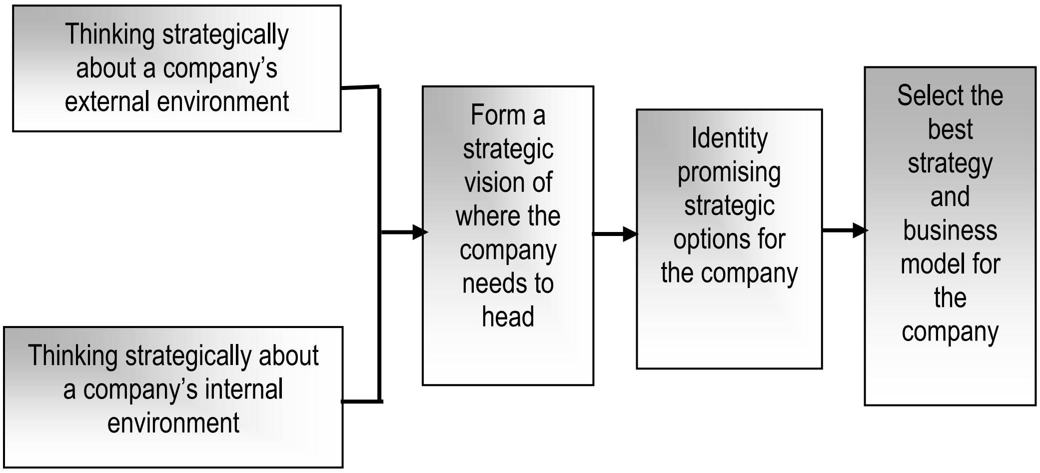


Figure: From Thinking Strategically about the Company's Situation to Choosing a Strategy

Also before developing any given marketing strategy it is important to conduct some form of analysis. This should form an essential part of any business plan and should be reviewed over time to ensure that it is kept current. Many ask what factors are important when doing this. The following is just a raw introduction to what to take into account when conducting an analysis and provides a checklist of the most important factors to take into account.

The elements worth considering include:

- *Product situation*: What is my current product? You may want to break this definition up into parts such as the core product and any secondary or supporting services or products that also make up what you sell. It is important to observe this in terms of its different parts in order to be able to relate this back to core client needs.
- *Competitive situation*: Analyze your main competitors - who are they what are they up to - how do they compare. What are their competitive advantages?
- *Distribution situation*: Review your distribution Situation - how are you getting your product to market? Do you need to go through distributors or other intermediaries?
- *Environmental factors*: What external and internal environmental factors are there that need to be taken into account. This can include economic or sociological factors that impact on your performance.

- *Opportunity and issue analysis*: Things to write down here are what current opportunities that are available in the market, the main threats that business is facing and may face in the future, the strengths that the business can rely on and any weaknesses that may effect the business performance.

We have seen earlier in the framework of strategic management that the first question to ask: 'where are we now'? So, strategic analysis is the starting point of strategic management as shown in the figure below:

Strategic Analysis

External Analysis

- **Customer Analysis**
  Segments, motivations, unmet needs.
- **Competitor Analysis**
  Identity, strategic groups, performance, image, objectives, strategies, culture, cost structure, strengths, weaknesses.
- **Market Analysis**
  Size, projected growth, profitability, entry barriers, cost structure, strengths, weaknesses
- **Environmental Analysis**
  Technological, government, economic, cultural, demographic, scenarios, information-need areas.

Opportunities, threats, trends, and strategic, uncertainties.

Internal Analysis

- **Performance Analysis**
  Profitability, sales, shareholder value analysis, customer satisfaction, product quality, brand associations, relative cost, new products, employee capability and performance, product portfolio analysis.
- **Determinates Analysis**
  Past and current strategies, strategic problems, organizational Capabilities and constraints, Financial resources and Constraints, strengths, and weaknesses.

Strategic strengths, weaknesses, problems, constraints, and uncertainties

Strategy Identification & Selection

- Identify strategic alternatives
  - Product-maker investment strategies
  - Functional area strategies
  - Assets, competencies, and synergies
- Select strategy
- Implement the operating plan
- Review strategies

Figure: Framework of Strategic Analysis

Industries differ widely in their economic characteristics, competitive situations, and future profit prospects. For example, the economic and competitive traits of the fast-food business have little in common with those of Internet service providers. The telecom business is shaped by industry and competitive considerations radically different from those that dominate the aviation business.

The economic character of industries varies according to such factors as overall size and market growth rate, the pace of technological change, the geographic boundaries of the market (which can extend from local to worldwide), the number and size of buyers and sellers, whether sellers' products are virtually identical or highly differentiated, the extent to which costs are affected by economies of scale, and the types of distribution channels used to access buyers. Competitive forces can be moderate in one industry and fierce, even cutthroat, in another. Moreover, in some industries competition focuses on who has the best price, while in others competition is centered on quality and reliability (as in monitors for PCs and laptops) or product features and performance (as in mobile phones) or quick service and convenience. (as in online shopping and fast foods) or brand reputation (as in laundry detergents and soft drinks). In other industries, the challenge is for companies to work cooperatively with suppliers, customers, and maybe even select competitors to create the next round of product innovations and open up whole new vistas of market opportunities.

An industry's economic traits and competitive conditions, and how they are expected to change, determine whether its profit prospects are poor, average, or excellent. Industry and competitive conditions differ so much that leading companies in unattractive industries can find it hard to earn respectable profits, while even weak companies in attractive industries can turn in good performances.

4. THE METHODS OF INDUSTRY AND COMPETITIVE ANALYSIS

Industry and competitive analysis can be done using a set of concepts and techniques to get a clear fix on key industry traits, the intensity of competition, the drivers of industry change, the market positions and strategies of rival companies, the keys to competitive success, and the industry's profit outlook. It provides a way of thinking strategically about any industry's overall situation and drawing conclusions about whether the industry represents an attractive investment for company funds. The analysis entails examining a company's business in the context of a much wider environment. Industry and competitive analysis aims at developing insight in several issues. Analysing these issues build understanding of a firm's surrounding environment and, collectively, form the basis for matching its strategy to changing industry conditions and competitive realities. The issues are given below:

4.1 Dominant economic features of the industry

Industries differ significantly in their basic character and structure. Industry and competitive analysis begins with an overview of the industry's dominant economic features. *Industry* is "a group of firms whose products have same and similar attributes such that they compete for the same buyers." The factors to consider in profiling an industry's economic features are fairly standard and are given as follows:

- Market size.
- Scope of competitive rivalry (local, regional, national, international, or global).
- Market growth rate and position in the business life (early development, rapid growth and takeoff, early maturity, maturity, saturation and stagnation, decline).
- Number of rivals and their relative sizes.
- Small companies dominant companies?
- The number of buyers and their relative sizes. Whether and to what extent industry rivals have integrated backward and/or forward.
- The types of distribution channels used to access consumers.
- The pace of technological change in both production process innovation and new product introductions.
- Whether the products and services of rival firms are highly differentiated, weakly differentiated, or essentially identical.
- Whether companies can realize economies of scale in purchasing, manufacturing, transportation, marketing, or advertising.
- Whether key industry participants are clustered in a particular location, for example, lock industry in Aligarh. Saris and diamonds in Surat, information technology in Bangalore. Similarly, there is also concentration of business in different countries on account of graphical and other reasons.
- Whether certain industry activities are characterized by strong learning and experience effects ("learning by doing") such that unit costs decline as *cumulative* output grows.
- Whether high rates of capacity utilization are crucial to achieving low-cost production efficiency.
- Capital requirements and the ease of entry and exit.
- Whether industry profitability is above/below par.

4.2 Nature and strength of competition

One important component of industry and competitive analysis involves delving into the industry's competitive process to discover what the main sources of competitive pressure are and how strong each competitive force is. This analytical step is essential because managers cannot devise a successful strategy without in-depth understanding of the industry's competitive character. Even though competitive pressures in various industries are never precisely the same, the competitive process works similarly enough to use a common analytical framework in gauging the nature and intensity of competitive forces.

Porter's five forces model included in the first chapter is useful in understanding the competition. It is a powerful tool for systematically diagnosing the principle competitive pressures in a market and assessing how strong and important each one is. Not only is it the widely used technique of competition analysis, but it is also relatively easy to understand and apply.

4.3 Triggers of change

An industry's economic features and competitive structure say a lot about its fundamental character but little about the ways in which its environment may be changing. All industries are characterized by trends and new developments that gradually produce changes important enough to require a strategic response from participating firms. The popular hypothesis about industries going through a life cycle helps explain industry change but is still incomplete. The life-cycle stages are strongly keyed to changes in the overall industry growth rate (which is why such terms as rapid growth, early maturity, saturation, and decline are used to describe the stages). Yet there are more causes of industry change than an industry's position in the life cycle.

The concept of driving forces: While it is important to judge what growth stage an industry is in, there's more analytical value in identifying the specific factors causing fundamental industry and competitive adjustments. Industry and competitive conditions change because forces are in motion that create incentives or pressures for changes. The most dominant forces are called driving forces because they have the biggest influence on what kinds of changes will take place in the industry's structure and competitive environment. Analyzing driving forces has two steps: identifying what the driving forces are and assessing the impact they will have on the industry.

The most common driving forces: Many events can affect an industry powerfully enough to qualify as driving forces. Some are unique and specific to a particular industry situation, but many drivers of change fall into general category affecting different industries simultaneously. Some of the categories/examples of drivers are follows:

- The internet and the new e-commerce opportunities and threats it breeds in the industry.
- Increasing globalization.
- Changes in the long-term industry growth rate.
- Product innovation.
- Marketing innovation.
- Entry or exit of major forms.

- Diffusion of technical know-how across more companies and more countries.
- Changes in cost and efficiency.

4.4 Identifying the companies that are in the strongest/weakest positions

The next step in examining the industry's competitive structure is to study the market positions of rival companies. One technique for revealing the competitive positions of industry participants is **strategic group mapping**, which is useful analytical tool for comparing the market positions of each firm separately or for grouping them into like positions when an industry has so many competitors that it is not practical to examine each one in depth.

A **strategic group** consists of those rival firms with similar competitive approaches and positions in the market. Companies in the same strategic group can resemble one another in any of several ways: they may have comparable product-line breadth, sell in the same price/quality range, emphasize the same distribution channels, use essentially the same product attributes to appeal to similar types of buyers, depend on identical technological approaches, or offer buyers similar services and technical assistance. An industry contains only one strategic group when all sellers pursue essentially identical strategies and have comparable market positions. At the other extreme, there are as many strategic groups as there are competitors when each rival pursues a distinctively different competitive approach and occupies a substantially different competitive position in the marketplace.

The procedure for constructing a strategic group map and deciding which firms belong in which strategic group is straightforward:

- Identify the competitive characteristics that differentiate firms in the industry typical variables are price/quality range (high, medium, low); geographic coverage (local, regional, national, global); degree of vertical integration (none, partial, full); product-line breadth (wide, narrow); use of distribution channels (one, some, all); and degree of service offered (no-frills, limited, full).
- Plot the firms on a two-variable map using pairs of these differentiating characteristics
- Assign firms that fall in about the same strategy space to the same strategic group
- Draw circles around each strategic group making the circles proportional to the size of the group's respective share of total industry sales revenues

4.5 Likely strategic moves of rivals

Unless a company pays attention to what competitors are doing, it ends up flying blind into competitive battle. A company can't expect to outmanoeuvre its rivals without monitoring their actions, understanding their strategies, and anticipating what moves they are likely to make next. As in sports, scouting the opposition is essential. Competitive intelligence about the strategies rivals are deploying, their latest moves, their resource strengths and weaknesses, and the plans they have announced is essential to anticipating the actions they are likely to take next and what bearing their moves might have on a company's own best strategic moves. Competitive intelligence can help a company determine whether it needs to defend against specific moves taken by rivals or whether those moves provide an opening for a new offensive thrust.

4.6 Key factors for competitive success

An industry's Key Success Factors (KSFs) are those things that most affect industry members' ability to prosper in the marketplace - the particular strategy elements, product attributes, resources, competencies, competitive capabilities, and business outcomes that spell the difference between profit and loss and, ultimately, between competitive success or failure. KSFs by their very nature are so important that all firms in the industry must pay close attention to them - they are - the prerequisites for industry success or, to put it another way, KSFs are the rules that shape whether a company will be financially and competitively successful. The answers to three questions help identify an industry's key success factors:

- On what basis do customers choose between the competing brands of sellers? What product attributes are crucial?
- What resources and competitive capabilities does a seller need to have to be competitively successful?
- What does it take for sellers to achieve a sustainable competitive advantage?

In apparel manufacturing, the KSFs are appealing designs and colour combinations (to create buyer interest) and low-cost manufacturing efficiency (to permit attractive retail pricing and ample profit margins). In tin and aluminium cans, because the cost of shipping empty cans is substantial, one of the keys is having plants located close to end-use customers so that the plant's output can be marketed within economical shipping distances (regional market share is far more crucial than national share).

Determining the industry's key success factors, given prevailing and anticipated industry and competitive conditions, is a top-priority analytical consideration. At the very least, managers need to understand the industry situation well enough to know what is more important to competitive success and what is less important. They heed to know what kinds of resources are competitively valuable. Misdiagnosing the industry factors critical to long-term competitive success greatly raises the risk of a misdirected strategy. In contrast, a company with perceptive understanding of industry KSFs can gain sustainable competitive advantage by training its strategy on industry KSFs and devoting its energies to being distinctively better than rivals on one or more of these factors. Indeed, companies that stand out on a particular KSF enjoy a stronger market position for their, efforts-being distinctively better than rivals on one or more key success factors presents a golden opportunity for gaining competitive advantage. Hence, using the industry's KSFs as cornerstones for the company's strategy and trying to gain sustainable competitive advantage by excelling at one particular KSF is a fruitful competitive strategy approach-

Key success factors vary from industry to industry and even from time to time within the same industry as driving forces and competitive conditions change. Only rarely does an industry have more than three or four key success factors at any one time. And even among these three or four, one or two usually outrank the others in importance. Managers, therefore, have to resist the temptation to include factors that have only minor importance on their list of key success factors- the purpose of identifying KSFs is to make judgments about what things are more important to competitive success and what things are less important. To compile a list of every factor that matters even a little bit defeats the purpose of concentrating management attention on the factors truly critical to long-term competitive success.

4.7 Prospects and financial attractiveness of industry

The final step of industry and competitive analysis is to use the results of analysis of previous six issues to draw conclusions about the relative attractiveness or unattractiveness of the industry, both near-term and long-term. Company strategists are obligated to assess the industry outlook carefully, deciding whether industry and competitive conditions present an attractive business opportunity for the company or whether the company's growth and profit prospects are gloomy. The important factors on which to base such conclusions include:

- The industry's growth potential.
- Whether competition currently permits adequate profitability and whether competitive forces will become stronger or weaker.
- Whether industry profitability will be favourably or unfavourably affected by the prevailing driving forces.
- The company's competitive position in the industry and whether its position is likely to grow stronger or weaker. (Being a well-entrenched leader or strongly positioned contender in an otherwise lackluster industry can still produce good profitability; however, having to fight an uphill battle against much stronger rivals can make an otherwise attractive industry unattractive).
- The company's potential to capitalize on the vulnerabilities of weaker rivals (perhaps converting an unattractive industry situation into a potentially rewarding company opportunity).
- Whether the company is able to defend against or counteract the factor that make the industry unattractive.
- The degrees of risk and uncertainty in the industry's future.

- The severity of problems confronting the industry as a whole.
- Whether continued participation in this industry adds importantly to the firm's ability to be successful in other industries in which it may have business interests.

As a general proposition, if an industry's overall profit prospects are above average, the industry can be considered attractive; if its profit prospects are below average, it is unattractive. However, it is a mistake to think of industries as being attractive or unattractive to all industry participants and all potential entrants. Attractiveness is relative, not absolute, Industry environments unattractive to weak competitors may be attractive to strong competitors.

An assessment that the industry is fundamentally attractive typically suggests that current industry participants employ strategies calculated to strengthen their long-term competitive positions in the business, expanding sales efforts and investing in additional facilities and equipment as needed. If the industry and competitive situation is judged relatively unattractive, more successful industry participants may choose to invest cautiously, look for ways to protect their long-term competitiveness and profitability, and perhaps acquire smaller firms if the price is right; over the longer term, strong companies may consider diversification into more attractive businesses. Weak companies in unattractive industries may consider merging with a rival to bolster market share and profitability or, alternatively, begin looking outside the industry for attractive diversification opportunities.

5. SWOT ANALYSIS

The next component of strategic thinking requires the generation of a series of strategic alternatives, or choices of future strategies to pursue, given the company's internal strengths and weaknesses and its external opportunities and threats. The comparison of strengths, weaknesses, opportunities, and threats is normally referred to as a SWOT analysis

- **Strength:** Strength is an inherent capability of the organization which it can use to gain strategic advantage over its competitors.
- **Weakness:** A weakness is an inherent limitation or constraint of the organization which creates strategic disadvantage to it.
- **Opportunity:** An opportunity is a favourable condition in the organisation's environment which enables it to strengthen its position.
- **Threat:** A threat is an unfavourable condition in the organisation's environment which causes a risk for, or damage to, the organisation's position.

Its central purpose is to identify the strategies that will create a firm-specific business model that will best align, fit, or match a company's resources and capabilities to the demands of the environment in which it operates. Strategic managers compare and contrast the various alternative possible strategies against each other with respect to their ability to achieve major goals and superior profitability. Thinking strategically requires managers to identify the set of strategies that will create and sustain a competitive advantage:

- *Functional-level strategy,* directed at improving the effectiveness of operations within a company, such as manufacturing, marketing, materials management, product development, and customer service.
- *Business-level strategy,* which encompasses the business's overall competitive theme, the way it position; itself in the marketplace to gain a competitive advantage, and the different positioning strategies that can be used in different industry settings-for example, cost leadership, differentiation, focusing on a particular niche or segment of the industry, or some combination of these.
- *Global strategy,* addressing how to expand operations outside the home country to grow and prosper in a world where competitive advantage is determined at a global level.
- *Corporate-level strategy,* which answers the primary questions. What business or businesses should we be in to maximize the long-run profitability of the organization, and how should we enter and increase our presence in these businesses to gain a competitive advantage?

The organization’s performance in the marketplace is significantly influenced by the three factors

- The organization’s correct market position
- The nature of environmental opportunities and threat
- The organization’s resource capability to capitalize the opportunities and its ability to protect against the threat

The significance of SWOT analysis lies in the following points:

- It provides a Logical Framework SWOT analysis provides us with a logical framework for systematic and sound thrashing of issues having bearing on the business situation, generation of alternative strategies and the choice of a strategy. Variation in managerial perceptions about organizational strengths and weaknesses and the environmental opportunities and threats lead to the approaches to specific strategies and finally the choice of strategy that takes place through an interactive process in dynamic backdrop.
- It presents a Comparative Account: SWOT analysis presents the information about both external and internal environment in a structured form where it is possible to compare external opportunities and threats with internal strengths and weaknesses. The helps in matching external and internal environments so that a strategist can come out with suitable strategy by developing certain patterns of relationship. The patterns are combinations say, high opportunities and high strengths, high opportunities and low strengths, high threats and high strengths, high threats and low strengths.

- It guides the strategist in Strategy Identification: It is natural that a strategist faces a problem when his organization cannot be matched in the four patterns. It is possible that the organization may have several opportunities and some serious threats. It is equally, true that the organization may have powerful strengths coupled with major weaknesses in the light of critical success factors. In such situation, SWOT analysis guides the strategist to think of overall position of the organization that helps to identify the major purpose of the strategy under focus.

SWOT analysis helps managers to craft a business model *(or* models) that will allow a company to gain a competitive advantage in its industry *(or* industries). Competitive advantage leads to increased profitability, and this maximizes a company's chances of surviving in the fast-changing, global competitive environment that characterizes most industries today.

Faced with a constantly changing environment, each business unit needs to develop a marketing information system to track trends and developments, which can be categorized as an opportunity or a threat. The company has to review its strength and weakness in the background of environment's opportunities and threat, i.e., an organization's SWOT analysis.

Potential Resource Strengths and Competitive Capabilities	**Potential Resource Weaknesses and Competitive Deficiencies**
A	B
Potential Company Opportunities	**Potential External Threats to Company's Well-Being**
C	D

Figure: SWOT Analysis: What to Look for in Sizing Up a Company's Strengths, weaknesses, Opportunities, and Threats.

A. Potential Resources Strengths and Competitive Capabilities

- A powerful strategy supported by competitively valuable skills and experience in key areas.
- A strong financial condition; ample financial resources to grow the business.
- Strong brand name, image/company reputation.

- A widely recognized market leader and an attractive customer base.
- Ability to take advantage of economies of scale and/or learning and experience curve effects.
- Proprietary technology/ superior technological skills/ important patents.
- Superior intellectual capital relative to key rivals.
- Cost advantages.
- Strong advertising and promotion.
- Product innovation skills.
- Proven skills in improving product processes.
- Sophisticated use of e-commerce technologies and processes.
- Superior skills in supply chain management.
- A reputation for good customer service.
- Better product quality relative to rivals.
- Wide geographic coverage and/or strong global distribution capability.
- Alliances/joint ventures with other firms that provide access to valuable technology, competencies, and/or attractive geographic markets.

B. Potential Resource Weaknesses and Competitive Deficiencies

- No clear strategic direction.
- Obsolete facilities.
- A weak balance sheet, burdened with too much debt.
- Higher overall unit costs relative to key competitors.
- Missing some key skills or competencies/lack of management depth/ a deficiency of intellectual capital relative to leading rivals.
- Subpar profitability; no cost control measures or cost accounting practices.
- Plagued with internal operating problems.
- Falling behind rivals in putting e-commerce capabilities and strategies in place.
- Too narrow a product line relative to rivals.

- Weak brand image or reputation.
- Weaker dealer network than key rivals and/or lack of adequate global distribution capability.
- Subpar e-commerce systems and capabilities relative to rivals.
- Short on financial resources to fund promising strategic initiatives.
- Lots of underutilized plant capacity.
- Behind on product quality and/or R&D and/or technological know-how.
- Not attracting new customers as rapidly as rivals.

C. Potential Company Opportunities

- Serving additional customer groups or expanding into new geographic markets or product segments.
- Expanding the company's product line to meet a broader range of customer needs.
- Utilizing existing company skills or technological know-how to enter new product lines or new businesses.
- Using the internet and e-commerce technologies to dramatically cut costs and/or to pursue new sales growth opportunities.
- Integrating forward or backward.
- Falling trade barriers in attractive foreign markets.
- Openings to take market share away from rivals.
- Ability to grow rapidly because of sharply rising demand in one or more market segments.
- Acquisition of rival firms or companies with attractive technological expertise.
- Alliances or joint ventures that expand the firm's market coverage or boost its competitive capability.
- Openings to exploit emerging new technologies.
- Market openings to extend the company's brand name or reputation to new geographic areas.

D. Potential External Threats to Company's Well-Being

- Likely entry of potent new competitors.
- Loss of sales to substitute products.
- Mounting competition from new Internet start-up companies pursuing e-commerce strategies.
- Increasing intensity of competition among industry rivals – may cause squeeze on profit margins.
- Technological changes or product innovations that undermine demand for the firm's product.
- Slowdowns in market growth.
- Adverse shifts in foreign exchange rates and trade policies of foreign governments.
- Costly new regulatory requirements.
- Growing bargaining power of customers or suppliers.
- A shift in buyer needs and tastes away from the industry's product.
- Adverse demographic changes that threaten to curtail demand for the firm's product.
- Vulnerability to industry driving forces.

SWOT Analyses at Moser Baer

Strengths	Weaknesses
♦ Integrated manufacturing allowing cost efficiencies and enhanced speed to market. ♦ Lower capital investment, manpower and overhead costs allow cost leadership. ♦ Strong focus on R&D and engineering to constantly innovate products and reduce costs. ♦ Committed shareholders add strength, longevity and sustainability to future plans.	♦ Need to scale up operations and evolve internal controls to meet exponential growth. ♦ Need to constantly expand capacities, requiring continuing capital investment.
Opportunities	**Threats**
♦ Exploding DVD-R market: With world-class capacities, existing top-tier customer base	♦ Emerging technologies: In a dynamic technology environment, the Company's

and efficient in-house technology, the Company is well positioned to tap this opportunity. ♦ Domestic market: India has one of the largest movie industries in the world and customers are shifting to CDs for audio and DVDs for video requirements. ♦ Blu-ray/HD-DVD: Efforts are on worldwide to define and develop the next-gen storage format and Moser Baer is part of that effort.	business could be threatened from more efficient emerging technologies. However, the extent of the threat is mitigated by the explosive growth in digital content, low cost and ease of storage on optical media, the huge installed base of read/write drives and time to market for a new format. ♦ Anti-dumping and anti-subsidy levies: The Company derives a significant part of its revenues from international markets. These have seen a growing protectionist attitude and a tendency by some local governments to use anti-dumping and trade protection tools to provide protection to local businesses. However, the Company continues to keep a close watch on this front and take necessary steps to minimize any fallout. ♦ Fall in product prices: As products move into the mature phase in their life-cycle, they start to emulate commodity-type characteristics. Also, as the industry is characterized by high volumes, large capacities and investments, a sharp reduction in product pricing can impact performance. Pricing could fall due to oversupply, low demand, cost reduction due to reduction in input costs or setting up of capacities in low-cost regions

About Moser Baer: Moser Baer, incorporated in 1983, is one of India's leading technology companies and ranks among the top three media manufacturers in the world. Based in New Delhi, India. it has a broad and robust product range of floppy disks, compact discs (CDs) and digital versatile discs (DVDs). (Source: http://moserbaer.com/investor_swot.asp)

6. TOWS MATRIX

Heinz Weihrich has developed a matrix called TOWS matrix by comparing strengths and weaknesses of organization with that of market opportunities and threats. It has been criticized that after conducting the SWOT Analysis managers frequently fail to come to terms with the strategic choices that the outcomes demand. In order to overcome this, Piercy argues for the TOWS Matrix, which, while using the same inputs (Threats, Opportunities, Weakness and Strengths) reorganizes them and integrates them more fully into the strategic planning process. The matrix is outlined below:

Internal / *External* Elements	Organizational strengths	Organizational weaknesses
	Strategic options	
Environmental opportunities (and risks)	**SO :** strengths can be used to capitalize or build upon existing or emerging opportunities	**WO :** the strategies developed need to overcome organizational weaknesses if existing or emerging opportunities are to be exploited
Environmental threats	**ST :** strengths in the organization can be used to minimize existing or emerging threats	**WT :** the strategies pursued must minimize or overcome weaknesses and as far as possible, cope with threats existing or emerging threats

Figure : The TOWS Matrix (Source: Weihrich, H)

7. PORTFOLIO ANALYSES

In order to analyse the current business portfolio, the company must conduct portfolio analysis (a tool by which management identifies and evaluates the various businesses that make up the company). In portfolio analyses top management views its product lines and business units as a series of investments from which it expects returns. A business portfolio is a collection of businesses and products that make up the company. The best business portfolio is the one that best fits the company's strengths and weaknesses to opportunities in the environment.

Portfolio analysis can be defined as a set of techniques that help strategists in taking strategic decisions with regard to individual products or businesses in a firm's portfolio. It is primarily used for competitive analysis and corporate strategic planning in multi product and multi business firms. They may also be used in less-diversified firms, if these consist of a main business and other minor complementary interests. The main advantage in adopting a portfolio approach in a multi-product, multi-business firm is that resources could be channelised at the corporate level to those businesses that posses the greatest potential. For instance, a diversified company may decide to divert resources from its cash-rich businesses to more prospective ones that hold promise of a faster growth so that the company achieves its corporate level objectives in an optima manner.

In order to design the business portfolio, the business must analyse its current business portfolio and decide which business should receive more, less, or no investment. Depending upon analyses businesses may develop growth strategies for adding new products or businesses to the portfolio.

There are three important concepts, the knowledge of which is a prerequisite to understand different models of portfolio analysis:

Strategic business unit: Analysing portfolio may begin with identifying key businesses also termed as strategic business unit (SBU). SBU is a unit of the company that has a separate mission and objectives and which can be planned independently from other company businesses. The SBU can be a company division, a product line within a division, or even a single product or brand. SBUs are common in organisations that are located in multiple countries with independent manufacturing and marketing setups. An SBU has following characteristics:

- Single business or collection of related businesses that can be planned for separately.
- Has its own set of competitors.
- Has a manager who is responsible for strategic planning and profit.

After identifying SBUs the businesses have to assess their respective attractiveness and decide how much support each deserves.

There are a number of techniques that could be considered as corporate portfolio analysis techniques. The most popular is the Boston Consulting Group (BGC) matrix or product portfolio matrix. But there are several other techniques that should be understood in order to have a comprehensive view of how objective factors can help strategists in exercising strategic choice.

Experience Curve: Experience curve is an important concept used for applying a portfolio approach. The concept is akin to a learning curve which explains the efficiency increase gained by workers through repetitive productive work. Experience curve is based on the commonly observed phenomenon that units costs decline as a firm accumulates experience in terms of a cumulative volume of production. The implication is that larger firms in an industry would tend to have lower unit costs as compared to those for smaller companies, thereby gaining a competitive cost advantage. Experience curve results from a variety of factors such as learning effects, economies of scale, product redesign and technological improvements in production.

The concept of experience curve is relevant for a number of areas in strategic management. For instance, experience curve is considered a barrier for new firms contemplating entry in an industry. It is also used to build market share and discourage competition. In the contemporary Indian two wheeler market, the experience curve phenomenon seems to be working in favour of Bajaj Auto, which for the past decade has been selling, on an average, 5 lakh scooters a year and retains more than 60 per cent of the market. Its only serious competitor is LML Vespa Ltd., which has a far lesser share of the market. The primary strategic advantage that Bajaj Auto has is in terms of costs. Other competitors like Gujarat Narmada and Kinetic Honda find it extremely difficult to compete due to the cost differentials that currently exist. The likely strategic choice for underdog competitors could be a market niche approach or segmentation based on demography or geography.

Product Life Cycle: Another important concept in strategic choice is that of product life cycle (PLC). It is a useful concept for guiding strategic choice. Essentially, PLC is an S-shaped curve which exhibits the relationship of sales with respect of time for a product that passes through the four successive stages of introduction (slow sales growth), growth (rapid market acceptance) maturity (slow down in growth rate) and decline (sharp downward drift). If businesses are substituted for product, the concept of PLC could work just as well. The main advantage of PLC is that it can be used to diagnose a portfolio of products (or businesses) in order to establish the stage at which each of them exists. Particular attention is to be paid on the businesses that are in the declining stage. Depending on the diagnosis, appropriate strategic choice could be made. For instance, expansion may be a feasible alternative for businesses in the introductory and growth stages. Mature businesses may be used as sources of cash for investment in other businesses which need resources. A combination of strategies like selective harvesting, retrenchment, etc. may be adopted for declining businesses. In this way, a balanced portfolio of businesses may be built up by exercising a strategic choice based on the PLC concept.

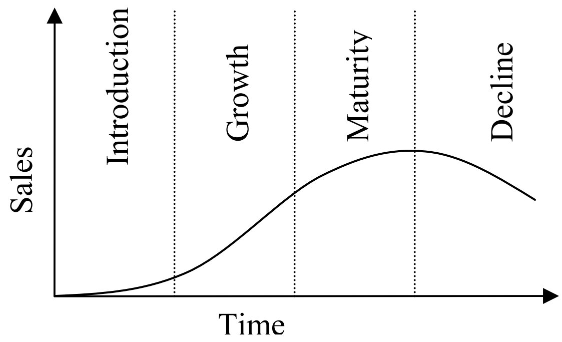


Figure: Product Life Cycle

7.2 Boston consulting group (BCG) growth-share matrix

The BCG growth-share matrix is the simplest way to portray a corporation's portfolio of investments. Growth share matrix also known for its cow and dog metaphors is popularly used for resource allocation in a diversified company. Using the BCG approach, a company classifies its different businesses on a two-dimensional growth-share matrix. In the matrix:

- The vertical axis represents market growth rate and provides a measure of market attractiveness.
- The horizontal axis represents relative market share and serves as a measure of company strength in the market.

Using the matrix, organisations can identify four different types of products or SBU as follows:

- **Stars** are products or SBUs that are growing rapidly. They also need heavy investment to maintain their position and finance their rapid growth potential. They represent best opportunities for expansion.
- **Cash Cows** are low-growth, high market share businesses or products. They generate cash and have low costs. They are established, successful, and need less investment to maintain their market share. In long run when the growth rate slows down, stars become cash cows.

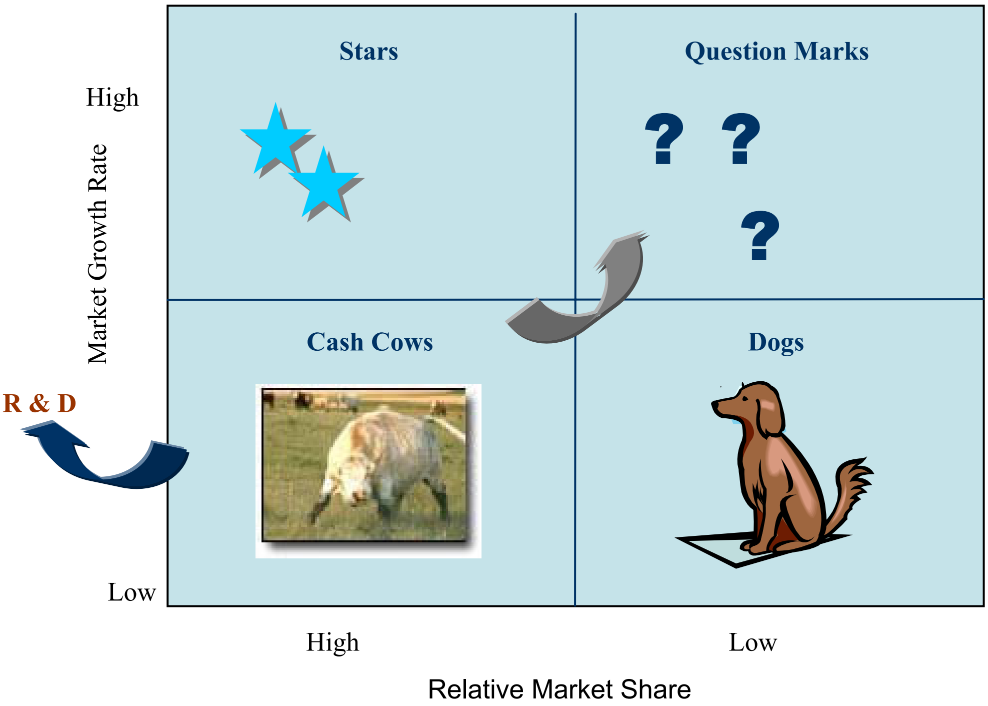


Figure: BCG Growth-Share Matrix

- **Question Marks,** sometimes called problem children or wildcats, are low market share business in high-growth markets. They require a lot of cash to hold their share. They need heavy investments with low potential to generate cash. Question marks if left unattended are capable of becoming cash traps. Since growth rate is high, increasing it should be relatively easier. It is for business organisations to turn them stars and then to cash cows when the growth rate reduces.

- **Dogs** are low-growth, low-share businesses and products. They may generate enough cash to maintain themselves, but do not have much future. Sometimes they may need cash to survive. Dogs should be minimised by means of divestment or liquidation.

Once the organisations have classified its products or SBUs, it must determine what role each will play in the future. The four strategies that can be pursued are:

1. **Build:** Here the objective is to increase market share, even by forgoing short-term earnings in favour of building a strong future with large market share.
2. **Hold:** Here the objective is to preserve market share.
3. **Harvest:** Here the objective is to increase short-term cash flow regardless of long-term effect.
4. **Divest:** Here the objective is to sell or liquidate the business because resources can be better used elsewhere.

The growth-share matrix has done much to help strategic planning study; however, there are problems and limitations with the method. BCG matrix can be difficult, time-consuming, and costly to implement. Management may find it difficult to define SBUs and measure market share and growth. It also focuses on classifying current businesses but provide little advice for future planning. They can lead the company to placing too much emphasis on market-share growth or growth through entry into attractive new markets. This can cause unwise expansion into hot, new, risky ventures or giving up on established units too quickly.

7.3 Ansoff's product market growth matrix

The Ansoff's product market growth matrix (proposed by Igor Ansoff) is a useful tool that helps businesses decide their product and market growth strategy. With the use of this matrix a business can get a fair idea about how its growth depends upon it markets in new or existing products in both new and existing markets. Companies should always be looking to the future. One useful device for identifying growth opportunities for the future is the product/market expansion grid. The product/market growth matrix is a portfolio-planning tool for identifying company growth opportunities.

Market Penetration: Market penetration refers to a growth strategy where the business focuses on selling existing products into existing markets. It is achieved by making more sales to present customers without changing products in any major way. Penetration might require greater spending on advertising or personal selling. Overcoming competition in a mature market requires an aggressive promotional campaign, supported by a pricing strategy designed to make the market unattractive for competitors. Penetration is also done by effort on increasing usage by existing customers.

Market Development: Market development refers to a growth strategy where the business seeks to sell its existing products into new markets. It is a strategy for company growth by identifying and developing new markets for current company products. This strategy may be achieved through new geographical markets, new product dimensions or packaging, new distribution channels or different pricing policies to attract different customers or create new market segments.

Product Development: Product development is refers to a growth strategy where business aims to introduce new products into existing markets. It is a strategy for company growth by offering modified or new products to current markets. This strategy may require the development of new competencies and requires the business to develop modified products which can appeal to existing markets.

Diversification: Diversification refers to a growth strategy where a business markets new products in new markets. It is a strategy by starting up or acquiring businesses outside the company's current products and markets. This strategy is risky because it does not rely on either the company's successful product or its position in established markets. Typically the business is moving into markets in which it has little or no experience.

As market conditions change overtime, a company may shift product-market growth strategies. For example, when its present market is fully saturated a company may have no choice other than to pursue new market.

	Existing Products	**New Products**
Existing Markets	Market Penetration	Product Development
New Markets	Market Development	Diversification

Figure: Ansoff's Product Market Growth Matrix

7.4 ADL matrix

The ADL matrix has derived its name from Arthur D. Little is a portfolio analysis method that is based on product life cycle. The approach forms a two dimensional matrix based on stage of industry maturity and the firms competitive position, environmental assessment and business strength assessment. Stage of industry maturity is an environmental measure that represents a position in industry's life cycle. Competitive position is a measure of business strengths that helps in categorization of products or SBU's into one of five competitive positions: dominant, strong, favorable, tenable, weak. It is 4 by five matrix as follows:

	Stage of industry maturity			
Competitive position	**Embryonic**	**Growth**	**Mature**	**Ageing**
Dominant	Fast grow Build barriers Act offensively	Fast grow Attend cost leadership Renew Defend position Act offensively	Defend position Attend cost leadership Renew Fast grow Act offensively	Defend position Renew Focus Consider withdrawal
Strong	Differentiate Fast grow	Differentiate Lower cost Attack small firms	Lower cost Focus Differentiate Grow with industry	Find niche Hold niche Harvest
Favourable	Differentiate Focus Fast grow	Focus Differentiate Defend	Focus Differentiate Harvest Find niche Hold niche Turnaround Grow with industry Hit smaller firms	Harvest Turnaround
Tenable	Grow with industry Focus	Hold niche Turnaround Focus Grow with industry Withdraw	Turnaround Hold niche Retrench	Divest Retrench
Weak	Find niche Catch-up Grow with industry	Turnaround Retrench Niche or withdraw	Withdraw Divest	Withdraw

Figure: Arthur D. Little Strategic Condition Matrix

The competitive position of a firm is based on an assessment of the following criteria:

Dominant: This is a comparatively rare position and in many cases is attributable either to a monopoly or a strong and protected technological leadership.

Strong: By virtue of this position, the firm has a considerable degree of freedom over its choice of strategies and is often able to act without its market position being unduly threatened by its competitions.

Favourable: This position, which generally comes about when the industry is fragmented and no one competitor stand out clearly, results in the market leaders a reasonable degree of freedom.

Tenable: Although the firms within this category are able to perform satisfactorily and can justify staying in the industry, they are generally vulnerable in the face of increased competition from stronger and more proactive companies in the market.

Weak: The performance of firms in this category is generally unsatisfactory although the opportunity for improvement do exist.

7.5 The General Electric Model

The General Electric Model (developed by GE with the assistance of the consulting firm McKinsey & Company) is similar to the BCG growth-share matrix. However, there are differences. Firstly, market attractiveness replaces market growth as the dimension of industry attractiveness, and includes a broader range of factors other than just the market growth rate. Secondly, competitive strength replaces market share as the dimension by which the competitive position of each SBU is assessed. This also uses two factors in a matrix / grid situation as shown below:

Business Position

Market Attractiveness	High	Medium	Low
High	Invest	Invest	Protect
Medium	Invest	Protect	Harvest
Low	Protect	Harvest	Divest

Figure : The GE Matrix

Each of the above two factors is rated according to criteria such as the following:

Evaluating the ability to compete: Business position	Evaluating the Market Attractiveness
Size Growth Share by segment Customer loyalty Margins Distribution Technology skills Patents Marketing Flexibility Organization	Size Growth Customer satisfaction levels Competition: quality, types, Effectiveness, commitment Price levels Profitability Technology Government regulations Sensitivity to economic trends

Figure: Criteria for rating Business Position and Market Attractiveness

The criteria used to rate market attractiveness and business position assigned different ways because some criteria are more important than others. Then each SBU is rated with respect to all criteria. Finally, overall rating for both factors are calculated for each SBU. Based on these ratings, each SBU is labelled as high, medium or low with respect to (a) market attractiveness, and (b) business position.

Every organization has to make decisions about how to use its limited resources most effectively. That's' where this planning models can help determining which SBU should be stimulated for growth, which one maintained in their present market position and which one eliminated.

SELF-EXAMINATION QUESTIONS

Multiple – Choice Questions

1. SWOT analysis is an evaluation of the organization's ________ strengths and weaknesses and its ________ opportunities and threats.

   (a) external; internal

   (b) internal; internal

   (c) external; external

   (d) internal; external

2. The goal of SWOT analysis is to ________ the organization's opportunities and strengths while ________ its threats and ________ its weaknesses.

   (a) avoid; neutralizing; correcting

   (b) exploit; neutralizing; correcting

   (c) avoid; capitalizing; neutralizing

   (d) exploit; avoiding; ignoring

3. Which of the following does “B” stand for in the BCG Matrix?

   (a) Boom

   (b) Balance

   (c) Bankruptcy

   (d) Boston

4. Which of the following competitive position of a firm is not as per ADL Matrix?

   (a) Dominant

   (b) Favourable

   (c) Difficult

   (d) Tenable

5. In BCG matrix, the cash cows represents:

   (a) High market share and Low market growth

   (b) High market share and High market growth

   (c) Low market share and Low market growth

   (d) Low market share and High market growth

6. Boston Consulting Group Matrix consists of:

   (a) Stars, Cash Cows, Cats and Rats

   (b) Stars, Sun, Moon and Universe

   (c) Stars, Cash Cows, Dogs and Question Marks

   (d) Problems, Questions, Consultancy and Solutions.

7. DL matrix derived its name from:

   (a) Arthur D. Little

   (b) Arthur D. Latin

(c) Ansoff's D. Little

(d) Ansoff's D. Latin

8. A ________ consists of those rival firms with similar competitive approaches and positions in the market.

(a) Business unit

(b) Strategic group

(c) Strategic fit

(d) None of these

9. KSFs stand for:

(a) Key strategic factors

(b) Key supervisory factors

(c) Key success factors

(d) Key sufficient factors

10. TOWS matrix has been developed by:

(a) Heinz Ulwrick

(b) Ulwrick Scholes

(c) Scholes and Jhonson

(d) Heinz Weihrich

11. External opportunities and threats are usually:

(a) the minor cause of organizational demise or success

(b) least important for CEOs and the board of directors

(c) not as important as internal strengths and weaknesses

(d) uncontrollable activities outside the organization

Objective Type Question

State with reasons which of the following statements are correct/incorrect:

(a) Industry is a group of firms whose products have same and similar attributes such that they compete for the same buyers.

(b) Industry is any business organization engaged in manufacturing activities.

(c) SWOT analysis is an evaluation of the organization's external strengths and weaknesses and its internal opportunities and threats.

(d) "C" in BCG Matrix stands for commitment.

Short answer questions

1. What is a key success factor?
2. What is product development?
3. Explain dogs in BCG matrix?

Essay type questions

1. Why organisations undertake portfolio analyses? Discuss any one model of portfolio analysis in detail.
2. What is TOWS matrix? Is it same as SWOT analysis? Discuss.

Case Study

The Managing Director of Big Ltd. called an internal meeting of senior managers to discuss issues involved in acquiring Small Ltd. for about Rs. 350 crores. He started the meeting with following observations:

'After acquiring Small, we will become the second largest consumer goods company in India with sales of over Rs. 4500 crores. We will have more money for marketing initiatives, product launches and aggressive price-cuts. The key reason behind buying Small is to create shareholder value over and above that of the sum of the two companies. Recent years have been tough for both the companies with strong competition. The merged company hopes to gain a greater market share and achieve greater efficiency.'

Different issues were discussed between the managers. Pertinent points that were raised were as follows:

Head Production. 'Although, I am involved little, till now, in the discussion regarding the acquisition, I have closely studied various production facilities available to both the companies. I feel production facilities of both the companies need to be synergised. There is also need to close down production facilities of two locations out of seven locations of Small. The costs of production of these locations is very high and also they are located in eastern India, whereas our major sales is in south and west.'

Head Marketing. We need to analyse it further. The market of the products is in mature phase with low growth rate. Small Ltd. has little presence in some regions and is not a major competitor for us. Further, there is marginal gap between our existing third position and second position. We can easily achieve second position if we are able to fully utilise our capacities.

(a) In a low growth product what are the different options available to a company.

(b) If you are appointed as a consulted, advise the Big Ltd. how to proceed before arriving at decision to acquire any company.

(c) Conduct SWOT analysis from the facts given in the case.

Answers- Multiple Choice Questions

1. (d), **2.** (b), **3.** (d), **4.** (c), **5.** (a), **6.** (c), **7.** (a), **8.** (b), **9.** (c), **10.** (d), **11.** (d)

CHAPTER 4

STRATEGIC PLANNING

LEARNING OBJECTIVES

- Learn the meaning of strategic intent and vision.
- Understand the process of strategy formulation.
- Know the different stages of strategy-formulation-implementation process.
- Have knowledge of different generic strategies as taken up by corporates.
- To have a basic knowledge of alternative growth/directional strategies.

Chance favors the prepared mind.

Louis Pasteur

Far better an approximate answer to the right question, which is often vague, than an exact answer to the wrong question, which can be made precise.

John Tukey, Statistician

Strategy is a deliberate search for a plan of action that will develop a business competitive advantage and compound it.

Bruce D. Henderson

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1. INTRODUCTION

Generally, the strategic planning process culminates in the formulation of corporate strategy. The strength of the entire process of strategic planning is tested by the efficacy of the strategy finally forged by the firm. The ultimate question is whether the strategy ironed out is the appropriate one-whether it would take the firm to its objectives. Corporate strategy is the game plan that actually steers the firm towards success. The degree of aptness of this game plan decides the extent of the firm's success. That is why formulation of corporate strategy forms the crux of the strategic planning process

2. CORPORATE STRATEGY

At an initial level, the concept of strategy has been discussed in the second chapter. Now we will take the concept forward. Corporate strategy is basically the growth design of the firm; it spells out the growth objective of the firm - the direction, extent, pace and timing of the firm's growth. It also spells out the strategy for achieving the growth. Thus, we can also describe corporate strategy as the objective-strategy design of the firm. And, to arrive at such an objective-strategy design is the basic burden of corporate strategy formulation.

2.1 Nature, scope and concerns of corporate strategy

Corporate strategy is basically concerned with the choice of businesses, products and markets. The following points will clarify the corporate strategy.

- It can also be viewed as the objective-strategy design of the firm.
- It is the design for filling the firm's strategic planning gap.
- It is concerned with the choice of the firm's products and markets; it actually denotes the changes / additions / deletions in the firm's existing product-market postures. It spells out the businesses in which the firm will play, the markets in which it will operate and the customer needs it will serve.
- It ensures that the right fit is achieved between the firm and its environment.
- It helps build the relevant competitive advantages for the firm.
- Corporate objectives and corporate strategy together describe the firm's concept of business.

2.2 What does corporate strategy ensure?

Corporate strategy in the first place ensures the growth of the firm and ensures the correct alignment of the firm with its environment. It serves as the design for filling the strategic planning gap. It also helps build the relevant competitive advantages. Masterminding and working out the right fit between the firm and its external environment is the primary contribution of corporate strategy. Basically the purpose of corporate strategy is to harness the opportunities available in the environment, countering the threats embedded therein. How does corporate strategy actually accomplish this task? It is by matching the unique capabilities of the firm with the promises and threats of the environment that it achieves this task.

It is obvious that responding to environment is part and parcel of a firm's existence. The question is how good or how methodical is the response. This is where strategy steps in. Strategy is the opposite of adhoc responses to the changes in the environment-in competition, consumer tastes, technology and other variables. It amounts to long-term, well thought-out and prepared responses to the various forces in the business environment.

2.3 Strategy is partly proactive and partly reactive

A company's strategy is typically a blend of (1) proactive actions on the part of managers to improve the company's market position and financial performance and (2) as needed reactions to unanticipated developments and fresh market conditions. The biggest portion of a company's current strategy flows from previously initiated actions and business approaches that are working well enough to merit continuation and newly launched managerial initiatives to strengthen the company's overall position and performance. This part of management's game plan is deliberate and proactive, standing as the product of management's analysis and strategic thinking about the company's situation and its conclusions about how to position the company in the marketplace and tackle the task of competing for buyer patronage.

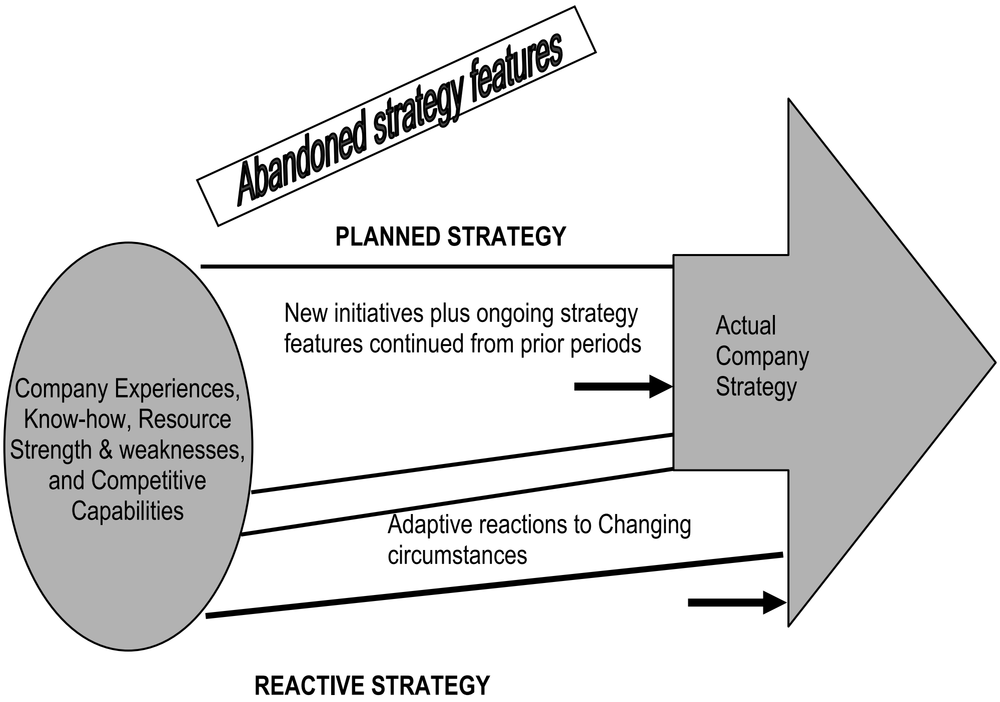

Figure: A Company's Actual Strategy Is Partly Planned & Partly Reactive

But not every strategic move is the result of proactive plotting and deliberate management design. Things happen that cannot be fully anticipated or planned for. When market and competitive conditions take an unexpected turn or some aspect of a company's strategy hits a stone wall, some kind of strategic reaction or adjustment is required. Hence, a portion of a company's strategy is always developed on the fly, coming as a reasoned response to unforeseen developments-fresh strategic maneuvers on the part of rival firms, shifting customer requirements and expectations, new technologies and market opportunities, a changing political or economic climate, or other unpredictable or unanticipated happenings in the surrounding environment. But apart from adapting strategy to changes in the market, there is also a need to adapt strategy as new learning emerges about which pieces of the strategy are working well and which aren't and as management hits upon new ideas for improving the strategy. Crafting a strategy thus involves stitching together a proactive/intended strategy and then adapting first one piece and then another as circumstances surrounding the company's situation change or better options emerge-a reactive/adaptive strategy.

2.3 Dealing with strategic uncertainty

Strategic uncertainty, uncertainty that has strategic implications, is a key construct in strategy formulation. A typical external analysis will emerge with dozens of strategic uncertainties. To be manageable, they need to be grouped into logical clusters or themes. It is then useful to assess the importance of each cluster in order to set priorities with respect to Information gathering and analysis.

Sometimes the strategic uncertainty is represented by a future trend or event that has inherent unpredictability. Information gathering and additional analysis will not be able to reduce the uncertainty. In that case, scenario analysis can be employed. Scenario analysis basically accepts the uncertainty as given and uses it to drive a description of two or more future scenarios. Strategies are then developed for each. One outcome could be a decision to create organizational and strategic flexibility so that as the business context changes the strategy will adapt.

Impact of a strategic uncertainty: Each strategic uncertainty involves potential trends or events that could have an impact on present, proposed, and even potential strategic business units (SBUs). For example, a trend toward natural foods may present opportunities for juices for a firm producing aerated drinks on the basis of a strategic uncertainty. The impact of a strategic uncertainty will depend on the importance of the impacted SBU to a firm. Some SBUs are more important than others. The importance of established SBUs may be indicated by their associated sales, profits, or costs. However, such measures might need to be supplemented for proposed or growth SBUs for which present sales, profits, or costs may not reflect the true value to a firm. Finally, because an information-need area may affect several SBUs, the number of involved SBUs can also be relevant to a strategic uncertainty's impact.

3. THE STAGES OF CORPORATE STRATEGY FORMULATION-IMPLEMENTATION PROCESS

Crafting and executing strategy are the heart and soul of managing a business enterprise. But exactly what is involved in developing a strategy and executing it proficiently? And who besides top management has strategy – formulation – executing responsibility?

Crafting and executing a company's strategy is a five-stage managerial process as given below:

1. Developing a strategic vision of where the company needs to head and what its future product-customer-market-technology focus should be.
2. Setting objectives and using them as yardsticks for measuring the company's performance and progress.
3. Crafting a strategy to achieve the desired outcomes and move the company along the strategic course that management has charted.
4. Implementing and executing the chosen strategy efficiently and effectively.
5. Monitoring developments and initiating corrective adjustments in the company's long-term direction, objectives, strategy, or execution in light of the company's actual performance, changing conditions, new ideas, and new opportunities.

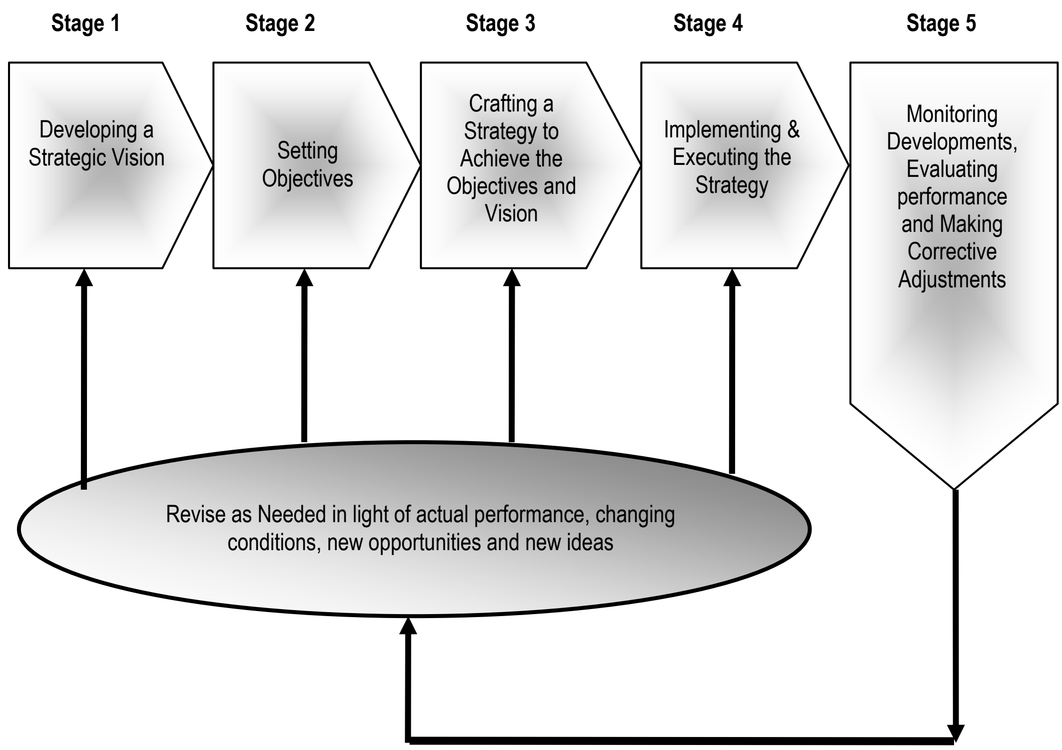

Figure: The Stages of Corporate Strategy Formulation- Implementation Process

Stage 1 : Developing a strategic vision

First a company must determine what directional path the company should take and what changes in the company's product – market – customer – technology – focus would improve its current market position and its future prospect. Deciding to commit the company to one path versus another pushes managers to draw some carefully reasoned conclusions about how to try to modify the company's business makeup and the market position it should stake out. Top management's views and conclusions about the company's direction and the product-customer-market-technology focus constitute a strategic vision for the company. A strategic vision delineates management's aspirations for the business and points an organization in a particular direction, charts a strategic path for it to follow in preparing for the future, and molds organizational identity. A clearly articulated strategic vision communicates management's aspirations to stakeholders and helps steer the energies of company personnel in a common direction.

Mission and Strategic Intents: Managers need to be clear about what they see as the role of their organization, and this is often expressed in terms of a statement of mission or strategic intent This is important because both external stakeholders and other managers in the organization need to be clear about what the organization is seeking to achieve and, in broad terms, how it expects to do so. At this level, strategy is not concerned with the details of SBU competitive strategy or the directions and methods the businesses might take to achieve competitive advantage Rather, the concern here is overall strategic direction.

The managers of a subsidiary, charged with developing a strategy for that business, also need to be clear where they fit into the corporate whole. As Hamel and Prahalad have highlighted, the importance of clear strategic intent can go much further: it can help galvanise motivation and enthusiasm throughout the organization by providing what they call a sense of destiny and discovery. In the absence of this, there is a risk of the different parts of the organization, different levels of management, indeed all members of the organization, pulling in different directions.

Decisions on overall mission in a major corporation will exercise constraints elsewhere. Does the corporation aspire to short-term profits or long-term growth; to a focused set of highly related businesses or a more diversified set of businesses; to global coverage or the focus on selected countries; to investment in internal innovation and new products, or the acquisition of other businesses? These are, of course, all matters of strategic choice, but they are unlikely to change regularly. The overall stance of the corporation with regard to such matters may develop over many years, but by being made explicit it can help direct strategic choice.

Stage 2 : Setting objectives

Corporate objectives flow from the mission and growth ambition of the corporation. Basically, they represent the quantum of growth the firm seeks who achieve in the given time frame. They also endow the firm with characteristics that ensures the projected the growth. Through the objective setting process, the firm is tackling the environment and deciding the locus it should have in the environment. The objective provides the basis for it major decisions of the firm and also said the organizational performance to be realised at each level. The managerial purpose of setting objectives is to convert the strategic vision into specific performance targets

– results and outcomes the management wants the achieve - and then use these objectives as yardsticks for tracking the company's progress and performance.

Ideally, managers ought to use the objective-setting exercise as a tool for truly stretching an organization to reach its full potential. Challenging company personnel to go all out and deliver big gains in performance pushes an enterprise to be more inventive, to exhibit some urgency in improving both its financial performance and its business position, and to be more intentional and focused in its actions.

The balanced scorecard approach: A combination of strategic and financial objectives – The balanced scorecard approach for measuring company performance requires setting both financial and strategic objectives and tracking their achievement. Unless a company is in deep financial difficulty, such that its very survival is threatened, company managers are well advised to put more emphasis on achieving strategic objectives than on achieving financial objectives whenever a trade-off has to be made. The surest path to sustained future profitability quarter after quarter and year after year is to relentlessly pursue strategic outcomes that strengthen a company’s business position and, ideally, give it a growing competitive advantage over rivals. What ultimately enables a company to deliver better financial results from operations is the achievement of strategic objectives that improve its competitiveness and market strength.

A need for both short-term and long-term objectives: As a rule, a company's set of financial and strategic objectives ought to include both short-term and long-term performance targets. Having quarterly or annual objectives focuses attention on delivering immediate performance improvements. Targets to be achieved within three to five years prompt considerations of what to do now to put the company in position to perform better down the road. A company that has an objective of doubling its sales within five years can't wait until the third or fourth year to begin growing its sales and customer base. By spelling out annual (or perhaps quarterly) performance targets, management indicates the speed at which longer-range targets are to be approached.

Long-term objectives: To achieve long-term prosperity, strategic planners commonly establish long-term objectives in seven areas.

- Profitability.
- Productivity.
- Competitive Position.
- Employee Development.
- Employee Relations.
- Technological Leadership.
- Public Responsibility.

Long-term objectives represent the results expected from pursuing certain strategies, Strategies represent the actions to be taken to accomplish long-term objectives. The time frame for objectives and strategies should be consistent, usually from two to five years, *Qualities of Long-Term Objectives*

- Acceptable.
- Flexible.
- Measurable.
- Motivating.
- Suitable.
- Understandable.
- Achievable.

Objectives should be quantitative, measurable, realistic, understandable, challenging, hierarchical, obtainable, and congruent among organizational units. Each objective should also be associated with a time line. Objectives are commonly stated in terms such as growth in assets, growth in sales, profitability, market share, degree and nature of diversification, degree and nature of vertical integration, earnings per share, and social responsibility. Clearly established objectives offer many benefits. They provide direction, allow synergy, aid in evaluation, establish priorities, reduce uncertainty, minimize conflicts, stimulate exertion, and aid in both the allocation of resources and the design of jobs,

Short-range objectives can be identical to long-range objectives if an organization is already performing at the targeted long-term level. For instance, if a company has an ongoing objective of 15 percent profit growth every year and is currently achieving this objective, then the company's long-range and short-range objectives for increasing profits coincide. The most important situation in which short-range objectives differ from long-range objectives occurs when managers are trying to elevate organizational performance and cannot reach the long-range target in just one year. Short-range objectives then serve as stair-steps or milestones.

Concept of Strategic Intent: A company exhibits strategic intent when it relentlessly pursues an ambitious strategic objective and concentrates its full resources and competitive actions on achieving that objective. A company's objectives sometimes play an other role – that of signaling unmistakable strategic intent to make quantum gains in competing against key rivals and establish itself as a clear-cut winner in the marketplace, often against long odds. A company's strategic intent can entail becoming the dominant company in the industry, unseating the existing industry leader, delivering the best customer service of any company in the industry (or the world), or turning a new technology into products capable of changing the way people work and live. Ambitious companies almost invariably begin with strategic intents that are out of proportion to their immediate capabilities and market positions. But they are undeterred by a grandiose objective that may take a sustained effort of 10 years or more to achieve. So intent are they on reaching the target that they set aggressive stretch objectives and pursue them relentlessly, sometimes even obsessively.

The need for objectives at all organizational levels: objective setting should not stop with top management's establishing of companywide performance targets. Company objectives need to be broken down into performance targets for each separate business, product line, functional department, and individual work unit. Company performance can't reach full potential unless each area of the organization does its part and contributes directly to the desired companywide outcomes and results. This means setting performance targets for each organization unit that support-rather than conflict with or negate-the achievement of companywide strategic and financial objectives.

The ideal situation is a team effort in which each organizational unit strives to produce results in its area of responsibility that contribute to the achievement of the company's performance targets and strategic vision. Such consistency signals that organizational units know their strategic role and are on board in helping the company move down the chosen strategic path and produce the desired results.

Stage 3: Crafting a strategy to achieve the objectives and vision

A company's strategy is at full power only when its many pieces are united. Ideally, the pieces and layers of a company's strategy should fit together like a jigsaw puzzle. To achieve this unity, the strategizing process generally has proceeded from the corporate level to the business level and then from the business level to the functional and operating levels. Midlevel and frontline managers cannot do good strategy making without understanding the company's long-term direction and higher-level strategies. All the strategy makers in a company are on the same team and the many different pieces of the overall strategy crafted at various organizational levels need to be in sync and united. Anything less than a unified collection of strategies weakens company performance.

Achieving unity in strategy making is partly a function of communicating the company's basic strategy themes effectively across the whole organization and establishing clear strategic principles and guidelines for lower-level strategy making. Cohesive strategy making down through the hierarchy becomes easier to achieve when company strategy is distilled into pithy, easy-to-grasp terminology that can be used to drive consistent strategic action throughout the company. The greater the numbers of company personnel who know, understand, and buy in to the company's basic direction and strategy, the smaller the risk that people and organization units will go off in conflicting strategic directions when decision making is pushed down to frontline levels and many people are given a strategy-making role. Good communication of strategic themes and guiding principles thus serves a valuable strategy-unifying purpose.

A company's strategic plan lays out its future direction, performance targets, and strategy. Developing a strategic vision, setting objectives, and crafting a strategy are basic direction-setting tasks. They map out the company's direction, its short-range and long-range performance targets, and the competitive moves and internal action approaches to be used in achieving the targeted business results. Together, they constitute a strategic plan for coping with industry and competitive conditions, the expected actions of the industry's key players, and the challenges and issues that stand as obstacles to the company's success.

In making strategic decisions, inputs from a variety of assessments are relevant. However, the core of any strategic decision should be based on three types of assessments. The first concerns organizational strengths and weaknesses. The second evaluates competitor strengths, weaknesses, and strategies, because an organization's strength is of less value if it is neutralized by a competitor's strength or strategy. The third assesses the competitive context, the customers and their needs, the market, and the market environment. These assessments focus on determining how attractive the selected market will be, given the strategy selected.

The goal is to develop a strategy that exploits business strengths and competitor weaknesses and neutralizes business weaknesses and. competitor strength. The ideal is to compete in a healthy, growing industry with a strategy based on strengths that are unlikely to be acquired or neutralized by competitor. Figure below summarizes how these assessments combine to influence strategy.

Figure: Structuring Strategic Decisions

Stage 4 : Implementing & executing the strategy

Managing strategy implementation and execution is an operations-oriented, activity aimed at shaping the performance of core business activities in a strategy-supportive manner. It is easily the most demanding and time-consuming part of the strategy-management process. To convert strategic plans into actions and results, a manager must be able to direct organizational change, motivate people, build and strengthen company competencies and competitive capabilities, create a strategy-supportive work climate, and meet or beat performance targets.

In most situations, managing the strategy-execution process includes the following principal aspects:

- Staffing the organization with the needed skills and expertise, consciously building and strengthening strategy-supportive competencies and competitive capabilities, and organizing the work effort.
- Developing budgets that steer ample resources into those activities critical to strategic success.
- Ensuring that policies and operating procedures facilitate rather than impede effective execution.
- Using the best-known practices to perform core business activities and pushing for continuous improvement.
- Installing information and operating systems that enable company personnel to better carry out their strategic roles day in and day out.
- Motivating people to pursue the target objectives energetically
- Tying rewards and incentives directly to the achievement of performance objectives and good strategy execution.
- Creating a company culture and work climate conducive to successful strategy implementation and execution.
- Exerting the internal leadership needed to drive implementation forward and keep improving strategy execution. When the organization encounters stumbling blocks or weaknesses, management has to see that they are addressed and rectified quickly.

Good strategy execution involves creating strong "fits" between strategy and organizational capabilities, between strategy and the reward structure, between strategy and internal operating systems, and between strategy and the organization's work climate and culture.

Stage 5 : Monitoring developments, evaluating performance and making corrective adjustments

A company's vision, objectives, strategy, and approach to strategy execution are never final; managing strategy is an ongoing process, not an every now and then task. The fifth stage of the strategy management process – evaluating the company's progress, assessing the impact of new external developments, and making corrective adjustments – is the trigger point for deciding whether to continue or change the company's vision, objectives, strategy, and/or strategy-execution methods. So long as the company's direction and strategy seem well matched to industry and competitive conditions and performance targets are being met, company executives may decide to stay the course. Simply fine-tuning the strategic plan and continuing with ongoing efforts to improve strategy execution are sufficient.

But whenever a company encounters disruptive changes in its external environment, questions need to be raised about the appropriateness of its direction and strategy. If a company experiences a downturn in its market position or shortfalls in performance, then company managers are obligated to ferret out whether the causes relate to poor strategy, poor execution, or both and then to take timely corrective action. A company's direction, objectives, and strategy have to be revisited anytime external or internal conditions warrant. It is to be expected that a company will modify its strategic vision, direction, objectives, and strategy over time.

Proficient strategy execution is always the product of much organizational learning. It is achieved unevenly – coming quickly in some areas and proving nettlesome and problematic in others. Periodically assessing what aspects of strategy execution are working well and what needs improving is normal and desirable. Successful strategy execution entails vigilantly searching for ways or continuously improve and then making corrective adjustments whenever and wherever it is useful to do so.

4. STRATEGIC ALTERNATIVES

We have learnt a few generic strategies in the second chapter. In this chapter we will see a few more strategic alternatives from the perspective of planning.

4.1 Michael Porter's Generic Strategies

According to Porter, strategies allow organizations to gain competitive advantage from three different bases: cost leadership, differentiation, and focus. Porter calls these base generic strategies. Cost leadership emphasizes producing standardized products at a very low per-unit cost for consumers who are price-sensitive. Differentiation is a strategy aimed at producing products and services considered unique industry wide and directed at consumers who are relatively price-insensitive. Focus means producing products and services that fulfill the needs of small groups of consumers.

Porter's strategies imply different organizational arrangements, control procedures, and incentive systems. Larger firms with greater access to resources typically compete on a cost leadership and/or differentiation basis, whereas smaller firms often compete on a focus basis.

Porter stresses the need for strategists to perform cost-benefit analyses to evaluate "sharing opportunities" among a firm's existing and potential business units. Sharing activities and resources enhances competitive advantage by lowering costs or raising differentiation. In addition to prompting sharing, Porter stresses the need for firms to “transfer" skills and expertise among autonomous business units effectively in order to gain competitive advantage. Depending upon factors such as type of industry, size of firm and nature of competition, various strategies could yield advantages in cost leadership differentiation, and focus.

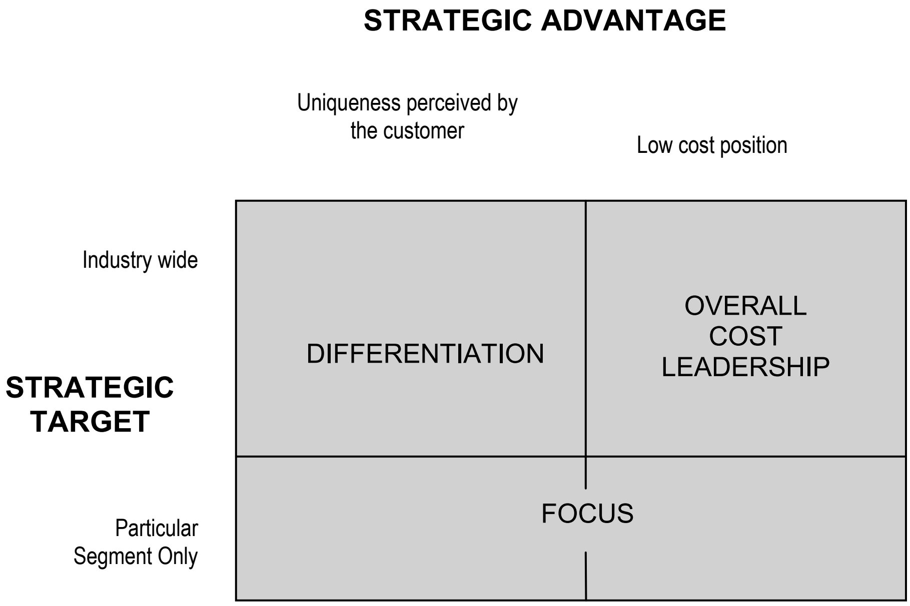

Figure: Michael Porter’s Generic Strategy

Cost Leadership Strategies

A primary reason for pursuing forward, backward, and horizontal integration strategies is to gain cost leadership benefits. But cost leadership generally must be pursued in conjunction with differentiation. A number of cost elements affect the relative attractiveness of generic strategies, including economies or diseconomies of scale achieved, learning and experience curve effects, the percentage of capacity utilization achieved, and linkages with suppliers and distributors. Other cost elements to consider in choosing among alternative strategies include the potential for sharing costs and knowledge within the organization, R&D costs associated with new product development or modification of existing products, labor costs, tax rates, energy costs, and shipping costs.

Striving to be the low-cost producer in an industry can be especially effective when the market is composed of many price-sensitive buyers, when there are few ways to achieve product differentiation, when buyers do not care much about differences from brand to brand, or when there are a large number of buyers with significant bargaining power. The basic idea is to under price competitors and thereby gain market share and sales, driving some competitors out of the market entirely.

A successful cost leadership strategy usually permeates the entire firm, as evidenced by high efficiency, low overhead, limited perks, intolerance of waste, intensive screening of budget requests, wide spans of control, rewards linked to cost containment, and broad employee participation in cost control efforts. Some risks of pursuing cost leadership are that competitors may imitate the strategy, thus driving overall industry profits down; that technological breakthroughs in the industry may make the strategy ineffective; or that buyer interest may swing to other differentiating features besides price.

Differentiation Strategies

Different strategies offer different degrees of differentiation. Differentiation does not guarantee competitive advantage, especially if standard products sufficiently meet customer needs or if rapid imitation by competitors is possible. Durable products protected by barriers to quick copying by competitors are best. Successful differentiation can mean greater product flexibility, greater compatibility, lower costs, improved service, less maintenance, greater convenience, or more features. Product development is an example of a strategy that offers the advantages of differentiation.

A differentiation strategy should be pursued only after a careful study of buyers' needs and preferences to determine the feasibility of incorporating one or more differentiating features into a unique product that features the desired attributes. A successful differentiation strategy allows a firm to charge a higher price for its product and to gain customer loyalty because consumers may become strongly attached to the differentiation features. Special features that differentiate one's product can include superior service, spare parts availability, engineering design, product performance, useful life, gas mileage, or ease of use.

A risk of pursuing a differentiation strategy is that the unique product may not be valued highly enough by customers to justify the higher price. When this happens, a cost leadership strategy easily will defeat a differentiation strategy. Another risk of pursuing a differentiation strategy is that competitors may develop ways to copy the differentiating features quickly. Firms thus must find durable sources of uniqueness that cannot be imitated quickly or cheaply by rival firms.

Common organizational requirements for a successful differentiation strategy include strong coordination among the R&D and marketing functions and substantial amenities to attract scientists and creative people.

Focus Strategies

A successful focus strategy depends on an industry segment that is of sufficient size, has good growth potential, and is not crucial to the success of other major competitors. Strategies such as market penetration and market development offer substantial focusing advantages. Midsize and large firms can effectively pursue focus-based strategies only in conjunction with differentiation or cost leadership-based strategies. All firms in essence follow a differentiated strategy. Because only one firm can differentiate itself with the lowest cost, the remaining firms in the industry must find other ways to differentiate their products.

Focus strategies are most effective when consumers have distinctive preferences or requirements and when rival firms are not attempting to specialize in the same target segment. Risks of pursuing a focus strategy include the possibility that numerous competitors will recognize the successful focus strategy and copy it, or that consumer preferences will drift toward the product attributes desired by the market as a whole. An organization using a focus strategy may concentrate on a particular group of customers, geographic markets, or on particular product-line segments in order to serve a well-defined but narrow market better than competitors who serve a broader market.

The comparative skill and resource requirement for these generic strategies is given below:

Generic Strategy	Commonly Required Skills and Resources	Common Organizational Requirements
Overall Cost Leadership	♦ Sustained capital investment and access to capital ♦ Process engineering skills ♦ Intense supervision of labour ♦ Products designed for ease in manufacture ♦ Low-cost distribution system	♦ Tight cost control ♦ Frequent, detailed control reports ♦ Structured organization and responsibilities ♦ Incentive based on meeting strict quantitative targets

Differentiation	♦ Strong marketing abilities ♦ Product engineering ♦ Creative flair ♦ Strong capability in basic research ♦ Corporate reputation for quality or technological leadership ♦ Long tradition in the industry or unique combinations of skills drawn from other business ♦ Strong cooperation from channels	♦ Strong coordination among function in R & D, product development, and marketing. ♦ Subjective measurement and incentives instead of quantitative measures ♦ Amenities to attract highly skilled labour, scientists, or creative people.
Focus	♦ Combination of the above policies directed at the particular strategic target	♦ Combination of the above policies directed at the particular strategic target

4.2 Best-Cost Provider Strategy

The new model of best cost provider strategy is a further development of above three generic strategies.

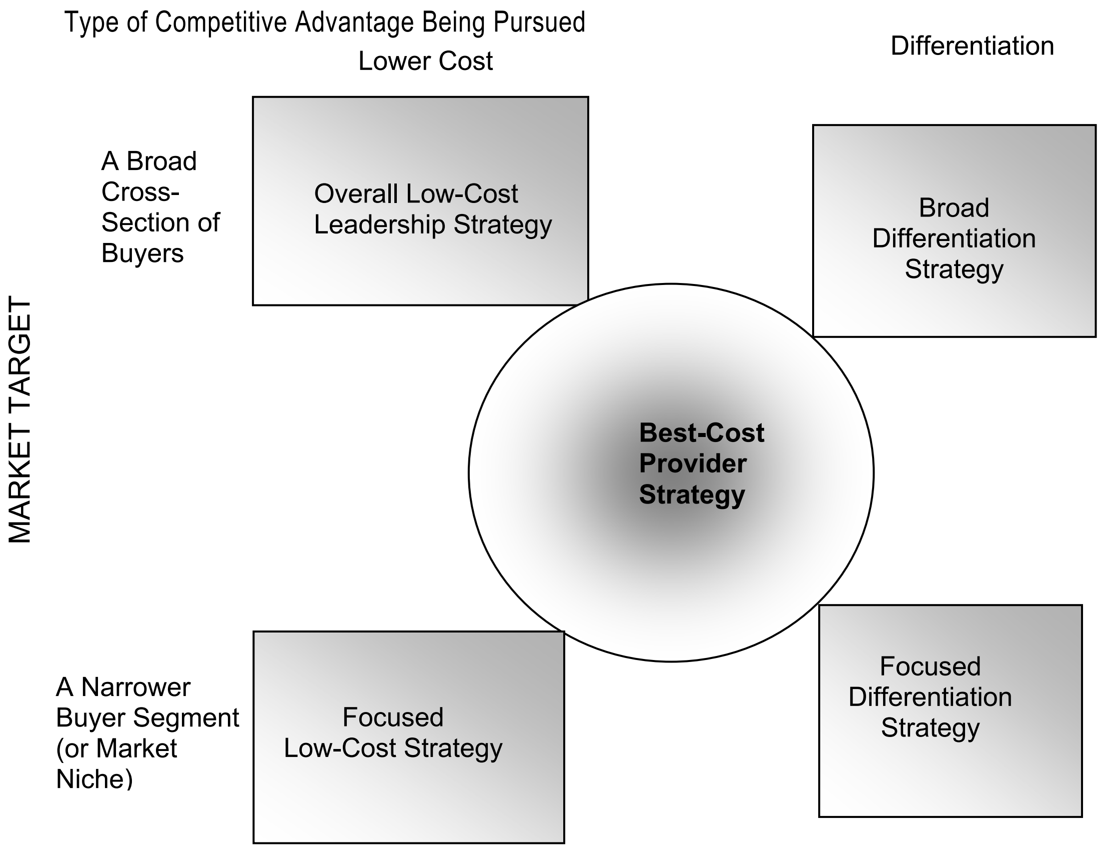

Figure: The Five Generic Competitive Strategies Distinctive features of the generic competitive strategies are given below :

Type of Feature	**Low-Cost Provider**	**Broad Differentiation**	**Best-Cost Provider**	**Focused Low-Cost and Focused Differentiation**
♦ Strategic target	♦ A broad cross-section of the market	♦ A broad cross-section of the market	♦ Value-conscious buyer	♦ A narrow market niche where buyer needs and preferences are distinctively different from the rest of the market

♦ Basic of competitive advantage	♦ Lower costs than competitors	♦ An ability to offer buyers something different from competitors	♦ More value for the money	♦ Lower cost in serving the niche (focused low cost) or special attributes that appeal to the tastes or requirements of niche members (focused differentiation)
♦ Market emphasis	♦ Try to make a virtue out of product features that lead to low cost	♦ Build in whatever features buyers are willing to pay for ♦ Charge a premium price to cover the extra cots of differentiating features	♦ Either underprice rival brands with comparable features or match the price of rivals and provide better features-to build a reputation for delivering the best value	♦ Communicate how the focuser's product attributes and capabilities aim at catering to niche member tastes and/or specialised requirements

♦ Sustaining the strategy	♦ Offer economical prices/good value ♦ Aim at contributing to a sustainable cost advantage- the key is to manage costs down, year after year, in every area of the business	♦ Communicate the points of difference in credible ways ♦ Stress constant improvement and use innovation to stay ahead of initiative competitors ♦ Concentrate on a few differentiating features; tout them to create a reputation and brand image.	♦ Develop unique expertise in simultaneously managing costs down and upscaling features and attributes	♦ Remain totally dedicated to serving the niche better than other competitors; don't blunt the firm's image and efforts by entering other segments or adding other product categories to widen market appeal.
♦ Product line	♦ A good basic product with few frills (acceptable quality and limited selection)	♦ Many product variations, wide selection, strong emphasis on differentiating features	♦ Good-to-excellent attributes, several-to-many upscale features	♦ Features and attributes that appeal to the tastes and/or special needs of the target segment
♦ Product emphasis	♦ A continuous search for cost reduction without sacrificing acceptable quality and essential features	♦ Creation of value for buyer; strive for product superiority	♦ Incorporation of upscale features and attributes at low cost	♦ Tailor-made for the tastes and requirements of niche members

4.3 Grand strategies/directional strategies Various strategy alternatives are available to a firm for achieving its growth objective. Here we shall see what these alternatives are, how they have been classified into a few broad categories, We shall also analyse the scope of each of these alternatives, since it is in view of their scope that firms choose the particular alternative. The corporate strategies a firm can adopt have been classified into four broad categories: *stability, expansion, retrenchment* and *combination* known as grand strategies. Grand strategies, which are often called master or business strategies, are intended to provide basic direction for strategic actions. They are seen as the basic of coordinated and sustained efforts directed toward achieving long-term business objectives.

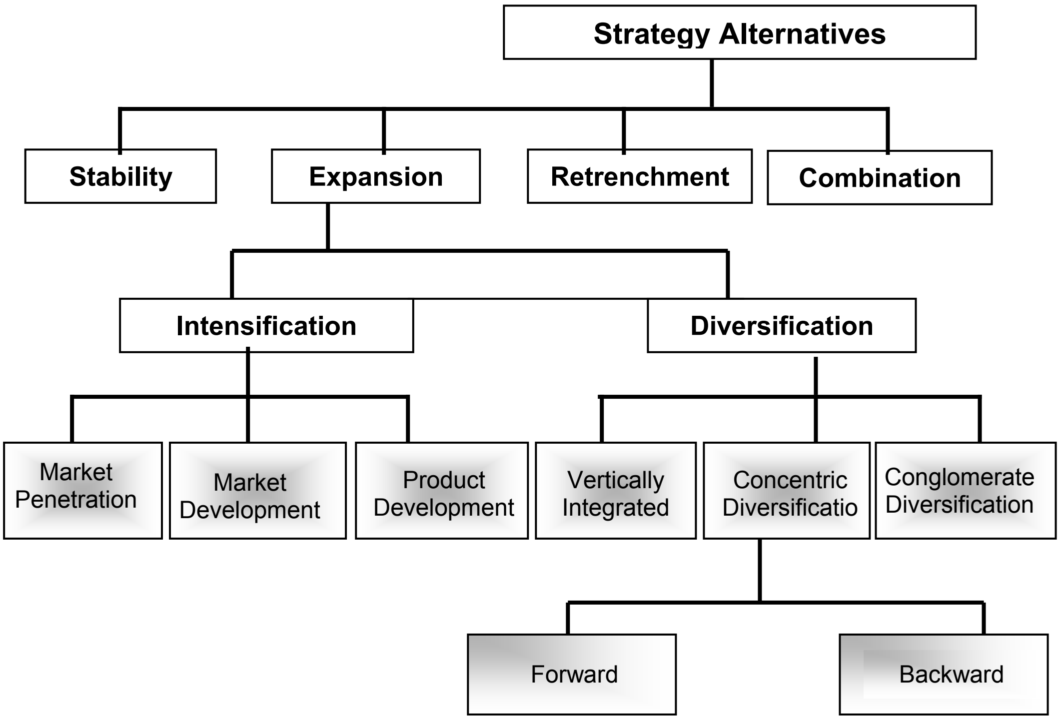

Figure: Grand Strategies

The basic features of the grand strategies is as follows:

Strategy	Basic Feature
Stability	The firm stays with its current businesses and product markets; maintains the existing level of effort; and is satisfied with incremental growth.
Expansion	Here, the firm seeks significant growth-maybe within the current businesses; maybe by entering new business that are related to existing businesses; or by entering new businesses that are unrelated to existing businesses.
Retrenchment	The firm retrenches some of the activities in a given business (es), or drops the business as such through sell-out or liquidation.
Combination	The firm combines the above strategic alternatives in some permutation/combination so as to suit the specific requirement of the firm.

Characteristics and Scope of Various Grand Strategies

A. Stability strategy:

- A firm opting for stability strategy stays with the same business, same product-market posture and functions, maintaining same level of effort as at present.
- The endeavour is to enhance functional efficiencies in an incremental way, through better deployment and utilization of resources. The assessment of the firm is that the desired income and profits would be forthcoming through such incremental improvements in functional efficiencies.
- Naturally, the growth objective of firms employing this strategy will be quite modest. Conversely, only firms with modest growth objective will vote for this strategy.
- Stability strategy does not involve a redefinition of the business of the corporation.
- It is basically a safety-oriented, status quo-oriented strategy.
- It does not warrant much of fresh investments.
- The risk is also less.
- It is a fairly frequently employed strategy.
- With the stability strategy, the firm has the benefit of concentrating its resources and attention on the existing businesses/products and markets.
- But the strategy does not permit the renewal process of bringing in fresh investments and new products and markets for the firm.

B. Expansion strategy:

- Expansion strategy is the opposite of stability strategy. While in stability strategy, rewards are limited, in expansion strategy they are very high. In the matter of risks, too, the two are the opposites of each other.
- Expansion strategy is the most frequently employed generic strategy.
- Expansion strategy is the true growth strategy. A firm with a mammoth growth ambition can meet its objective only through the expansion strategy.
- Expansion strategy involves a redefinition of the business of the corporation.
- The process of renewal of the firm through fresh investments and new businesses/products/markets is facilitated only by expansion strategy.
- Expansion strategy is a highly versatile strategy; it offers several permutations and combinations for growth. A firm opting for the expansion strategy can generate many alternatives within the strategy by altering its propositions regarding products, markets and functions and pick the one that suits it most.
- Expansion strategy holds within its fold two major strategy routes: Intensification Diversification
- Both of them are growth strategies; the difference lies in the way in which the firm actually pursues the growth.
- With intensification strategy, the firm pursues growth by working with its current businesses.
- Intensification, in turn, encompasses three alternative routes:
  - Market penetration strategy
  - Market development strategy
  - Product development strategy
- Diversification strategy involves expansion into new businesses that are outside the current businesses and markets.
- There are three broad types of diversification
  - Vertically integrated diversification
  - Concentric diversification
  - Conglomerate diversification
- Vertically integrated diversification involves going into new businesses that are related to the current ones.
- It has two components – forward integration and backward integration.
- The firm remains vertically within the given product-process sequence; the intermediaries in the chain become new businesses.

- In concentric diversification, too, the new products are connected to the firm's existing process/technology. But the new products are not vertically linked to the existing ones. They are not intermediates. They serve new functions in new markets. A new business is spinned off from the firm's existing facilities.
- In conglomerate diversification too, a new business is added to the firm's portfolio. But, it is disjointed from the existing businesses; in process/ technology/function, there is no connection between the new business and the existing ones. It is unrelated diversification.

C. Divestment strategy:

- Divestment strategy involves retrenchment of some of the activities in a given business of the firm or sell-out of some of the businesses as such.
- Divestment is to be viewed as an integral part of corporate strategy without any stigma attached.
- Like expansion strategy, divestment strategy, too, involves a redefinition of the business of the corporation.
- Compulsions for divestment can be many and varied, such as
- Obsolescence of product/process
  - Business becoming unprofitable
  - High competition
  - Industry overcapacity
  - Failure of strategy

Major reasons for organizations adopting different grand strategies:

A. Stability strategy is adopted because:

- It is less risky, involves less changes and people feel comfortable with things as they are.
- The environment faced is relatively stable.
- Expansion may be perceived as being threatening.
- Consolidation is sought through stabilising after a period of rapid expansion.

B. Expansion strategy is adopted because:

- It may become imperative when environment demands increase in pace of activity.
- Psychologically, strategists may feel more satisfied with the prospects of growth from expansion; chief executives may take pride in presiding over organizations perceived to be growth-oriented.
- Increasing size may lead to more control over the market vis-a-vis competitors.

- Advantages from the experience curve and scale of operations may accrue.

C. Retrenchment strategy is adopted because:

- The management no longer wishes to remain in business either partly or wholly due to continuous losses and unviability.
- The environment faced is threatening.
- Stability can be ensured by reallocation of resources from unprofitable to profitable businesses.

D. Combination strategy is adopted because:

- The organization is large and faces complex environment.
- The organization is composed of different businesses, each of which lies in a different industry requiring a different response.

Expansion Strategy

Expansion or growth strategy can either be through intensification or diversification. Igor Ansoff gave a framework as shown which describe the intensification options available to a firm.

I. Growth in existing product markets Increase market share Increase product usage Increase the frequency used Increase the quantity used Find new application for current users	II. Product development Add product features, product refinement Develop a new-generation product Develop new product for the same market
III. Market development Expand geographically Target new segments	**IV.** Diversification involving new products and new markets Related Unrelated

Figure: Product-Market Expansion Greed

Market Penetration

The most common expansion strategy is market penetration/concentration on the current business. The firm directs its resources to the profitable growth of a single product, in a single market, and with a single technology.

Market Development

It consists of marketing present products, to customers in related market areas by adding different channels of distribution or by changing the content of advertising or the promotional media.

Product Development

Product Development involves substantial modification of existing products or creation of new but related items that can be marketed to current customers through establish channels.

Diversification Strategy

Diversification endeavours can be related or unrelated to existing businesses of the firm. Based on the nature and extent of their relationship to existing businesses, diversification endeavours have been classified into four broad categories:

(i) Vertically integrated diversification

(ii) Horizontally integrated diversification

(iii) Concentric diversification

(iv) Conglomerate diversification

Vertically integrated diversification

In vertically integrated diversification, firms opt to engage in businesses that are related to the existing business of the firm. The firm remains vertically within the same process. Sequence It moves forward or backward in the chain and enters specific product/process steps with the intention of making them into new businesses for the firm. The characteristic feature of vertically integrated diversification is that here, the firm does not jump outside the vertically linked product-process chain. The example of Reliance Industries provided at the close of this chapter illustrates this dimension of vertically integrated diversification.

Horizontal integrated diversification

Through the acquisition of one or more similar business operating at the same stage of the production-marketing chain that is going into complementary products, by-products or taking over competitors' products.

RELATED DIVERSIFICATION	UNRELATED DIVERSIFICATION
• Exchange or share assets or competencies, thereby exploiting • Brand name • Marketing skills • Sales and distribution capacity • Manufacturing skills • R&D and new product capability • Economies of scale	• Manage and allocate cash flow. • Obtain high ROI. • Obtain a bargain price. • Refocus a firm. • Reduce risk by operating in multiple product markets. • Tax benefits. • Obtain liquid assets. • Vertical integration. • Defend against a takeover.

Figure: Related Diversification Options For A Manufacturer

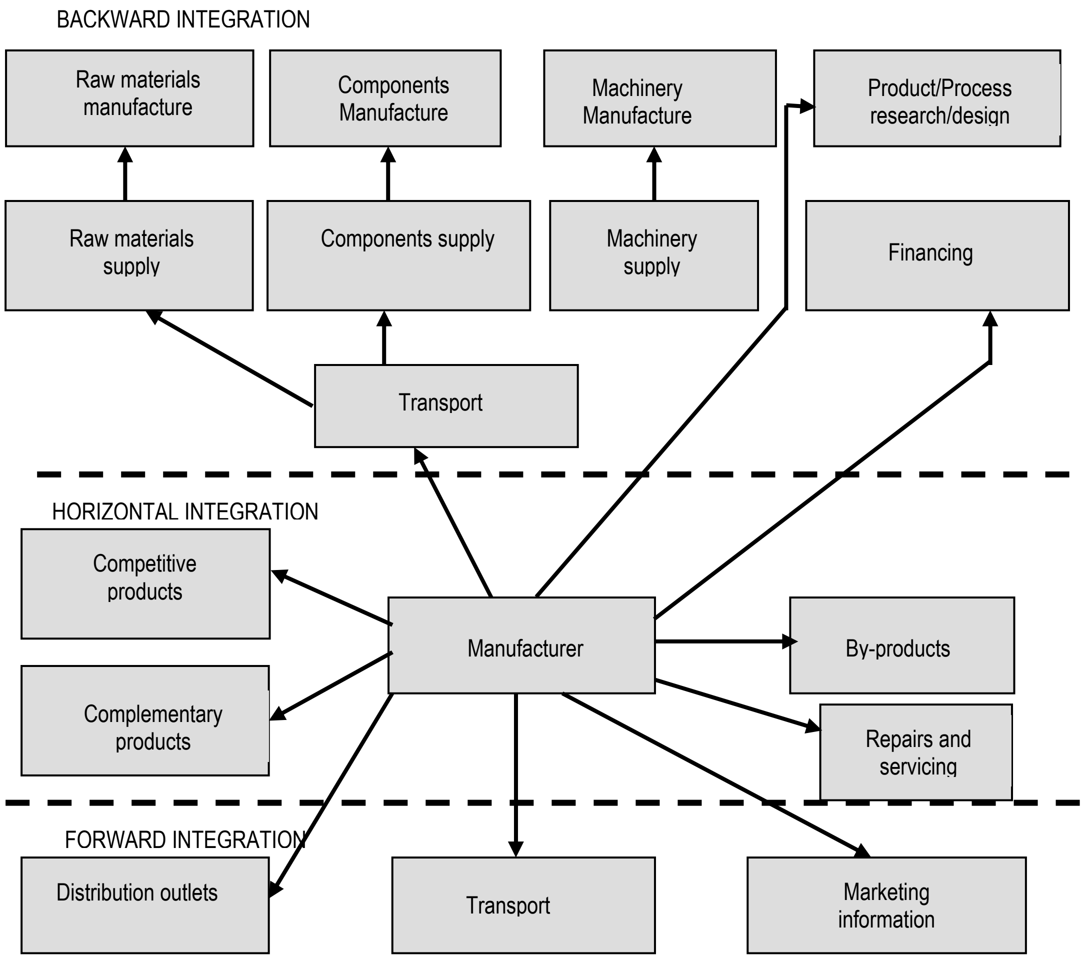

Figure : Motivations for Diversification

Concentric diversification

Concentric diversification too amounts to related diversification. In concentric diversification, the new business is linked to the existing businesses through process, technology or marketing. The new product is a spin-off from the existing facilities and products/processes. This means that in concentric diversification too, there are benefits of synergy with the current operations. However, concentric diversification differs from vertically integrated diversification in the nature of the linkage the new product has with the existing ones. While in vertically integrated diversification, the new product falls within the firm's current process-product chain, in concentric diversification, there is a departure from this vertical linkage. The new product is only connected in a loop-like manner at one or more points in the firm's existing process/technology/product chain.

Conglomerate diversification

In conglomerate diversification, no such linkages exist; the new businesses/ products are disjointed from the existing businesses/products in every way; it is a totally unrelated diversification. In process/technology/function, there is no connection between the new products and the existing ones. Conglomerate diversification has no common thread at all with the firm's present position.

Retrenchment, Divestment and Liquidation Strategies

Retrenchment grand strategy is followed when an organization substantially reduces the scope of its activity. This is done through an attempt to find out the problem areas and diagnose the causes of the problems. Next, steps are taken to solve the problems. These steps result in different kinds of retrenchment strategies. If the organization chooses to focus on ways and means to reverse the process of decline, it adopts at turnaround strategy. If it cuts off the loss-making units, divisions, or SBUs, curtails its product line, or reduces the functions performed, it adopts a divestment (or divestiture) strategy. If none of these actions work, then it may choose to abandon the activities totally, resulting in a liquidation strategy. We deal with each of these strategies below.

Turnaround Strategies

Retrenchment may be done either internally or externally. For internal retrenchment to take place, emphasis is laid on improving internal efficiency, known as turnaround strategy.

There are certain conditions or indicators which point out that a turnaround is needed if the organization has to survive. These danger signs are:

- Persistent negative cash flow
- Negative profits
- Declining market share
- Deterioration in physical facilities
- Overmanning, high turnover of employees, and low morale
- Uncompetitive products or services
- Mismanagement

For turnaround strategies to be successful, it is imperative to focus on the short and long-term financing needs as well as on strategic issues. A workable action plan for turnaround should include:

Analysis of product, market, production processes, competition, and market segment positioning.

Clear thinking about the market place and production logic.

Implementation of plans by target-setting, feedback, and remedial action.

A set of ten elements that contribute to turnaround are:

- Changes in the top management
- Initial credibility-building actions
- Neutralising external pressures
- Initial control
- Identifying quick payoff activities
- Quick cost reductions
- Revenue generation
- Asset liquidation for generating cash
- Mobilization of the organizations
- Better internal coordination.

Divestment Strategies

Divestment strategy involves the sale or liquidation of a portion of business, or a major division, profit centre or SBU. Divestment is usually a part of rehabilitation or restructuring plan and is adopted when a turnaround has been attempted but has proved to be unsuccessful. The option of a turnaround may even be ignored if it is obvious that divestment is the only answer.

A divestment strategy may be adopted due to various reasons:

- A business that had been acquired proves to be a mismatch and cannot be integrated within the company.
- Persistent negative cash flows from a particular business create financial problems for the whole company, creating the need for divestment of that business.
- Severity of competition and the inability of a firm to cope with it may cause it to divest.
- Technological upgradation is required if the business is to survive but where it is not possible for the firm to invest in it, a preferable option would be to divest.
- A better alternative may be available for investment, causing a firm to divest a part of its unprofitable businesses.

Liquidation Strategies

A retrenchment strategy considered the most extreme and unattractive is liquidation strategy, which involves closing down a firm and selling its assets. It is considered as the last resort because it leads to serious consequences such as loss of employment for workers and other employees, termination of opportunities where a firm could pursue any future activities, and the stigma of failure. Many small-scale units, proprietorship firms, and partnership ventures liquidate frequently but medium-and large-sized companies rarely liquidate in India. The company management, government, banks and financial institutions, trade unions, suppliers and creditors, and other agencies are extremely reluctant to take a decision, or ask, for liquidation.

Selling assets for implementing a liquidation strategy may also be difficult as buyers are difficult to find. Moreover, the firm cannot expect adequate compensation as most assets, being unusable, are considered as scrap.

Liquidation strategy may be unpleasant as a strategic alternative but when a "dead business is worth more than alive", it is a good proposition. For instance, the real estate owned by a firm may fetch it more money than the actual returns of doing business. When liquidation is evident (though it is difficult to say exactly when), an abandonment plan is desirable. Planned liquidation would involve a systematic plan to reap the maximum benefits for the firm and its shareholders through the process of liquidation. Under the Companies Act, 1956, liquidation (termed as winding up*)* may be either by the court, voluntary, or subject to the supervision of the court.

SELF-EXAMINATION QUESTIONS

Multiple – Choice Questions

1. An organisation diversifies in backward sequence in the product chain and enters specific product/process to be used in existing products. It is:

   (a) Forward diversification.

   (b) Vertical diversification.

   (c) Horizontal diversification.

   (d) Reactive diversification.

2. In Michael Porter's generic strategy _____________ emphasizes producing standardized products at a very low per unit-cost for consumers who are price sensitive.

   (a) Cheap leadership.

   (b) Inferior product leadership.

(c) Cost leadership.

(d) Cost benefit.

3. Focus strategies are _________ when consumers have _________ preferences and when rival firms are not attempting to specialize in the same target segment.

   (a) effective, no

   (b) effective, distinctive

   (c) ineffective, clear

   (d) fragmented, fragmented

4. Concentric diversification amounts to _______ diversification.

   (a) related

   (b) unrelated

   (c) non integrated

   (d) uninitiated

5. If a firm attempts to gain a competitive advantage primarily by reducing its economic costs below its competitor, it is pursuing:

   (a) Cost leadership strategy

   (b) Differentiation strategy

   (c) Divisionalization

   (d) None of these

6. Major dimensions while taking strategic decisions includes:

   (a) top management decisions

   (b) allocation of large amounts of company resources

   (c) issues related to future oriented

   (d) All the above

   (e) None of these

7. Corporate strategy includes:

   (i) expansion and growth, diversification, takeovers and mergers

   (ii) Vertical and horizontal integration, new investment and divestment areas

   (iii) determination of the business lines, research and development projects

From the combinations given below select a correct alternative:

(a) (i) and (ii)

(b) (ii) and (iii)

(c) (iii) and (iv)

(d) (i), (ii) and (iii)

8. Which one of the following is totally an unrelated diversification?

(a) Conglomerate diversification

(b) Concentric diversification

(c) Vertical diversification

(d) Horizontal diversification

9. Which strategy is implemented after the failure of turnaround strategy?

(a) Liquidation strategy

(b) Retrenchment strategy

(c) Divestment strategy

(d) All the above

10. Expansion strategy is opposite to:

(a) stability strategy

(b) divestment strategy

(c) liquidation strategy

(d) diversification strategy

11. What are the three different bases given by Michael Porter's Generic Strategies to gain competitive advantage?

(a) differentiation, integration and compensation

(b) integration, focus and differentiation

(c) compensation, integration and focus

(d) cost leadership, differentiation and focus

Objective Type Question

State with reasons which of the following statements are correct/incorrect:

(a) In vertically integrated diversification, firms enter specific product/process that are forward or backward in the chain, as new businesses for the firm.

(b) Objectives should be quantitative, challenging and associated with time line.

(c) Successful differentiation can mean greater product flexibility.

Short answer questions

1. What do you understand by focus strategy?
2. What is differentiation strategy?
3. Explain conglomerate diversification.

Essay type questions

1. Strategy is partly proactive and partly reactive. Discuss.
2. Discuss various stages in strategic formulation and implementation process.
3. Discuss strategic alternatives with reference Michael Porter's strategies.

Case Study

Cool Garments is exploring options of picking up a strategic equity stake in north based Jazzy Wear, a Kanpur -based garment manufacture catering to gents segment. The takeover may boost its production of premium garments. This will also increase Cool Garments' presence in the North.

The size of the acquisition would be small — within Rs 50 crore — compared to Cool Garments recent big deals in other states. Jazzy Wear special products fit perfectly into Cool Garment's future plans. Acquiring Jazzy will give it a bigger product portfolio and also a considerable presence in the north Indian market.

With the fragmented shareholding the top managers of Jazzy Wear know that the Cool Garments will be definitely able to acquire controlling share in their company. They feel that if a deal is striked it would also be in their favour. However, they are not clear how to formulate right strategy for the Jazzy Wear.

If you are appointed as strategic consultant by the Jazzy Wear, explain to their top managers the process of strategy formulation.

Discuss the nature of strategy for both the companies.

Answers - Multiple Choice Questions

1. (b), **2.** (c), **3.** (b), **4.** (a), **5.** (a), **6.** (d), **7.** (d), **8.** (a), **9.** (c), **10.** (a), **11.** (d)

CHAPTER 5

FORMULATION OF FUNCTIONAL STRATEGY

LEARNING OBJECTIVES

- ♦ Understand how functional strategies are formulated.
- ♦ To have a fair idea about the role of marketing strategy in implementation.
- ♦ Learn different aspects of financial strategy.
- ♦ Know how to formulate production, logistics, human resource and other important functional strategies.

> Most of the time, strategists should not be formulating strategy at all; they should be getting on with implementing strategies they already have.
>
> Henry Mintzberg

1. INTRODUCTION

Once higher level corporate and business strategies are developed, management need to formulate and implement strategies for each functional area. Strategy of one functional area can not be looked at in isolation, because it is the extent to which all of the functional tasks are interwoven that determine the effectiveness of the major strategy.

For effective implementation, strategists have to provide direction to functional managers regarding the plans and policies to be adopted. In fact, the effectiveness of strategic management depends critically on the manner in which strategies are implemented. Functional strategies provide details to business strategy & governs as to how key activities of the business will be managed. Functional strategies play two important roles. Firstly, they provide support to the overall business strategy. Secondly, they spell out as to how functional managers will work so as to ensure better performance in their respective functional areas.

Functional area strategy such as marketing, financial, production and Human Resource are based on the functional capabilities of an organisation. For each functional area, first the major sub areas are identified and then for each of these sub functional areas, content of functional strategies, important factors, and their importance in the process of strategy implementation is identified.

In terms of the levels of strategy formulation, functional strategies operate below the SBU or business-level strategies. Within functional strategies there might be several sub-functional areas. Functional strategies, are made within the higher level strategies and guidelines therein that are set at higher levels of an organization. Functional managers need guidance from the business strategy in order to make decisions. Operational plans tell the functional managers what has to be done while policies state how the plans are to be implemented.

Major strategies need to be translated to lower levels to give holistic strategic direction to an organization. The reasons why functional strategies are needed can be enumerated as follows:

- The development of functional strategies is aimed at making the strategies-formulated at the top management level-practically feasible at the functional level.
- Functional strategies fecilitate flow of strategic decisions to the different parts of an organization.
- They act as basis for controlling activities in the different functional areas of business.
- The time spent by functional managers in decision-making is reduced as plans lay down clearly what is to be done and policies provide the discretionary framework within which decisions need to be taken.
- Functional strategies help in bringing harmony and coordination as they remain part of major strategies.
- Similar situations occurring in different functional areas are handled in a consistent manner by the functional managers.

Thus, strategies need to be segregated into viable functional plans and policies that are compatible with each other. In this way, strategies can be implemented by the functional managers. Environmental factors relevant to each functional area have an impact on the choice of functional strategies. Organizational strategies affect the choice of functional strategies. However, the actual process of choice is influenced by objective as well as subjective factors. Functional strategies affect, and are affected by, the resource allocation decisions.

2. MARKETING STRATEGY FORMULATION

Marketing is a social and managerial process by which individuals and groups obtain what they need and want through creating, offering and exchanging products of value with others.

Philip Kotler

Ordinary marketing is an activity performed by business organizations. However, it is not necessarily confined only to business enterprises. It is an activity that creates and sustains exchange relationships among those who are willing and able to buy and sell products, services, satisfaction and even ideas. In the present day for business, it is considered to be the activities related to identifying the needs of customers and taking such actions to satisfy them in return of some consideration. In marketing it is more important to do what is strategically right than what is immediately profitable.

The term marketing constitutes different processes, functions, exchanges and activities that create perceived value by satisfying needs of individuals. Marketing induces or helps in moving people closer to making a decision to purchase and facilitate a sale.

Marketing in recent decades has assumed an astounding importance. It is an immediate cause and effect of rapid economic growth, globalization, technological upgradation, development of ever-increasing human needs and wants and increasing purchasing power.

A business organization faces countless marketing variables that affect the success or failure of strategy implementation. Some examples of marketing decisions that may require special attention are as follows:

1. The kind of distribution network to be used. Whether to use exclusive dealerships or multiple channels of distribution.
2. The amount and the extent of advertising. Whether to use heavy or light advertising. What should be the amount of advertising in print media, television or internet.
3. Whether to limit or enhance the share of business done with a single or a few customer.
4. Whether to be a price leader or a price follower.
5. Whether to offer a complete or limited warranty.
6. Whether to reward salespeople based on straight salary, straight commission, or on a combination of salary/commission.

2.1 Delivering value to Customer: Marketing alone cannot produce superior value for the consumer. It needs to work in coordination with other departments to accomplish this. Marketing acts as part of the organizational chain of activities. Marketers are challenged to find ways to get all departments to think with focus on customer. In its search for competitive advantage, the firm needs to look beyond its own chain of activities and into the chains of its suppliers, distributors, and ultimately customers. This “partnering” will produce a value delivery network.

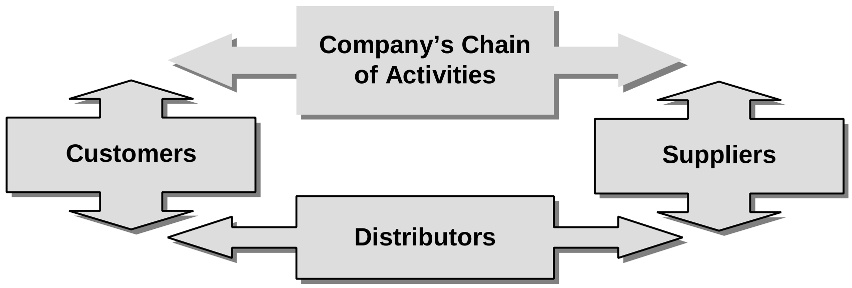

Figure 5.1 : Value Delivery Network

Connecting with consumers

To succeed in today's competitive marketplace, companies must be customer centered. They must win customers from competitors and keep them by delivering greater value. Since companies cannot satisfy all consumers in a given market, they must divide up the total market (market segmentation), choose the best segments (market targeting), and design strategies for profitably serving chosen segments better than the competition (market positioning).

2.2 The Marketing Process

- Once the strategic plan has defined the company's overall mission and objectives, marketing plays a role in carrying out these objectives.
- The marketing process is the process of analyzing market opportunities, selecting target markets, developing the marketing mix, and managing the marketing effort.
- Target customers stand at the center of the marketing process.

2.3 Marketing mix

Marketing mix forms an important part of overall competitive marketing strategy. The marketing mix is the set of controllable marketing variables that the firm blends to produce the response it wants in the target market. The marketing mix consists of everything that the firm can do to influence the demand for its product. These variables are often referred to as the "4 Ps." The 4 Ps stand for product, price, place and promotion. An effective marketing program blends all of the marketing mix elements into a coordinated program designed to achieve the company's marketing objectives by delivering value to consumers. The 4 Ps are from a marketer's angle. When translated to buyers angle they may be termed as 4 Cs. Product may be referred as customer solution, price as customer cost, place as convenience and promotion as communication.

- Product stands for the "goods-and-service" combination the company offers to the target market. Strategies are needed for managing existing product over time adding new ones and dropping failed products. Strategic decisions must also be made regarding branding, packaging and other product features such as warrantees.

  Products and markets are infinitely dynamic. An organization has to capture such dynamics through a set of policies and strategies. Some products have consistent customer demand over long period of time while others have short and fleeting life spans. There are products that have wide range of quality and workmanship and these also change over time. There are industrial or consumer products, essentials or luxury products, durables or perishables.

  Products can be differentiated on the basis of size, shape, colour, packaging, brand names, after-sales service and so on. Organizations seek to hammer into customers' minds that their products are different from others. It does not matter whether the differentiation is real or imaginary. Quite often the differentiation is psychological rather than physical. It is enough if customers are persuaded to believe that the marketers product is different from others.

  Organizations formalize product differentiation through christening 'brand names' to their respective products. These are generally reinforced with legal sanction and protection. Brands enable customers to identify the product and the organization behind it. The products' and even firms' image is built around brand through advertising and other promotional strategies. Customers tend to develop strong brand loyalty for a particular product over a period of time.

- Price stands for the amount of money customers have to pay to obtain the product. Necessary strategies pertain to the location of the customers, price flexibility, related items within a product line and terms of sale. The price of a product is its composite expression of its value and utility to the customer, its demand, quality, reliability, safety, the competition it faces, the desired profit and so on.

  In an industry there would be organizations with low cost products and other organizations with high costs. The low cost organizations may adopt aggressive pricing strategy as they enjoy more freedom of action in respect of their prices. They may also afford selective increase in costs to push their sales.

  Theoretically, organizations may also adopt cost plus pricing wherein a margin is added to the cost of the product to determine its price. However, in the competitive environment such an approach may not be feasible. More and more companies of today have to accept the market price with minor deviations and work towards their costs. They reduce their cost in order to maintain their profitability.

For a new product pricing strategies for entering a market needs to be designed. In pricing a really new product at least three objectives must be kept in mind.

(a) Making the product acceptable to the customers.

(b) Producing a reasonable margin over cost.

(c) Achieving a market that helps in developing market share.

For a new product an organization may either choose to skim or penetrate the market. In skimming prices are set at a very high level. The product is directed to those buyers who are relatively price insensitive but sensitive to the novelty of the new product. For example call rates of mobile telephony were set very high initially. Even the incoming calls were charged. Since the initial offtake of the product is low, high price, in a way, helps in rationing of supply in favour of those who can afford it. In penetration firm keeps a temptingly low price for a new product which itself is selling point. A very large number of the potential consumer may be able to afford and willing to try the product.

- Place stands for company activities that make the product available to target consumers. One of the most basic marketing decision is choosing the most appropriate marketing channel. Strategies should be taken for the management of channel(s) by which ownership of product is transferred from producers to customers and in many cases, the system(s) by which goods are moved from where they are produced from they are purchases by the final customers. Strategies applicable to the middleman such as wholesalers and retails must be designed.

  The distribution policies of a company are important determinants of the functions of marketing. The decision to utilize a particular marketing channel or channels sets the pattern of operations of sales force. We will learn more about place when we study logistics later in this chapter.

- Promotion stands for activities that communicate the merits of the product and persuade target consumers to buy it. Strategies are needed to combine individual methods such as advertising, personal selling, and sales promotion into a coordinated campaign. In addition promotional strategies must be adjusted as a product move from an earlier stages from a later stage of its life.

  Modern marketing is highly promotional oriented. Organizations strive to push their sales and market standing on a sustained basis and in a profitable manner under conditions of complex direct and indirect competitive situations. Promotion also acts as an impetus to marketing. It is simultaneously a communication, persuasion and conditioning process. There are at least four major direct promotional methods or tools – personal selling, advertising, publicity and sales promotion. They are briefly explained as follows:

(i) Personal Selling: Personal selling is one of the oldest forms of promotion. It involves face-to-face interaction of sales force with the prospective customers and provides a high degree of personal attention to them. In personal selling, oral communication is made with potential buyers of a product with the intention of making a sale. It may initially focus on developing a relationship with the potential buyer, but end up with efforts for making a sale. Personal selling suffers from a very high costs as sales personnel are expensive. They can physically attend only one customer at a time. Thus it is not a cost-effective way of reaching a large number of people.

(ii) Advertising: Advertising is a non-personal, highly flexible and dynamic promotional method. The media for advertisings are several such as pamphlets, brochures, newspapers, magazines, hoardings, display boards, radio, television and internet. Choice of appropriate media is important for effectiveness of the message. The media may be local, regional, or national. The type of the message, copy, illustration are a matter of choice and creativity. Advertising may be directed towards consumers, middlemen or opinion leaders. Advertising is likely to succeed in promoting the sales of an organization but its effectiveness in respect to the expenditure can not be directly measured. Sales is a function of several variables out of which advertising is only one.

(iii) Publicity: Publicity is also a non-personal form of promotion similar to advertising. However, no payments are made to the media as in case of advertising. Organizations skillfully seek to promote themselves and their product without payment. Publicity is communication of a product, brand or business by placing information about it in the media without paying for the time or media space directly. Thus it is way of reaching customers with negligible cost. Basic tools for publicity are press releases, press conferences, reports, stories, and internet releases. These releases must be of interest to the public.

(iv) Sales promotion: Sales promotion is an omnibus term that includes all activities that are undertaken to promote the business but are not specifically included under personal selling, advertising or publicity. Activities like discounts, contests, money refunds, installments, kiosks, exhibitions and fairs constitute sales promotion. All these are meant to give a boost to the sales. Sales promotion done periodically may help in getting a larger market share to an organization.

Expanded Marketing Mix: Typically, all organizations use a combination of 4 Ps in some form or the other. However, the above elements of marketing mix are not exhaustive. It is pertinent to discuss a few more elements that may form part of an organizational marketing mix strategy. They have got more currency in recent years. Growth of services has its own share for the inclusion of newer elements in marketing. A few new Ps are as follows:

- People: all human actors who play a part in delivery of the market offering and thus influence the buyer's perception, namely the firm's personnel and the customer.
- Physical evidence: the environment in which the market offering is delivered and where the firm and customer interact.
- Process: the actual procedures, mechanisms and flow of activities by which the product / service is delivered.

2.4 Marketing Analysis: Marketing analysis involves a complete analysis of the company's situation. A company performs analysis by identifying environmental opportunities and threats. It also analyzes its strengths and weaknesses to determine which opportunities the company can best pursue.Marketing Analyses has three components as planning implementation and control. Through analyses organization feed information and other inputs to each of the other marketing management functions.

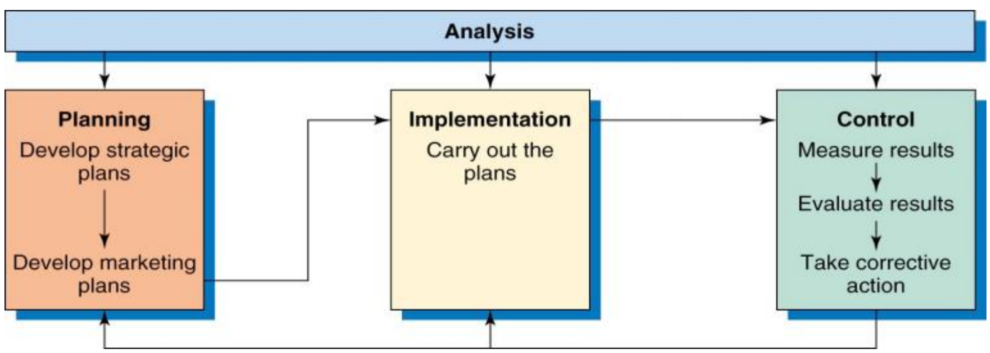

Figure: Managing the marketing effort

Marketing Planning

Marketing planning involves deciding on marketing strategies that will help the company attains its overall strategic objectives. A detailed plan is needed for each business, product, or brand. A product or brand plan may contain different sections: executive summary, current marketing situation, threats and opportunity analysis, objectives and issues, marketing strategies, action programs, budgets, and controls.

- The executive summary is a short summary of the main goals and recommendations to be presented in the plan.
- The current marketing situation is the section of a marketing plan that describes the target market and the company's position in it. Important sections include:
- A market description.

- A product review.
- Analysis of the competition.
- A section on distribution.
- In the threats and opportunities section, managers are forced to anticipate important developments that can have an impact, either positive or negative, on the firm.
- Having studied the product's threats and opportunities, the manager can set objectives and consider issues that will affect them. The objectives should be stated as goals that the company would like to attain during the plan's term.
- Marketing strategy is the marketing logic by which the business unit hopes to achieve its marketing objectives. Strategies should be created for all marketing mix components.
- The marketing budget is a section of the marketing plan that shows projected revenues, costs, and profits.
- The last section of the marketing plan outlines the controls that will be used to monitor progress. This allows for progress checks and corrective action.

Dealing with the Marketing Environment

The company must carefully analyze its environment in order to avoid the threats and take advantage of the opportunities. Areas to be analyzed in the environment normally include:

- Forces close to the company such as its ability to serve customers, other company departments, channel members, suppliers, competitors, and publics.
- Broader forces such as demographic and economic forces, political and legal forces, technological and ecological forces, and social and cultural forces.

Marketing strategy techniques

- Social Marketing: It refers to the design, implementation, and control of programs seeking to increase the acceptability of a social ideas, cause, or practice among a target group. For instance, the publicity campaign for prohibition of smoking in Delhi explained the place where one can and can't smoke in Delhi.
- Augmented Marketing. It is provision of additional customer services and benefits built around the care and actual products that relate to introduction of hi-tech services like movies on demand, on-line computer repair services, secretarial services, etc. Such innovative offerings provide a set of benefits that promise to elevate customer service to unprecedented levels.
- Direct Marketing: Marketing through various advertising media that interact directly with consumers, generally calling for the consumer to make a direct response. Direct

marketing includes Catalogue Selling, Mail, Telecomputing, Electronic Marketing, Shopping, and TV shopping.

- Relationship Marketing: The process of creating, maintaining, and enhancing strong, value- laden relationships with customers and other stakeholder. For example, British Airways offers special lounges with showers at 199 airports for frequent flyers. Thus, providing special benefits to select customers to strength bonds. It will go a long way in building relationships.
- Services Marketing: It is applying the concepts, tools, and techniques, of marketing to services. Services is any activity or benefit that one party can offer to another that is essentially intangible and does not result in the, banking, savings, retailing, educational or utilities.
- Person Marketing: People are also marketed. Person marketing consists of activities undertaken to create, maintain or change attitudes or behavior towards particular people. For example, politicians, sports stars, film stars, professional i.e., market themselves to get votes, or to promote their careers and income.
- Organization Marketing: It consists of activities undertaken to create, maintain, or change attitudes and behavior of target audiences towards an organization. Both profit and nonprofit organizations practice organization marketing.
- Place Marketing: Place marketing involves activities undertaken to create, maintain, or change attitudes and behavior towards particular places say, business sites marketing, tourism marketing.
- Enlightened Marketing: A marketing philosophy holding that a company's marketing should support the best long-run performance of the marketing system; its five principles include customer-oriented marketing, innovative marketing, value marketing, sense-of-mission marketing, and societal marketing.
- Differential Marketing: A market-coverage strategy in which a firm decides to target several market segments and designs separate offer for each. For example, Hindustan Lever Limited has Lifebuoy, Lux and Rexona in popular segment and Liril and Pears in premium segment.
- Synchro-marketing: When the demand for the product is irregular due to season, some parts of the day, or on hour basis, causing idle capacity or over-worked capacities, synchromaketing can be used to find ways to alter the same pattern of demand through flexible pricing, promotion, and other incentives. For example woollens or coolers; or hospitals underbooked on weekend or end of the week.
- Concentrated Marketing: A market-coverage strategy in which a firm goes after a large share of one or few sub-markets.

- Demarketing: Marketing strategies to reduce demand temporarily or permanently-the aim is not to destroy demand, but only to reduce or shift it. This happens when there is overfull demand. For example, buses are overloaded in the morning and evening, roads are busy for most of times, zoological parks are over-crowded on Saturdays, Sundays and holidays. Here demarketing can be applied to regulate demand.

3. FINANCIAL STRATEGY FORMULATION

The financial strategies of an organization are related to several finance/accounting concepts considered to be central to strategy implementation. These are: acquiring needed capital/sources of fund, developing projected financial statements/budgets, management/ usage of funds, and evaluating the worth of a business. Strategists need to formulate strategies in these areas so that they are implemented. Some examples of decisions that may require finance/accounting policies are:

1. To raise capital with short-term debt, long-term debt, preferred stock, or common stock.
2. To lease or buy fixed assets.
3. To determine an appropriate dividend payout ratio.
4. To extend the time of accounts receivable.
5. To establish a certain percentage discount on accounts within a specified period of time.
6. To determine the amount of cash that should be kept on hand.

Acquiring capital to implement strategies / sources of funds

Successful strategy implementation often requires additional capital. Besides net profit from operations and the sale of assets, two basic sources of capital for an organization are debt and equity. Determining an appropriate mix of debt and equity in a firm's capital structure can be vital to successful strategy implementation. Theoretically, an enterprise should have enough debt in its capital structure to boost its return on investment by applying debt to products and projects earning more than the cost of the debt. In low earning periods, too much debt in the capital structure of an organization can endanger stockholders' return and jeopardize company survival. Fixed debt obligations generally must be met, regardless of circumstances. This does not mean that stock issuances are always better than debt for raising capital. Some special stock is issued to finance strategy implementation, ownership and control of the enterprise are diluted. This can be a serious concern in today's business environment of hostile takeovers, mergers, and acquisitions.

The major factors regarding which strategies have to be made are: capital structure; procurement of capital and working capital borrowings; reserves and surplus as sources of funds; and relationship with lenders, banks and financial institutions. Strategies related to the sources of funds are important since they determine how financial resources will be made available for the implementation of strategies. Organizations have a range of alternatives regarding the sources of funds. While one company may rely on external borrowings, another may follow a policy of internal financing.

Projected financial statements / budgets

Projected (pro forma) financial statement analysis is a central strategy-implementation technique because it allows an organization to examine the expected results of various actions and approaches. This type of analysis can be used to forecast the impact of various implementation decisions (for example, to increase promotion expenditures by 50 percent to support a market-development strategy, to increase salaries by 25 percent to support a market-penetration strategy, to increase research and development expenditures by 70 percent to support product development, or to sell common stock to raise capital for diversification). Nearly all financial institutions require a projected financial statements whenever a business seeks capital. A pro forma income statement and balance sheet allow an organization to compute projected financial ratios under various strategy-implementation scenarios. When compared to prior years and to industry averages, financial ratios provide valuable insights into the feasibility of various strategy-implementation approaches.

Primarily as a result of the Enron collapse and accounting scandal, companies today are being much more diligent in preparing projected financial statements to "reasonably rather than too optimistically" project future expenses and earnings.

A financial budget is also a document that details how funds will be obtained and spent for a specified period of time. Annual budgets are most common, although the period of time for a budget can range from one day to more than ten years. Fundamentally, financial budgeting is a method for specifying what must be done to complete strategy implementation successfully. Financial budgeting should not be thought of as a tool for limiting expenditures but rather as a method for obtaining the most productive and profitable use of an organization's resources. Financial budgets can be viewed as the planned allocation of a firm's resources based on forecasts of the future.

There are almost as many different types of financial budgets as there are types of organizations. Some common types of budgets include cash budgets, operating budgets, sales budgets, profit budgets, factory budgets, capital budgets, expense budgets, divisional budgets, variable budgets, flexible budgets, and fixed budgets. When an organization is experiencing financial difficulties, budgets are especially important in guiding strategy implementation.

Financial budgets have some limitations. First, budgetary programs can become so detailed that they are cumbersome and overly expensive. Over budgeting or under budgeting can cause problems. Second, financial budgets can become a substitute for objectives, A budget is a tool and not an end in itself. Third, budgets can hide inefficiencies if based solely on precedent rather than on periodic evaluation of circumstances and standards. Finally, budgets are sometimes used as instruments of tyranny that result in frustration, resentment, absenteeism, and high turnover. To minimize the effect of this last concern, managers should increase the participation of subordinates in preparing budgets.

Management / usage of funds

Plans and policies for the usage of funds deal with investment or asset-mix decisions. The important factors regarding which plans and policies are to be made are: capital investment; fixed asset acquisition; current assets; loans and advances; dividend decisions; and relationship with shareholders. Usage of funds is important since it relates to the efficiency and effectiveness of resource utilization in the process of strategy implementation.

Implementation of projects in pursuance of expansion strategies typically results in increase in capital work in progress and current assets. If plans and policies are not clear, the usage of funds is inefficient, leading to less than an optimum utilization of resources. An example is of Modi Cement, which followed a deliberate policy of generous capital investment in setting up its plant based on the latest technology. As compared to its competitor Jaypee Rewa's plant, which cost Rs 120 crore, Modi's plant had an investment of Rs 153 crore. The result was high interest liability and depreciation, causing a serious dent in profitability in the initial years. Other factors of usage of funds are also considered by companies to attract and retain shareholders' interest. Payout policies for dividends and bonus distribution play an important role in the usage of funds.

The management of funds is an important area of financial strategies. It basically deals with decisions related to the systemic aspects of financial management. The major factors regarding which plans and policies related to the management of funds have to be made are: the systems of finance, accounting, and budgeting; management control system; cash, credit, and risk management; cost control and reduction; and tax planning and advantages.

The management of funds can play a pivotal role in strategy implementation as it aims at the conservation and optimum utilization of funds objectives which are central to any strategic action. Organizations that implement strategies of stability, growth or retrenchment cannot escape the rigours of a proper management of funds. In fact, good management of funds often creates the difference between a strategically successful and unsuccessful company. For instance, Gujarat Ambuja Cements, currently a highly profitable cement company in the country, has achieved tremendous financial success primarily on the basis of its policies of cost control. This company has been particularly successful in maintaining a low cost for power, which is a major input in cement manufacturing.

Financial plans and policies, however, present a dilemma before management. The priorities of management may often conflict with those of shareholders. It is the responsibility of the strategists to minimize the conflict of interest between the management and the shareholders.

Evaluating the worth of a business

Evaluating the worth of a business is central to strategy implementation because integrative, intensive, and diversification strategies are often implemented by acquiring other firms. Other strategies, such as retrenchment may result in the sale of a division of an organization or of the firm itself. Thousands of transactions occur each year in which businesses are bought or sold in the United States. In all these cases, it is necessary to establish the financial worth or cash value of a business to successfully implement strategies.

All the various methods for determining a business's worth can be grouped into three main approaches:

- The first approach in evaluating the worth of a business is determining its net worth or stockholders' equity. Net worth represents the sum of common stock, additional paid-in capital, and retained earnings. After calculating net worth, add or subtract an appropriate amount for goodwill and overvalued or undervalued assets. This total provides a reasonable estimate of a firm's monetary value. If a firm has goodwill, it will be listed on the balance sheet, perhaps as "intangibles".
- The second approach to measuring the value of a firm grows out of the belief that the worth of any business should be based largely on the future benefits its owners may derive through net profits. A conservative rule of thumb is to establish a business's worth as five times the firm's current annual profit. A five-year average profit level could also be used. When using the approach, remember that firms normally suppress earnings in their financial statements to minimize taxes.
- The third approach, letting the market determine a business's worth, involves three methods. First, base the firm's worth on the selling price of a similar company. A potential problem, however, is that sometimes comparable figures are not easy to locate, even though substantial information on firms that buy or sell to other firms is available in major libraries. The second approach is called the price-earnings ratio method. To use this method, divide the market price of the firm's common stock by the annual earnings per share and multiply this number by the firm's average net income for the past five years. The third approach can be called the outstanding shares method. To use this method, simply multiply the number of shares outstanding by the market price per share and add a premium. The premium is simply a per-share amount that a person or firm is willing to pay to control (acquire) the other company. As indicated in the Global Perspective, European firms aggressively are acquiring American firms, using these and perhaps other methods for evaluating the worth of their target companies.

4. PRODUCTION STRATEGY FORMULATION

The strategy for production are related to the production system, operational planning and control, and research and development (R&D). The strategy adopted affects the nature of product/service, the markets to be served, and the manner in which the markets are to be served. All these collectively influence the operations system structure and objectives which are used to determine the operations plans and policies. Thus, a strategy of expansion through related diversification, for instance, will affect what products are offered to which market and how these markets are served. The operations system structure, which is concerned with the manufacturing/ service and supply/delivery system, and operations system objectives, which are related to customer service and resource utilisation, both determine what operations, plans and policies are set.

Production System

The production system is concerned with the capacity, location, layout, product or service design, work systems, degree of automation, extent of vertical integration, and such factors. Strategies related to production system are significant as they deal with vital issues affecting the capability of the organisation to achieve its objectives.

Strategy implementation would have to take into account the production system factors as they involve decisions which are long-term in nature and influence not only the operations capability of an organisation but also its ability to implement strategies and achieve objectives. For example, Excel Industries, a pioneering company in the area of industrial and agro chemicals, adopts a policy of successive vertical integration for import substitution. It starts with the end product and then integrates backward to make raw materials for it. Another example is of Lakshmi Machine Works, where operations policy related to the product range is aimed at the successive enlargement of its textile machinery range. This is done through a policy of mastering the process of production by absorption of technology, indigenisation, and adaptation to customer needs.

Operations Planning and Control

Strategies related to operations planning and control are concerned with aggregate production planning; materials supply; inventory, cost, and quality management; and maintenance of plant and equipment. Here, the aim of strategy implementation is to see how efficiently resources are utilized and in what manner the day-to-day operations can be managed in the light of long-term objectives.

Operations planning and control provides an example of an organizational activity that is aimed at translating the objectives into reality. For instance, Instrumentation Ltd is a public sector company engaged in the business of process control and automation and is currently-following a strategy of expansion and diversification. Operations planning and control at this company is based on the policy of ancillarisation. There are about 259 ancillary units that supply sub-assemblies and components. The company's centralized production is at Kota in Rajasthan and its operations plans are based on the plans of its ancillary units. The centralized production provides all the basic inputs to ancillaries and performs the functions of testing, standardizing, and fabricating the equipment.

Some companies use quality as a strategic tool. The operations policies at KSB Pumps Ltd lay a great emphasis on quality aspects. In implementing its strategy of stable growth, KSB Pumps has built a solid reputation for its quality products. Structurally, it has a separate department of quality assurance having two groups of quality inspection and quality engineering. Thus, quality is a consideration not only at the inspection stage but is built into the design itself.

5. LOGISTICS STRATEGY

Management of logistics is a process which integrates the flow of supplies into, through and out of an organization to achieve a level of service which ensures that the right materials are available at the right place, at the right time, of the right quality, and at the right cost. Organizations try to keep the cost of transporting materials as low as possible consistent with safe and reliable delivery.

Supply chain management helps in logistics and enables a company to have constant contact with its distribution team, which could consist of trucks, trains, or any other mode of transportation. Given the changes that affect logistics operations such as emerging technologies and industry initiatives, developing and using a formal logistics strategy is very important. For a business organization effective logistic strategy will involve raising and finding solutions to the following questions:

- ♦ Which sources of raw materials and components are available?
- ♦ How many manufacturing locations are there?
- ♦ What products are being made at each manufacturing location?
- ♦ What modes of transportation should be used for various products.
- ♦ What is the nature of distribution facilities?
- ♦ What is the nature of materials handling equipment possessed? Is it ideal?
- ♦ What is the method for deploying inventory in the logistics network?
- ♦ Should the business organization own the transport vehicles?

Improvement in logistics can results in savings in cost of doing business. These savings can also reveal in the profits of the company. Some examples of how logistics can help a business are as follows:

- ♦ Cost savings
- ♦ Reduced inventory
- ♦ Improved delivery time
- ♦ Customer satisfaction
- ♦ Competitive advantage

5.1 Supply Chain Management

The way businesses were conducted in the yesteryears is entirely different as they are conducted now. Today, organisations work in highly turbulent environment. There are several changes in business environment that have contributed to the development of supply chain networks. The technology has made impact on all spheres of business activities. Organisational systems have improved. Even the available infrastructure is improving. Technological changes and reduction in information communication costs with increase in its speed has led to changes in coordination among the members of the supply chain network. Availability of newer technologies have resulted in creation of innovative products with shorter product life cycles.

Traditionally companies have been managing themselves by taking orders, buying supplies, manufacturing products and shipping them from their warehouses. Such organisations may lose out the businesses that strongly lay their focus on key areas of marketing, branding and delivering value to the customer and outsourcing the rest. Today organisations and individual customers have become more demanding. They desire customised products that are made according to their needs. They also aspire that these should be available at lower costs.

5.2 What is Supply Chain Management?

The term supply chain refers to the linkages between suppliers, manufacturers and customers. Supply chains involve all activities like sourcing and procurement of material, conversion, and logistics. Planning and control of supply chains are important components of its management. Naturally, management of supply chains include closely working with channel partners – suppliers, intermediaries, other service providers and customers.

Supply chain management is defined as the process of planning, implementing, and controlling the supply chain operations. It is a cross-functional approach to managing the movement of raw materials into an organization and the movement of finished goods out of the organization toward the end-consumer who are to be satisfied as efficiently as possible. It encompasses all movement and storage of raw materials, work-in-process inventory, and finished goods from point-of-origin to point-of-consumption. Organizations are finding that they must rely on the chain to successfully compete in the global market.

Modern organizations are striving to focus on core competencies and reduce their ownership of sources of raw materials and distribution channels. These functions can be outsourced to other business organizations that specialize in those activities and can perform in better and cost effective manner. In a way organizations in the supply chain do tasks according to their core-competencies. Working in the supply chain improve trust and collaboration amongst partners and thus improve flow and management of inventory.

5.3 Is logistic management same as supply chain management

Supply chain management is an extension of logistic management. However, there is difference between the two. Logistical activities typically include management of inbound and outbound goods, transportation, warehousing, handling of material, fulfilment of orders, inventory management, supply/demand planning. Although these activities also form part of Supply chain management, the latter has different components. Logistic management can be termed as one of its part that is related to planning, implementing, and controlling the movement and storage of goods, services and related information between the point of origin and the point of consumption.

Supply chain management includes more aspects apart from the logistics function. It is a tool of business transformation and involves delivering the right product at the right time to the right place and at the right price. It reduces costs of organizations and enhances customer service.

5.4 Implementing Supply Chain Management Systems

Successful implementing supply management systems requires a change from managing individual functions to integrating activities into key supply chain processes. It involves collaborative work between buyers and suppliers, joint product development, common systems and shared information. A key requirement for successfully implementing supply chain will be network of information sharing and management. The partners need to link together to share information through electronic data interchange and take decisions in timely manner.

Implementing and successfully running supply chain management system will involve:

1. Product development: Customers and suppliers must work together in the product development process. Right from the start the partners will have knowledge of all Involving all partners will help in shortening the life cycles. Products are developed and launched in shorter time and help organizations to remain competitive.

2. Procurement: Procurement requires careful resource planning, quality issues, identifying sources, negotiation, order placement, inbound transportation and storage. Organizations have to coordinate with suppliers in scheduling without interruptions. Suppliers are involved in planning the manufacturing process.

3. Manufacturing: Flexible manufacturing processes must be in place to respond to market changes. They should be adaptive to accommodate customization and changes in the taste and preferences. Manufacturing should be done on the basis of just-in-time (JIT) and minimum lot sizes. Changes in the manufacturing process be made to reduce manufacturing cycle.

4. Physical distribution: Delivery of final products to customers is the last position in a marketing channel. Availability of the products at the right place at right time is important for

each channel participant. Through physical distribution processes serving the customer become an integral part of marketing. Thus supply chain management links a marketing channel with customers.

5. Outsourcing: Outsourcing is not limited to the procurement of materials and components, but also include outsourcing of services that traditionally have been provided within an organization. The company will be able to focus on those activities where it has competency and everything else will be outsourced.

6. Customer services: Organizations through interfaces with the company's production and distribution operations develop customer relationships so as to satisfy them. They work with customer to determine mutually satisfying goals, establish and maintain relationships. This in turn help in producing positive feelings in the organization and the customers

7. Performance measurement: There is a strong relationship between the supplier, customer and organisation. Supplier capabilities and customer relationships can be correlated with a firm performance. Performance is measured in different parameters such as costs, customer service, productivity and quality.

6. RESEARCH AND DEVELOPMENT

Research and development (R&D) personnel can play an integral part in strategy implementation. These individuals are generally charged with developing new products and improving old products in a way that will allow effective strategy implementation. R&D employees and managers perform tasks that include transferring complex technology, adjusting processes to local raw materials, adapting processes to local markets, and altering products to particular tastes and specifications. Strategies such as product development, market penetration, and concentric diversification require that new products be successfully developed and that old products be significantly improved. But the level of management support for R&D is often constrained by resource availability.

Technological improvements that affect consumer and industrial products and services shorten product life cycles. Companies in virtually every industry are relying on the development of new products and services to fuel profitability and growth. Surveys suggest that the most successful organizations use an R&D strategy that ties external opportunities to internal strengths and is linked with objectives. Well formulated R&D policies match market opportunities with internal capabilities. R&D policies can enhance strategy implementation efforts to:

- Emphasize product or process improvements.
- Stress basic or applied research.
- Be leaders or followers in R&D.
- Develop robotics or manual-type processes.

- Spend a high, average, or low amount of money on R&D.
- Perform R&D within the firm or to contract R&D to outside firms.
- Use university researchers or private sector researchers.

There must be effective interactions between R&D departments and other functional departments in implementing different types of generic business strategies. Conflicts between marketing, finance/accounting, R&D, and information systems departments can be minimized with clear policies and objectives.

Many firms wrestle with the decision to acquire R&D expertise from external firms and develop R&D expertise internally. The following guidelines can be used to help make this decision:

- If the rate of technical progress is slow, the rate of market growth is moderate, and there are significant barriers to possible new entrants, then in-house R&D is the preferred solution. The reason is that R&D, if successful, will result in a temporary product or process monopoly that the company can exploit.
- If technology is changing rapidly and the market is growing slowly, then a major effort in R&D may be very risky, because it may lead to the development of an ultimately obsolete technology or one for which there is no market.
- If technology is changing slowly but the market is growing quickly, there generally is not enough time for in-house development. The prescribed approach is to obtain R&D expertise on an exclusive or nonexclusive basis from an outside firm.
- If both technical progress and market growth are fast, R&D expertise should be obtained through acquisition of a well-established firm in the industry?

There are at least three major R&D approaches for implementing strategies. The first strategy is to be the first firm to market new technological products. This is a glamorous and exciting strategy but also a dangerous one. Firms such as 3M and General Electric have been successful with this approach, but many other pioneering firms have fallen, with rival firms seizing the initiative.

A second R&D approach is to be an innovative imitator of successful products, thus minimizing the risks and costs of start up. This approach entails allowing a pioneer firm to develop the first version of the new product and to demonstrate that a market exists. Then, laggard firms develop a similar product. This strategy requires excellent R&D personnel and an excellent marketing department.

A third R&D strategy is to be a low-cost producer by mass-producing products similar to but less expensive than products recently introduced. As a new product accepted by customers, price becomes increasingly important in the buying decision. Also, mass marketing replaces personal selling as the dominant selling strategy. This R&D strategy requires substantial investment in plant and equipment, but fewer expenditures in R&D than the two approaches described earlier.

7. HUMAN RESOURCE STRATEGY FORMULATION

The job of human resource manager is changing rapidly as there companies that downsize and reorganize. Strategic responsibilities of the human resource manager include assessing the staffing needs and costs for alternative strategies proposed during Strategy formulation and developing a staffing plan for effectively implementing strategies. This plan must consider how best to manage spiralling healthcare insurance costs. Employers' health coverage expenses consume an average 26 percent of firms' net profits, even though most companies now require employees to pay part of their health insurance premiums. The plan must also include how to motivate employees and managers.

The human resource department must develop performance incentives that clearly link performance and pay to strategies. The process of empowering managers and employees through their involvement in strategic management activities yields the greatest benefits when all organizational members understand clearly how they will benefit personally if the firm does well. Linking company and personal benefits is a major new strategic responsibility of human resource managers. Other new responsibilities for human resource managers may include establishing and administering an employee stock ownership plan (ESOP), instituting an effective childcare policy, and providing leadership for managers and employees in a way that allows them to balance work and family.

A well-designed strategic-management system can fail if insufficient attention is given to the human resource dimension. Human resource problems that arise when business implement strategies can usually be traced to one of three causes: (1) disruption of Social and political structures, (2) failure to match individuals' aptitudes with implementation tasks, and (3) inadequate top management support for implementation activities.

Strategy implementation poses a threat to many managers and employees in an organization. New power and status relationships are anticipated and realized. New formal and informal groups' values, beliefs, and priorities may be largely unknown. Managers and employees may become engaged in resistance behaviour as their roles, prerogatives, and power in the firm change. Disruption of social and political structures that accompany strategy execution must be anticipated and considered during strategy formulation and managed during strategy implementation.

A concern in matching managers with strategy is that jobs have specific and relatively static responsibilities, although people are dynamic in their personal development. Commonly used methods that match managers with strategies to be implemented include transferring managers, developing leadership workshops, offering career development activities, promotions, job enlargement, and job enrichment.

A number of other guidelines can help ensure that human relationships facilitate rather than disrupt strategy-implementation efforts. Specifically, managers should do a form of chatting and informal questioning to stay abreast of how things are progressing and to know when to intervene. Managers can build support for strategy-implementation efforts by giving few orders, announcing few decisions, depending heavily on informal questioning, and seeking to probe and clarify until a consensus emerges. Key thrusts that needed should be rewarded generously and visibly.

It is surprising that so often during strategy formulation, individual values, skills, and abilities needed for successful strategy implementation are not considered. It is rare that a firm selecting new strategies or significantly altering existing strategies possesses the right line and staff personnel in the tight positions for successful strategy implementation. The need to match individual aptitudes with strategy-implementation tasks should be considered in strategy choice.

Inadequate support from strategists for implementation activities often undermines organizational success. Chief executive officers, small business owners, and government agency heads must be personally committed to strategy implementation and express this commitment in highly visible ways. Strategists' formal statements about the Importance of strategic management must be consistent with actual support and rewards given for activities completed and objectives reached. Otherwise, stress created by inconsistency can cause uncertainty among managers and employees at all levels.

Perhaps the best method for preventing and overcoming human resource problems in strategic management is to actively involved many managers and employees' as possible in the process. Although time-consuming, this approach builds understanding, trust, commitment and ownership and reduces resentment and hostility. The true potential of strategy formulation and implementation presides in people.

The firm's external opportunities and threats on the one hand and its internal strengths and weaknesses on the other. In Human Resource Strategic management, the strategist tries to achieve a competitive advantage for his organization. The competitive advantage may be in the form of low cost relationship in the industry or being unique in the industry along dimensions that are widely valued by the customers in particular and the society at large. And so that they can obtain a competitive edge by becoming a low-cost leader or a differentiator puts a heavy premium on having a highly competent and committed team for human resources. To quote Charles Greer,

In a growing number of organizations, human resources are now viewed as a source of competitive advantage. There is greater recognition that distinctive competencies are obtained through highly developed employee skills, distinctive organizational cultures, management processes and systems.

The role of human resources in enabling the organization to effectively deal with the external environmental challenges, the human resource management function has been accepted as a strategic partner in the formulation of organization's strategies and in the implementation of such strategies through human resource planning, employment, training, appraisal and rewarding of personnel. An organization's recruitment, selection, training, performance appraisal, and compensation practices can have a strong influence on employee competence is very important. The following points should be kept in mind :

1. Recruitment and selection: The workforce will be more competent if a firm can successfully identify, attracts, and select the most competent applicants.
2. Training. The workforce will be more competent if employees are well trained to perform their jobs property.
3. Appraisal of Performance. The performance appraisal is to identify any performance deficiencies experienced by employees due to lack of competence. Such deficiencies, once identified, can often be solved through counselling, coaching or training.
4. Compensation. A firm can usually increase the competency of its workforce by offering pay and benefit packages that are more attractive than those of there competitors. This practice enables organizations to attract and retain the most capable people.

Strategy and Human Resource Management

The human resource strategy of business should reflect and support the corporate strategy. An effective human resource strategy includes the way in which the organization plans to develop its employees and provide them suitable opportunities and better working conditions so that their optimal contribution is ensured. This implies selecting the best available personnel, ensuring a 'fit' between the employee and the job and retaining, motivating and empowering employees to perform well in direction of corporate objectives.

Strategic human resource management may be defined as the linking of human resource management with strategic goals and objectives to improve business performance and develop organizational culture that fosters innovation and flexibility. The success of an organization depends on its human resources. This means how they are acquired, developed, motivated and retained organization play an important role in organizational success. This presupposes an integrated approach towards human resource functions and overall business functions of an organization.

The Human Resource Management practices of an organization may be an important source of competitive advantage. For this strategic focus should be given in the following points:

- Pre-selection practices including human resource planning and job analysis.
- Selection practices meant to staff various positions in the organization. Both recruitment and selection policies and procedures should be designed keeping in view the mission and the purpose of the organization.

- Post-selection practices to maintain and improve the workers job performance levels. Human Resources decisions related to training and development, performance appraisal, compensation and motivation should be based on corporate strategy of the organization.

Strategic Role of Human Resource Management

The prominent areas where the human resource manager can play strategic role are as follows:

1. Providing purposeful direction: The human resource management must be able to lead people and the organization towards the desired direction involving people right from the beginning. The most important tasks of a professional management is to ensure that the object of an organization has been internalized by each individual working in the organization. Goals of an organization states the very purpose and justification of its existence.

The management have to ensure that the objects of an organization becomes the object of each person working in the organization and the objectives are set to fulfill the same. Objectives are specific aims which must be in the line with the goal of the organization and the all actions of each person must be consistent with the objectives defined.

2. Creating competitive atmosphere: Present's globalized market maintaining a competitive gain is the object of any organization. There are two important ways of business can achieve a competitive advantages over the others. The first is cost leadership which means the firm aims to become a low cost leader in the industry. The second competitive strategy is differentiation under which the firm seeks to be unique in the industry in terms of dimensions that are highly valued by the customers. Putting these strategies into effect carries a heavy premium on having a highly committed and competent workforce.

3. Facilitation of change: The Human resource will be more concerned with substance rather than form, accomplishments rather than activities, and practice rather than theory. The personnel function will be responsible for furthering the organization not just maintaining it. Human resource management will have to devote more time to promote changes than to maintain the status quo.

4. Diversion of workforce: In the modern organization management of diverse workforce is a great challenge. Workforce diversity can be observed in terms of male and female workers, young and old workers, educated and uneducated workers, unskilled and professional employee, etc. Moreover, many organizations also have people of different castes, religious and nationalities. The workforce in future will comprise more of educated and self conscious workers. They will ask for higher degree of participation and avenues for fulfilment. Money will no longer be the sole motivating force for majority of the workers. Non-financial incentives will also play an important role in motivating the workforce.

5. Empowerment of human resources: Empowerment means authorizing every member of a society or organization to take of his/her own destiny realizing his/her full potential. It involves

giving more power to those who, at present, have little control what they do and little ability to influence the decisions being made around them.

6. Building core competency: The human resource manager has a great role to play in developing core competency by the firm. A core competence is a unique strength of an organization which may not be shared by others. This may be in the form of human resources, marketing, capability, or technological capability. If the business is organized on the basis of core competency, it is likely to generate competitive advantage. Because of this reason, many organization have restructured their businesses by divesting those businesses which do not match core competence. Organization of business around core competence implies leveraging the limited resources of a firm. It needs creative, courageous and dynamic leadership having faith in organization's human resources.

6. Development of works ethics and culture: Greater efforts will be needed to achieve cohesiveness because workers will have transient commitment to groups. As changing work ethic requires increasing emphasis on individuals, jobs will have to be redesigned to provide challenge. Flexible starting and quitting times for employees may be necessary. Focus will shift from extrinsic to intrinsic motivation. A vibrant work culture will have to be developed in the organizations to create an atmosphere of trust among people and to encourage creative ideas by the people. Far reaching changes with the help of technical knowledge will be required for this purpose.

SELF-EXAMINATION QUESTIONS

Multiple Choice Questions

1. Read the following statements:

    (i) Functional-level managers are responsible for the specific business functions.

    (ii) Functional-level managers take decisions related to human resources, purchasing, product development, customer service, and so on.

    Select the correct alternative:

    (a) Both (i) and (ii) truly explain features of functional-level manager.

    (b) Only (i) truly explains features of functional-level manager.

    (c) Only (ii) truly explains features of functional-level manager.

    (d) None of (i) and (ii) truly explains features of functional-level manager.

2. The process of creating, maintaining, and enhancing strong, value- laden relationships with customers and other stakeholder is:

    (a) Social marketing

    (b) Augmented marketing

(c) Direct marketing

(d) Relationship marketing

3. A core competence is a ________ of an organization which may not be shared by others.

   (a) Unique strength

   (b) Unique opportunity

   (c) Unique product

   (d) None of the above

4. If both technical progress and market growth are fast, R&D expertise should be obtained through:

   (a) Acquisition of a technologically sound and well-established firm.

   (b) In-house development.

   (c) Hiring management consultant

   (d) None of the above.

5. Functional managers need ________ from the business strategy in order to _______.

   (a) to function, control

   (b) guidance, make decisions

   (c) money, purchase raw material.

   (d) None of the above

Objective type Question

State with reasons which of the following statements are correct/incorrect

(a) Penetration means keeping prices very low.

(b) A core competence of an organization is shared uniformly within the industry.

(c) Functional strategies help in bringing harmony and coordination.

Short answer questions

1. Write a short note on marketing mix?

2. Write a short note on evaluating worth of a business.

3. How proper logistics management helps business.

Essay type questions

1. What is human resource management? Discuss its role in implementation of strategy.

2. Discuss the concept of production strategy formulation
3. What is financial strategy? How worth of a business can be evaluated?

Case Study

Many companies are harping on making their products affordable to the mass consumers as part of their growth strategy. Two years back Clean Head Ltd started selling their shampoo at an affordable price of Rs 10 for 40 ml bottle. The price of 100 ml and 200 bottles were retained at Rs 45 and 85 respectively. The product was aggressively pushed in small and mofussil towns. The company expected that the existing customers would continue with the convenience of bigger bottles and purchase them. Contrary to the expectations, big cities also witnessed a shift towards smaller size bottles. There was some increase in the volumes, but squeeze in the margins tremendously reduced the profits. Moreover, the turnover did not increase as forecasted.

The chairman of the company called a meeting of all the functional heads and made following observations:

"We have to chart out long-term strategies for our company. At this moment, sustainable but profitable growth is sacrosanct for us, but may prove to be elusive. We are not in a position to offer lower-priced shampoos with declining profits. If we continue like this, gradually the company may start incurring losses. Our competitors have also followed us by reducing their prices. My dilemma is if we roll back our prices, our competitors may not do so."

(a) What went wrong? Give your assessment of the situation

(b) How competitors are related to the internal decisions?

(c) What is the strategy used by Clean Head Ltd.

Answers – Multiple Choice Questions

1. (a), 2. (d), 3. (a), 4. (a), 5. (b)

CHAPTER 6

STRATEGY IMPLEMENTATION AND CONTROL

LEARNING OBJECTIVES

- Learn the concept of strategy implementation.
- Understand why strategy implementation is more difficult than strategy formulation.
- Understand the importance of organizational structure in strategy implementation.
- Understand how to establish strategic Business Units.
- Understand the role of leadership in the execution of strategy.
- Learn how to build a supportive corporate culture.

Winning companies know how to do their work better

– Michael Hammer and James Champy

A management truism says structure follows strategy. However, this truism is often ignored. Too many organizations attempt to carry out a new strategy with an old structure.

– Dale McConkey

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1. INTRODUCTION

Strategic-management process does not end when the firm decides what strategies to pursue. There must be a translation of strategic thought into strategic action. Translation requires support of all managers and employees of the business. Implementing strategy affects an organization from top to bottom; it affects all the functional and divisional areas of a business.

2. INTERRELATIONSHIPS BETWEEN STRATEGY FORMULATION AND IMPLEMENTATION

Strategy implementation concerns the managerial exercise of putting a freshly chosen strategy into place. Strategy execution deals with the managerial exercise of supervising the ongoing pursuit of strategy, making it work, improving the competence with which it is executed and showing measurable progress in achieving the targeted results. Strategic implementation is concerned with translating a decision into action, with presupposes that the decision itself (i.e., the strategic choice) was made with some thought being given to feasibility and acceptability.

The allocation of resources to new courses of action will need to be undertaken, and there may be a need for adapting the organization's structure to handle new activities as well as training personnel and devising appropriate system.

The basic elements of strategic management are summarized in the figure below:

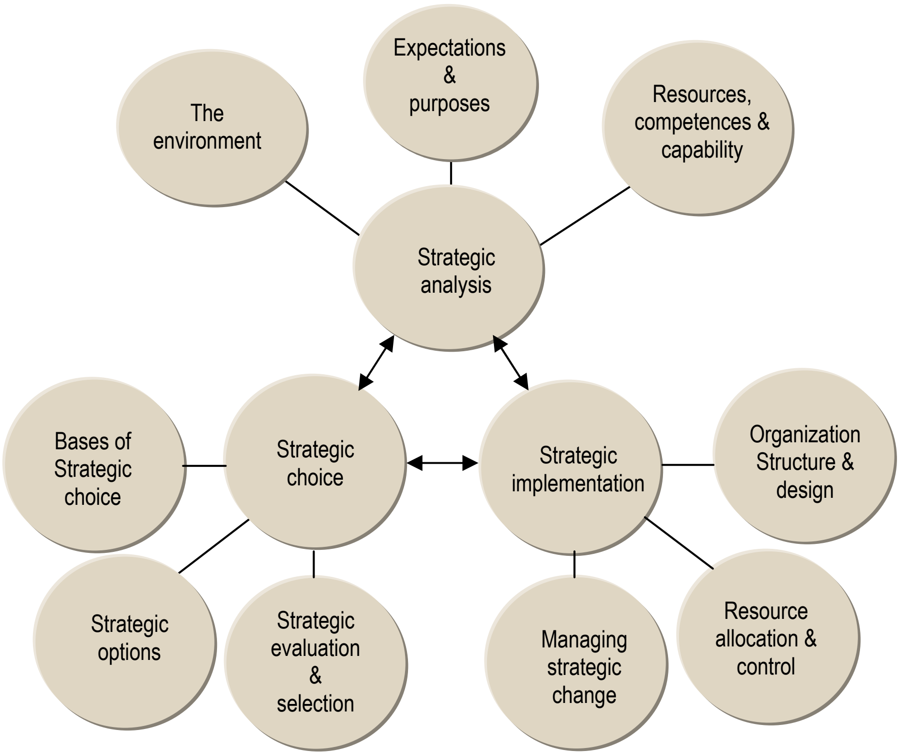

Figure: A summary model of the elements of strategic management

Source : Johnson and Scholes (1988)

Many managers fail to distinguish between strategy formulation and strategy implementation. Yet, it is crucial to realize the difference between the two because they both require very different skills. Also, a company will be successful only when the strategy formulation is sound and implementation is excellent. There is no such thing as successful strategic design per se. This sounds obvious, but in practice the distinction is not always made. Often people, blame the strategy model for the failure of a company while the main flaw might lie in failed implementation. Thus organizational success is a function of good strategy and proper implementation. The matrix in the figure below represent various combination of strategy formulation and implementation:

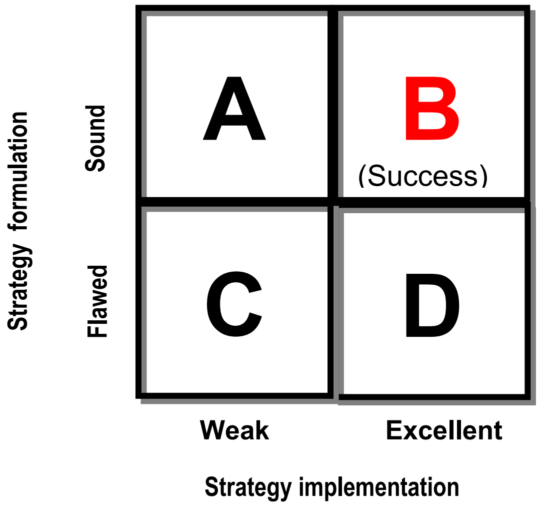

Figure: Strategy formulation and implementation matrix

The Figure shows the distinction between sound/flawed strategy formulation and excellent/ weak strategy implementation. Square B is the ideal situation where a company has succeeded in designing a sound and competitive strategy and has been successful in implementing it.

Square A is the situation where a company apparently has formulated a very competitive strategy, but is showing difficulties in implementing it successfully. This can be due to various factors, such as the lack of experience (e.g. for startups), the lack of resources, missing leadership and so on. In such a situation the company will aim at moving from square A to square B, given they realize their implementation difficulties.

Square D is the situation where the strategy formulation is flawed, but the company is showing excellent implementation skills. When a company finds itself in square D the first thing they have to do is to redesign their strategy before readjusting their implementation/execution skills.

Square C is reserved for companies that haven't succeeded in coming up with a sound strategy formulation and in addition are bad at implementing their flawed strategic model. Their path to success also goes through business model redesign and implementation/execution readjustment.

Taken together all the elements of business strategy it is to be seen as a chosen set of actions by means of which a market position relative to other competing enterprises is sought and maintained. This gives us the notion of competitive position.

It needs to be emphasized that 'strategy' is not synonymous with 'long-term plan' but rather consists of an enterprise's attempts to reach some preferred future state by adapting its competitive position as circumstances change. While a series of strategic moves may be planned, competitors' actions will mean that the actual moves will have to be modified to take account of those actions.

In contrast to this view of strategy there is another approach to management practice, which has been common in many organizations. In organizations that lack strategic direction there has been a tendency to look inwards in times of stress, and for management to devote their attention to cost cutting and to shedding unprofitable divisions. In other words, the focus has been on efficiency (i.e. the relationship between inputs and outputs, usually with a short time horizon) rather than on effectiveness (which is concerned with the organization's attainment of goals - including that of desired competitive position). While efficiency is essentially introspective, effectiveness highlights the links between the organization and its environment. The responsibility for efficiency lies with operational managers, with top management having the primary responsibility for the strategic orientation of the organization.

		Strategic management	
		Effective	**Ineffective**
Operational Management	**Efficient**	1 **Thrive**	2 **Die Slowly**
	Inefficient	3 **Survive**	4 **Die Quickly**

Figure: Principal combinations of efficiency and effectiveness

An organization that finds itself in cell 1 is well placed and thrives, since it is achieving what it aspires to achieve with an efficient output/input ratio. In contrast, an organization in cell 2 or 4 is doomed, unless it can establish some strategic direction. The particular point to note is that cell 2 is a worse place to be than is cell 3 since, in the latter, the strategic direction is present to ensure effectiveness even if rather too much input is being used to generate outputs. To be effective is to survive whereas to be efficient is not in itself either necessary or sufficient for survival.

In crude terms, to be effective is to do the right thing, while to be efficient is to do the thing right. An emphasis on efficiency rather than on effectiveness is clearly wrong. But who determines effectiveness? Any organization can be portrayed as a coalition of diverse interest groups each of which participates in the coalition in order to secure some advantage. This advantage (or inducement) may be in the form of dividends to shareholders, wages to employees, continued business to suppliers of goods and services, satisfaction on the part of consumers, legal compliance from the viewpoint of government, responsible behaviour towards society and the environment from the perspective of pressure groups, and so on.

Even the most technically perfect strategic plan will serve little purpose if it is not implemented. Many organizations tend to spend an inordinate amount of time, money, and effort on developing the strategic plan, treating the means and circumstances under which it will be implemented as afterthoughts! Change comes through implementation and evaluation, not through the plan. A technically imperfect plan that is implemented well will achieve more than the perfect plan that never gets off the paper on which it is typed.

Successful strategy formulation does not guarantee successful strategy implementation. It is always more difficult to do something (strategy implementation) than to say you are going to do it (strategy formulation)! Although inextricably linked, strategy implementation is fundamentally different from strategy formulation. Strategy formulation and implementation can be contrasted in the following ways:

Strategy formulation	Strategy implementation
♦ Strategy formulation is positioning forces before the action.	♦ Strategy implementation is managing forces during the action.
♦ Strategy formulation focuses on effectiveness.	♦ Strategy implementation focuses on efficiency.
♦ Strategy formulation is primarily an intellectual process.	♦ Strategy implementation is primarily an operational process.
♦ Strategy formulation requires good intuitive and analytical skills.	♦ Strategy implementation requires special motivation and leadership skills
♦ Strategy formulation requires coordination among a few individuals	♦ Strategy implementation requires combination among many individuals.

Strategy - formulation concepts and tools do not differ greatly for small, large, for-profit, or non-profit organizations. However, strategy implementation varies substantially among different types and sizes of organizations. Implementing strategies requires such actions as altering sales territories, adding new departments, closing facilities, hiring new employees, changing an organization's pricing strategy, developing financial budgets, developing new employee benefits, establishing cost-control procedures, changing advertising strategies, building new facilities, training new employees, transferring managers among divisions, and building a better management information system, These types of activities obviously differ greatly between manufacturing, service, and governmental organizations.

It is to be noted that the division of strategic management into different phases is only for the purpose of orderly study. In real life, the formulation and implementation processes are intertwined. Two types of linkages exist between these two phases of strategic management. The forward linkages deal with the impact of the formulation on implementation while the backward linkages are concerned with the impact in the opposite direction.

Forward Linkages: The different elements in strategy formulation starting with objective setting through environmental and organizational appraisal, strategic alternatives and choice to the strategic plan determine the course that an organization adopts for itself. With the formulation of new strategies, or reformulation of existing strategies, many changes have to be effected within the organization. For instance, the organizational structure has to undergo a change in the light of the requirements of the modified or new strategy. The style of leadership has to be adapted to the needs of the modified or new strategies. In this way, the formulation of strategies has forward linkages with their implementation.

Backward Linkages: Just as implementation is determined by the formulation of strategies, the formulation process is also affected by factors related with 'implementation. While dealing with strategic choice, remember that past strategic actions also determine the choice of strategy. Organizations tend to adopt those strategies which can be implemented with the help of the present structure of resources combined with some additional efforts. Such incremental changes, over a period of time, take the organization from where it is to where it wishes to be.

It is to be noted that while strategy formulation is primarily an entrepreneurial activity, based on strategic decision -making, the implementation of strategy is mainly an administrative task based on strategic as well as operational decision-making. The next section focuses on the various issues involved in the implementation of strategies.

3. ISSUES IN STRATEGY IMPLEMENTATION

The different issues involved in strategy implementation cover practically everything that is included in the discipline of management studies. A strategist, therefore, has to bring to his or her task a wide range of knowledge, skills, attitudes, and abilities. The implementation tasks put to test the strategists' abilities to allocate resources, design structures, formulate functional policies, and take into account the leadership styles required, besides dealing with various other issues.

- The strategic plan devised by the organization proposes the manner in which the strategies could be put into action. Strategies, by themselves, do not lead to action. They are, in a sense, a statement of intent: implementation tasks are meant to realise the intent. Strategies, therefore, have to be activated through implementation.
- Strategies should lead to plans. For instance, if stability strategies have been formulated, they may lead to the formulation of various plans. One such plan could be a modernization plan. Plans result in different kinds of programmes. A programme is a broad term, which includes goals, policies, procedures, rules, and steps to be taken in putting a plan into action. Programmes are usually supported by funds allocated for plan implementation. An example of a programme is a research and development programme for the development of a new product.
- Programmes lead to the formulation of projects. A project is a highly specific programme for which the time schedule and costs are predetermined. It requires allocation of funds based on capital budgeting by organizations. Thus, research and development programmes may consist of several projects, each of which is intended to achieve a specific and limited objective, requires separate allocation of funds, and is to be completed within a set time schedule.
- Projects create the needed infrastructure for the day-to-day operations in an organization. They may be used for setting up new or additional plants, modernising the existing facilities, installation of newer systems, and for several other activities that are needed for the implementation of strategies.

Implementation of strategies is not limited to formulation of plans, programmes, and projects. Projects would also require resources. After that is provided, it would be essential to see that a proper organizational structure is designed, systems are installed, functional policies are devised, and various behavioural inputs are provided so that plans may work.

Given below in sequential manner the issues in strategy implementation which are to be considered:

- Project implementation
- Procedural implementation
- Resource allocation
- Structural implementation
- Functional implementation
- Behavioural implementation

But it should be noted that the sequence does not mean that each of the following activities are necessarily performed one after another. Many activities can be performed simultaneously, certain other activities may be repeated over time; and there are activities, which are performed only once.

In all but the smallest organizations, the transition from strategy formulation to strategy implementation requires a shift in responsibility from strategists to divisional and functional managers. Implementation problems can arise because of this shift in responsibility, especially if strategy-formulation decisions come as a surprise to middle and lower-level managers. Managers and employees are motivated more by perceived self-interests than by organizational interests, unless the two coincide. Therefore, it is essential that divisional and functional managers be involved as much as possible in strategy-formulation activities. Of equal importance, strategists should be involved as much as possible in strategy-implementation activities.

Management issues central to strategy implementation include establishing annual objectives, devising policies, allocating resources, altering an existing organizational structure, restructuring and reengineering, revising reward and incentive plans, minimizing resistance to change, matching managers with strategy, developing a strategy-supportive culture, adapting production/operations processes, developing an effective human resource function and, if necessary, downsizing. Management changes are necessarily more extensive when strategies to be implemented move a firm in major new direction.

Managers and employees throughout an organization should participate early and directly in strategy-implementation decisions. Their role in strategy implementation should build upon prior involvement in strategy-formulation activities. Strategists' genuine personal commitment to implementation is a necessary and powerful motivational force for managers and employees. Too often, strategists are too busy to actively support strategy-implementation efforts, and their lack of interest can be detrimental to organizational success. The rationale for objectives and strategies should be understood clearly communicated throughout an organization. Major competitors' accomplishments, products, plans, actions, and performance should be apparent to all organizational members. Major external opportunities and threats should be clear, and managers and employees' questions should be answered. Top-down flow of communication is essential for developing bottom-up support.

Firms need to develop a competitor focus at all hierarchical levels by gathering and widely distributing competitive intelligence; every employee should be able to be benchmark her or his efforts against best-in-class competitors so that the challenge becomes personal. This is a challenge for strategists of the firm. Firms should provide training for both managers and employees to ensure that they have and maintain the skills necessary to be world-class performers.

4. ORGANIZATION AND STRATEGY IMPLEMENTATION

The ideal organizational structure is a place where ideas filter up as well as down, where the merit of ideas carries more weight than their source, and where participation and shared objectives are valued more than executive order.

– Edson Spencer

Changes in strategy often require changes in the way an organization is structured for two major reasons. First, structure largely dictates how objectives and policies will be established. For example, objectives and policies established under a geographic organizational structure are couched in geographic terms. Objectives and policies are stated largely in terms of products in an organization whose structure is based on product groups. The structural format for developing objectives and policies can significantly impact all other strategy-implementation activities.

The second major reason why changes in strategy often require changes in structure is that structure dictates how resources will be allocated. If an organization's structure is based on customer groups, then resources will be allocated in that manner. Similarly, if an organization's structure is set up along functional business lines, then resources are allocated by functional areas.

Changes in strategy lead to changes in organizational structure. Structure should be designed to facilitate the strategic pursuit of a firm and, therefore, follows strategy. Without a strategy or reasons for being (mission), companies find it difficult to design an effective structure. Chandler found a particular structure sequence to be often repeated as organizations grow and change strategy over time. There is no one optimal organizational design or structure for a given strategy or type of organization. What is appropriate for one organization may not be appropriate for a similar firm, although successful firms in a given industry do tend to organize themselves in a similar way. For example, consumer goods companies tend to emulate the divisional structure-by-product form of organization. Small firms tend to be functionally structured (centralized). Medium-size firms tend to be divisionally structured (decentralized). Large firms tend to use an SBU (strategic business unit) or matrix structure. As organizations grow, their structures generally change from simple to complex as a result of linking together of several basic strategies.

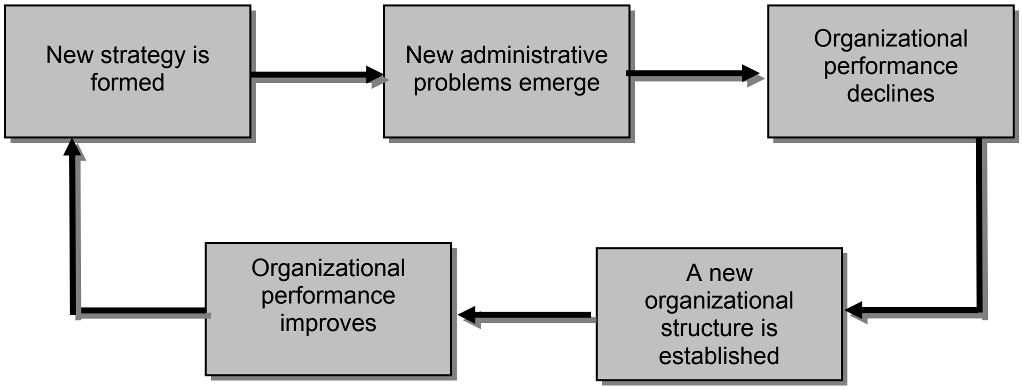

Figure: Chandler's Strategy-Structure Relationship

Numerous external and internal forces affect an organization; no firm could change its structure in response to every one of these forces, because to do so would lead to chaos. However, when a firm changes its strategy, the existing organizational structure may become ineffective. Symptoms of an ineffective organizational structure include too many levels of management, too many meetings attended by too many people, too much attention being directed toward solving interdepartmental conflicts, too large a span of control, and too many unachieved objectives. Changes in structure can facilitate strategy-implementation efforts, but changes in structure should not be expected to make a bad strategy good, to make bad managers good, or to make bad products sell.

Structure undeniably can and does influence strategy. Strategies formulated must be workable, so if a certain new strategy required massive structural changes it would not be an attractive choice. In this way, structure can shape the choice of strategies. But a more important concern is determining what types of structural changes are needed to Implement new strategies and how these changes can best be accomplished. We examine this Issue by focusing on seven basic types of organizational structure: functional, divisional by geographic area, divisional by product, divisional by customer, divisional process, strategic business unit (SBU), and matrix.

4.1 The Functional Structure

A widely used structure in business organisations is functional type because of its simplicity and low cost. A functional structure groups tasks and activities by business function, such as production/operations, marketing, finance/accounting, research and development, and management information systems. Besides being simple and inexpensive, a functional structure also promotes specialization of labour, encourages efficiency, minimizes the need for an elaborate control system, and allows rapid decision making.

Some disadvantages of a functional structure are that it forces accountability to the top, minimizes career development opportunities, and is sometimes times characterized by low employee morale, line/staff conflicts, poor delegation of authority, and inadequate planning for products and markets. Most large companies abandoned the functional structure in favour of decentralization and improved accountability.

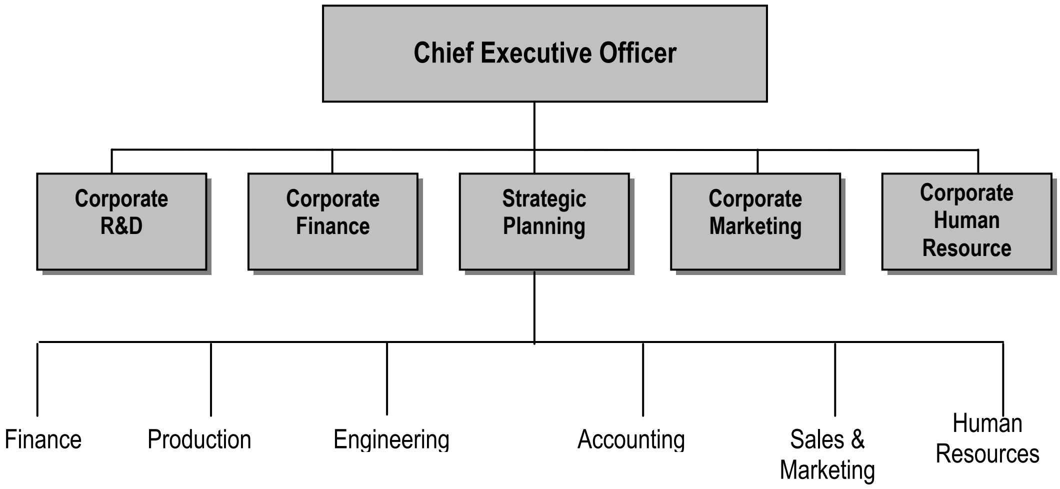

Figure: Functional Organization Structure

A competitive advantage is created when there is a proper match between strategy and structure. Ineffective strategy/structure matches may result in company rigidity and failure, given the complexity and need for rapid changes in today's competitive landscape. Thus, effective strategic leaders seek to develop an organizational structure and accompanying controls that are superior to those of their competitors.

Selecting the organizational structure and controls that result in effective implementation of chosen strategies is a fundamental challenge for managers, especially top-level managers. This is because companies must be flexible, innovative, and creative in the global economy if they are to exploit their core competencies in the pursuit of marketplace opportunities. Companies must also maintain a certain degree of stability in their structures so that day-to-day tasks can be completed efficiently.

Access to reliable information is imperative if executives are to reach decisions regarding the selection of a structure that is sufficiently flexible and stable. Useful information contributes to the formation and use of effective structures and controls, which yield improved decision making.

In order to implement and manage strategies that have been formulated, all companies-need some form of organizational structure. And, as companies formulate new strategies, increase in size, or change their level of diversification, new organizational structures may be required.

Organizational structure is the company's formal configuration of its intended roles, procedures, governance mechanisms, authority, and decision-making processes. Organizational structure, influenced by factors such as an organization's age and size, acts as a framework which reflects managers' determination of what a company does and how tasks are completed, given the chosen strategy. The most important issue is that the company's structure must be congruent with or fit with the company's strategy.

Simple organizational structure is most appropriate for companies that follow a single-business strategy and offer a line of products in a single geographic market. The simple structure also is appropriate for companies implementing focused cost leadership or focused differentiation strategies. A simple structure is an organizational form in which the owner-manager makes all major decisions directly and monitors all activities, while the company's staff merely serves as an executor.

Little specialization of tasks, few rules, little formalization, unsophisticated information systems and direct involvement of owner-manager in all phases of day-to-day operations characterise the simple structure. In the simple structure, communication is frequent and direct, and new products tend to be introduced to the market quickly, which can result in a competitive advantage. Because of these characteristics, few of the coordination problems that are common in larger organizations exist.

A simple organizational structure may result in competitive advantages for some small companies relative to their larger counterparts. These potential competitive advantages include a broad-based openness to innovation, greater structural flexibility, and an ability to respond more rapidly to environmental changes. However, if they are successful, small companies grow larger. As a result of this growth, the company outgrows the simple structure. Generally, there are significant increases in the amount of competitively relevant information that requires processing. More extensive and complicated information-processing requirements place significant pressures on owner-managers (often due to a lack of organizational skills or experience or simply due to lack of time).

Thus, it is incumbent on the company's managers to recognise the inadequacies or inefficiencies of the simple structure and change it to one that is more consistent with company's strategy.

To coordinate more complex organizational functions, companies should abandon the simple structure in favour of the functional structure. The functional structure is used by larger companies and by companies with low levels of diversification.

The functional structure consists of a chief executive officer or a managing director and limited corporate staff with functional line managers in dominant functions such as production, accounting, marketing, R&D, engineering, and human resources. The functional structure enables the company to overcome the growth-related constraints of the simple structure, enabling or facilitating communication and coordination.

However, compared to the simple structure, there also are some potential problems. Differences in functional specialization and orientation may impede communications and coordination. Thus, the chief executive officer must integrate functional decision-making and coordinate actions of the overall business across functions. Functional specialists often may develop a myopic (or narrow) perspective, losing sight of the company's strategic vision and mission. When this happens, this problem can be overcome by implementing the multidivisional structure.

The multidivisional (M-form) structure is composed of operating divisions where each division represents a separate business to which the top corporate officer delegates responsibility for day-to-day operations and business unit strategy to division managers. By such delegation, the corporate office is responsible for formulating and implementing overall corporate strategy and manages divisions through strategic and financial controls.

The multidivisional or M-form structure was developed in the 1920s, in response to coordination- and control-related problems in large firms. Functional departments often had difficulty dealing with distinct product lines and markets, especially in coordinating conflicting priorities among the products. Costs were not allocated to individual products, so it was not possible to assess an individual product's profit contribution. Loss of control meant that optimal allocation of firm resources between products was difficult (if not impossible). Top managers became over-involved in solving short-run problems (such as coordination, communications, conflict resolution) and neglected long-term strategic issues.

The new, innovative structure called for

- Creating separate divisions, each representing a distinct business
- Each division would house its functional hierarchy;
- Division managers would be given responsibility for managing day-to-day operations;
- A small corporate office that would determine the long-term strategic direction of the firm and exercise overall financial control over the semi-autonomous divisions.

This would enable the firm to more accurately monitor the performance of individual businesses, simplifying control problems, facilitate comparisons between divisions, improving the allocation of resources and stimulate managers of poorly performing divisions to seek ways to improve performance.

When the firm is less diversified, strategic controls are used to manage divisions. Strategic control refers to the operational understanding by corporate officers of the strategies being implemented within the firm's separate business units.

An increase in diversification strains corporate officers' abilities to understand the operations of all of its business units and divisions are then managed by financial controls, which enables corporate officers to manage the cash flow of the divisions through budgets and an emphasis on profits from distinct businesses.

However, because financial controls are focused on financial outcomes, they require that each division's performance be largely independent of the performance of other divisions. So the Strategic Business Units come into picture.

4.2 The Divisional Structure

As a small organization grows, it has more difficulty managing different products and services in different markets. Some form of divisional structure generally becomes necessary to motivate employees, control operations, and compete successfully in diverse locations. The divisional structure can be organized in one of four ways: by geographic area, by product or service, by customer, or by process. With a divisional structure, functional activities are performed both centrally and in each separate division.

Cisco Systems discarded its divisional structure by customer and reorganized into a functional structure. CEO John Chambers replaced the three-customer structure based on big businesses, small business, and telecoms, and now the company has centralized its engineering and marketing units so that they focus on technologies such as wireless networks. Chambers says the goal was to eliminate duplication, but the change should not be viewed as a shift in strategy. Chambers' span of control in the new structure is reduced to 12 managers reporting directly to him from 15.

Kodak reduced its number of business units from seven by-customer divisions to five by-product divisions. As consumption patterns become increasingly similar worldwide, a by-product structure is becoming more effective than a by-customer or a by geographic type divisional structure. In the restructuring, Kodak eliminated its global operations division and distributed those responsibilities across the new by-product divisions.

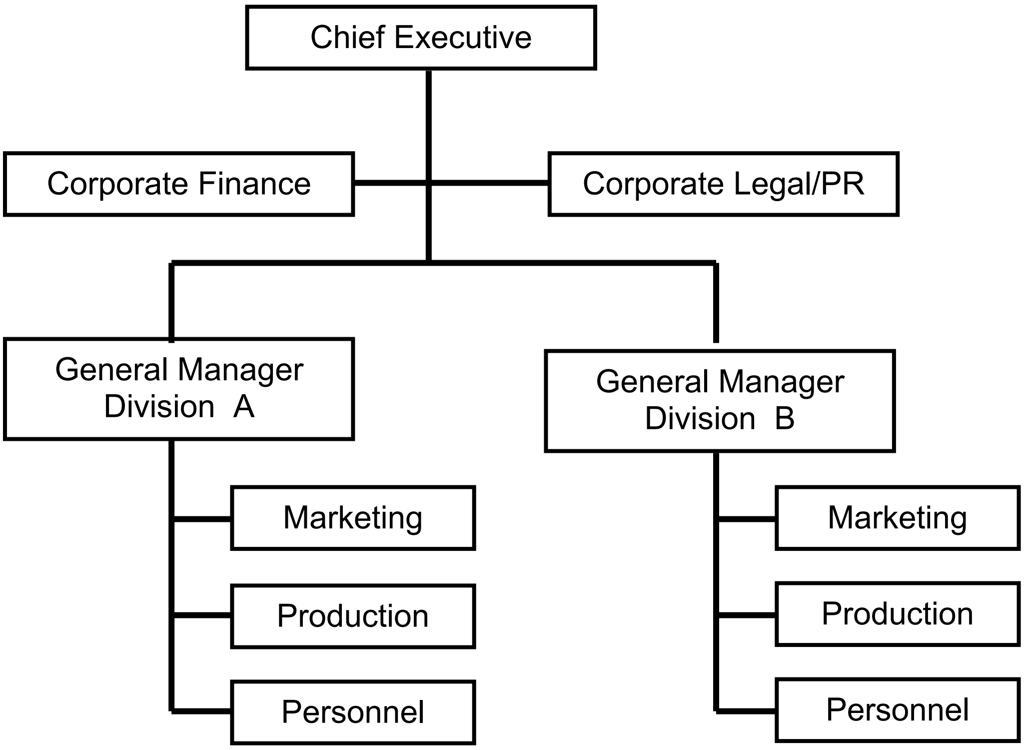

Figure : Divisional Structure

A divisional structure has some clear advantages. First and perhaps foremost accountability is clear. That is, divisional managers can be held responsible for sales and profit levels. Because a divisional structure is based on extensive delegation of authority, managers and employees can easily see the results of their good or bad performances. As a result, employee morale is generally higher in a divisional structure than it is in centralized structure. Other advantages of the divisional design are that it creates career development opportunities for managers, allows local control of local situations, leads to a competitive climate within an organization, and allows new businesses and products In be added easily.

The divisional design is not without some limitations, however. Perhaps the most important limitation is that a divisional structure is costly, for a number of reasons. First, each division requires functional specialists who must be paid. Second, there exists some duplication of staff services, facilities, and personnel; for instance, functional specialists are also needed centrally (at headquarters) to coordinate divisional activities. Third, managers must be well qualified because the divisional design forces delegation of authority better-qualified individuals require higher salaries. A divisional structure can also be costly because it requires an elaborate, headquarters-driven control system. Finally, certain regions, products, or customers may sometimes receive special treatment, and It may be difficult to maintain consistent, company wide practices. Nonetheless, for most large organizations and many small firms, the advantages of a divisional structure more than offset the potential limitations.

A divisional structure by geographic area is appropriate for organizations whose Strategies need to be tailored to fit the particular needs and characteristics of customers indifferent geographic areas. This type of structure can be most appropriate for organization that have similar branch facilities located in widely dispersed areas. A divisional structure by geographic area allows local participation in decision making and improved coordination within a region.

The divisional structure by product (or services) is most effective for implementing strategies when specific products or services need special emphasis. Also, this type of structure is widely used when an organization offers only a few products or services, when an organization's products or services differ substantially. The divisional structure allows strict control over and attention to product lines, but it may also require a more skilled management force and reduced top management control. General Motors, DuPont, and Procter & Gamble use a divisional structure by product to implement strategies.

When a few major customers are of paramount importance and many different services are provided to these customers, then a divisional structure by customer can be the most effective way to implement strategies. This structure allows an organization to cater effectively to the requirements of clearly defined customer groups. For example, book-publishing companies often organize their activities around customer groups such as colleges, secondary schools, and private commercial schools. Some airline companies have two major customer divisions: passengers and freight or cargo services. Merrill Lynch is organized into separate divisions that cater to different groups of customers, including wealthy individuals, institutional investors, and small corporations.

A divisional structure by process is similar to a functional structure, because activities are organized according to the way work is actually performed. However, a key difference between these two designs is that functional departments are not accountable for profits or revenues, whereas divisional process departments are evaluated on these criteria.

4.3 The Strategic Business Unit (SBU) Structure

As the number, size, and diversity of divisions in an organization increase, controlling and evaluating divisional operations become increasingly difficult for strategists. Increases in sales often are not accompanied by similar increases in profitability. The span of control becomes too large at top levels of the firm. Because of limits to an individual chief executive officer's ability to process complex strategic information, problems related to isolation of functional area managers, and increasing diversification, the structure of the company needs to change. In these instances, the SBU structure is most appropriate. Also in multidivisional organizations, an SBU structure can greatly facilitate strategy implementation efforts.

The SBU structure is composed of operating units where each unit represents a separate business to which the top corporate officer delegates responsibility for day-to-day operations and business unit strategy to its managers. By such delegation, the corporate office is responsible for formulating and implementing overall corporate strategy and manages SBUs through strategic and financial controls. Hence, the SBU structure groups similar divisions into strategic business units and delegates authority and responsibility for each unit to a senior executive who reports directly to the chief executive officer. This change in structure can facilitate strategy implementation by improving coordination between similar divisions and channelling accountability to distinct business units. In the ninety-division conglomerate just mentioned, the ninety divisions could perhaps be regrouped into ten SBUs according to certain common characteristics, such as competing in the same industry, being located in the same area, or having the same customers.

Two disadvantages of an SBU structure are that it requires an additional layer of management, which increases salary expenses, and the role of the group vice president is often ambiguous. However, these limitations often do not outweigh the advantages of unproved coordination and accountability.

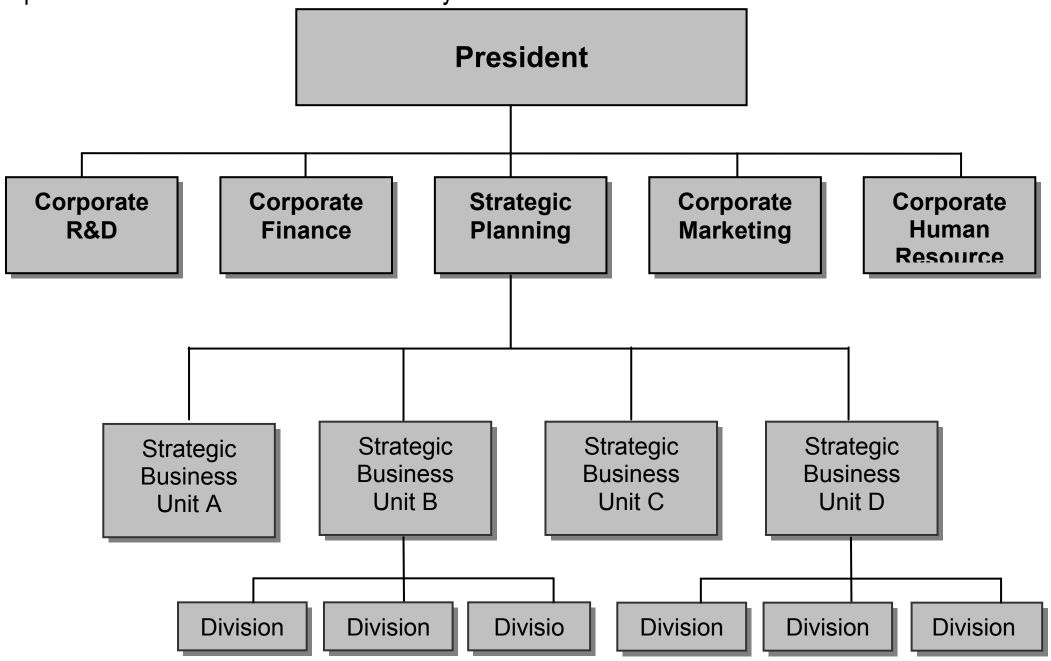

Figure: SBU Structure

This enables the company to more accurately monitor the performance of individual businesses, simplifying control problems. It also facilitates comparisons between divisions, improving the allocation of resources and can be used to stimulate managers of poorly performing divisions to seek ways to improve performance.

A strategic business unit (SBU) structure consists of at least three levels, with a corporate headquarters at the top, SBU groups at the second level, and divisions grouped by relatedness within each SBU at the third level.

This means that, within each SBU, divisions are related to each other, as also that SBU groups are unrelated to each other. Within each SBU, divisions producing similar products and/or using similar technologies can be organised to achieve synergy. Individual SBUs are treated as profit centres and controlled by corporate headquarters that can concentrate on strategic planning rather than operational control so that individual divisions can react more quickly to environmental changes.

For example, Sony has been restructuring to match the SBU structure with its ten internal companies as organised into four strategic business units. Because it has been pushing the company to make better use of software products and content (e.g., Sony's music, films and games) in its televisions and audio gear to increase Sony's profitability. By its strategy, Sony is one of the few companies that have the opportunity to integrate software and content across a broad range of consumer electronics products. It will implement this strategy through the SBU structure.

For General Electric, this structure will enable the company to "walk, talk and think" like smaller companies by making decisions and introducing innovative products more rapidly. GE's SBU form is made up of 10 strategic business units which should enable it to act quickly and more effectively. Structural flexibility is perceived to be of equal importance with strategic flexibility and both of them would enable the company to respond more rapidly to emerging opportunities.

Newer Forms of Organization Structures

As companies successfully implement business-level strategies and achieve above average returns, they may diversify their operations by offering different products or following a product diversification strategy or offering the same or additional products in new markets or by following a market diversification strategy. Following such diversification, companies generally formulate and implement a corporate-level strategy and business-level strategies for individual units.

However, the structural and control characteristics of the functional structure do not adequately support the successful implementation of corporate-level strategies that call for diversification beyond the single or dominant-business level. Increased levels of diversification call for newer structures that enable fast decision making and where other structures do not seem to be working properly.

4.4 The Matrix Structure

Most organizations find that organising around either functions (in the functional structure) or around products and geography (in the divisional structure) provides an appropriate organizational structure. The matrix structure, in contrast, may be very appropriate when organizations conclude that neither functional nor divisional forms, even when combined with horizontal linking mechanisms like strategic business units, are right for their situations. In matrix structures, functional and product forms are combined simultaneously at the same level of the organization. Employees have two superiors, a product or project manager and a functional manager. The "home" department – that is, engineering, manufacturing, or sales – is usually functional and is reasonably permanent. People from these functional units are often assigned temporarily to one or more product units or projects. The product units or projects are usually temporary and act like divisions in that they are differentiated on a product-market basis.

A matrix structure is the most complex of all designs because it depends upon both vertical and horizontal flows of authority and communication (hence the term matrix). In contrast, functional and divisional structures depend primarily on vertical flows of authority and communication. A matrix structure can result in higher overhead because it more management positions. Other characteristics of a matrix structure that contribute to overall complexity include dual lines of budget authority (a violation of the unity command principle), dual sources of reward and punishment, shared authority, dual reporting channels, and a need for an extensive and effective communication system.

Despite its complexity, the matrix structure is widely used in many industries, including construction, healthcare, research and defence. Some advantages of a matrix structure are that project objectives are clear, there are many channels of communication workers can see the visible results of their work, and shutting down a project is accomplished relatively easily.

In order for a matrix structure to be effective, organizations need Planning, training, clear mutual understanding of roles and responsibilities, excellent internal communication, and mutual trust and confidence. The matrix structures used more frequently by American businesses because firms are pursuing strategies add new products, customer groups, and technology to their range of activities. Out of these changes are coming product managers, functional managers, and geographic managers, all of whom have important strategic responsibilities. When several variables such as product, customer, technology, geography, functional area, and line of bus II have roughly equal strategic priorities, a matrix organization can be an effective structural form.

The matrix structure was developed to combine the stability of the functional structure with the flexibility of the product form. The matrix structure is very useful when the external environment (especially its technological and market aspects) is very complex and changeable. It does, however, produce conflicts revolving around duties, authority, and resource allocation. To the extent that the goals to be achieved are vague and the technology used is poorly understood, a continuous battle for power between product and functional mangers is likely. The matrix structure is often found in an organization or within an SBU when the following three conditions exists: 1) Ideas need to be cross-fertilised across projects or products, 2) Resources are scarce and 3) Abilities to process information and to make decisions need to be improved.

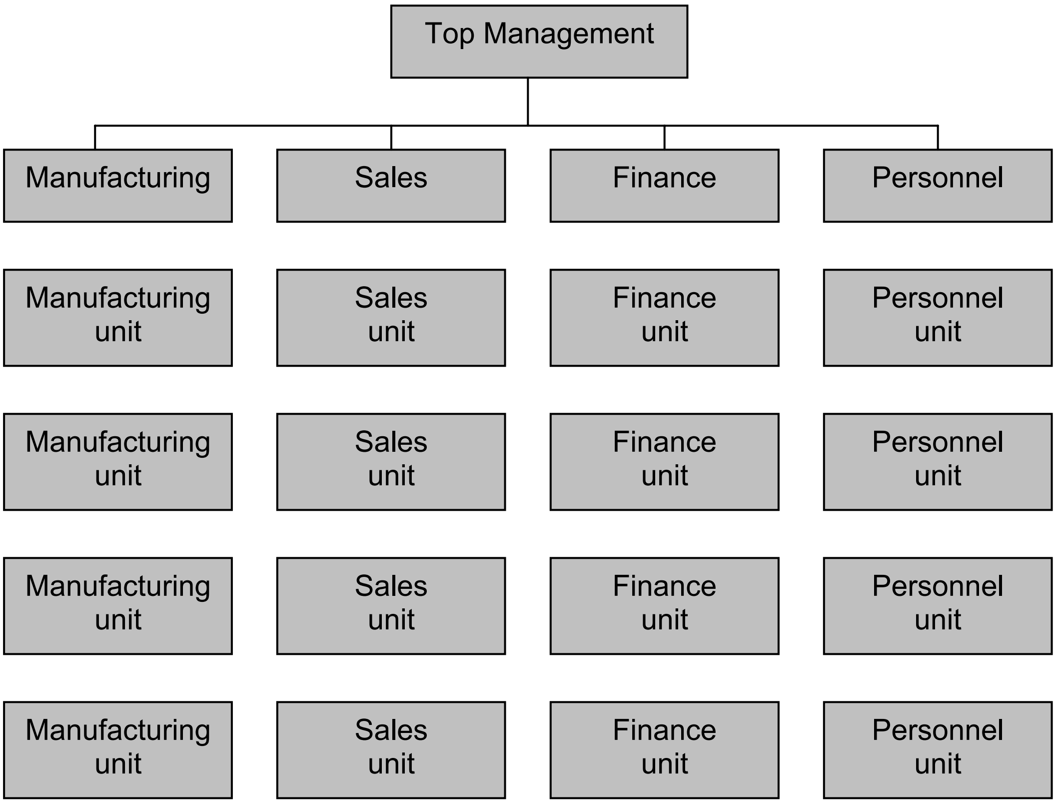

Figure: Matrix Organization Structure

Changing organizational design

Old Organizational Design	New Organizational Design
♦ One large corporation	♦ Mini-business units & cooperative relationships
♦ Vertical communication	♦ Horizontal communication
♦ Centralised top-down decision making	♦ Decentralised participative decision making

♦ Vertical integration	♦ Outsourcing & virtual organizations
♦ Work/quality teams	♦ Autonomous work teams
♦ Functional work teams	♦ Cross-functional work teams
♦ Minimal training	♦ Extensive training
♦ Specialised job design focused on individual	♦ Value-chain team-focused job design

For development of matrix structure Davis and Lawrence, have proposed three distinct phases:

1. *Cross-functional task forces*: Temporary cross-functional task forces are initially used when a new product line is being introduced. A project manager is in charge as the key horizontal link.
2. *Product/brand management*: If the cross-functional task forces become more permanent, the project manager becomes a product or brand manager and a second phase begins. In this arrangement, function is still the primary organizational structure, but product or brand managers act as the integrators of semi permanent products or brands.
3. *Mature matrix*: The third and final phase of matrix development involves a true dual-authority structure. Both the functional and product structures are permanent. All employees are connected to both a vertical functional superior and a horizontal product manager. Functional and product managers have equal authority and must work well together to resolve disagreements over resources and priorities.

However, the matrix structure is not very popular because of difficulties in implementation and trouble in managing.

4.5 Network Structure

A newer and somewhat more radical organizational design, the network structure is an example of what could be termed a "non-structure" by its virtual elimination of in house business functions. Many activities are outsourced. A corporation organized in this manner is often called a virtual organization because it is composed of a series of project groups or collaborations linked by constantly changing non-hierarchical, cobweb-like networks. The network structure becomes most useful when the environment of a firm is unstable and is expected to remain so. Under such conditions, there is usually a strong need for innovation and quick response. Instead of having salaried employees, it may contract with people for a specific project or length of time. Long-term contracts with suppliers and distributors replace services that the company could provide for itself through vertical integration. Electronic markets and sophisticated information systems reduce the transaction costs of the marketplace, thus justifying a "buy" over a "make" decision. Rather than being located in a single building or area, an organization's business functions are scattered worldwide. The organization is, in effect, only a shell, with a small headquarters acting as a "broker", electronically connected to some completely owned divisions, partially owned subsidiaries, and other independent companies. In its ultimate form, the network organization is a series of independent firms or business units linked together by computers in an information system that designs, produces, and markets a product or service.

Companies like Nike, Reebok and Benetton use the network structure in their operations function by subcontracting manufacturing to other companies in low-cost

The network organization structure provides an organization with increased flexibility and adaptability to cope with rapid technological change and shifting patterns of international trade and competition. It allows a company to concentrate on its distinctive competencies, while gathering efficiencies from other firms who are concentrating their efforts in their areas of expertise. The network does, however, have disadvantages. The availability of numerous potential partners can be a source of trouble. Contracting out functions to separate suppliers/distributors may keep the firm from discovering any synergies by combining activities. If a particular firm overspecialises on only a few functions, it runs the risk of choosing the wrong functions and thus becoming non-competitive.

The new structural arrangements that are evolving typically are in response to social and technological advances. While they may enable the effective management of dispersed organizations, there are some serious implications, such as those faced by DuPont, the world's largest chemical company. With new organizational forms, many workers become deskilled-that is, they cannot perform well in a new structure that often demands constant innovation and adaptation. The learning organization that is a part of new organizational forms requires that each worker become a self motivated, continuous learner. Employees may lack the level of confidence necessary to participate actively in organization-sponsored learning experiences. The flatter organizational structures that accompany contemporary structures can seem intrusive as a result of their demand for more intense and personal interactions with internal and external stakeholders. Combined, the conditions above may create stress for many employees.

5. STRATEGIC BUSINESS UNITS & CORE COMPETENCE

At this juncture, it is pertinent to introduce the concept of Strategic Business Unit (SBU). In modern times, most corporations organise their businesses into appropriate SBUs. And in their internal appraisal they carry out an assessment of their SBUs. The student must have a good grasp of this concept, since it is a vital idea in the strategic planning and strategic management endeavour. In fact, reference to this idea will keep recurring in our subsequent discussions in this text.

The concept is relevant to multi-product, multi-business enterprises. It is impractical for an enterprise with a multitude of businesses to provide separate strategic planning treatment to each one of its products/businesses; it has to necessarily group the products/businesses into a manageable number of strategically related business units and then take them up for strategic planning. The question is: what is the best way of grouping the products/businesses of such large enterprises?

An SBU is a grouping of related businesses, which is amenable to composite planning treatment. As per this concept, a multi-business enterprise groups its multitude of businesses into a few distinct business units in a scientific way. The purpose is to provide effective strategic planning treatment to each one of its products/businesses.

Historically, large, multi-business firms were handling business planning on a territorial basis since their structure was territorial. And in many cases, such a structure was the outcome of a manufacturing or distribution logistics. Often, the territorial structure did not suit the purpose of strategic planning.

When strategic planning was carried out treating territories as the units for planning, it gave rise to two kinds of difficulties: (i) since a number of territorial units handled the same product, the same product was getting varied strategic planning treatments; and (ii) since a given territorial planning unit carried different and unrelated products, products with dissimilar characteristics were getting identical strategic planning treatment.

The concept of strategic business units (SBU) breaks away from this practice. It recognises that just because a firm is structured into a number of territorial units, say six units, it is not necessarily in six different businesses. It may be engaged in only three distinct businesses. It is also possible that it is engaged in more than six businesses. The endeavour should be to group the businesses into an appropriate number of strategic business units before the firm takes up the strategy formulation task.

The principle underlying the grouping is that all related products-related from the standpoint of "function"-should fall under one SBU. In other words, the SBU concept helps a multi-business corporation in scientifically grouping its businesses into a few distinct business units. Such a grouping would in its turn, help the corporation carry out its strategic management endeavour better. The concept provides the right direction to strategic planning by removing the vagueness and confusion often experienced in such multi-business enterprises in the matter of grouping of the businesses.

The attributes of an SBU and the benefits a firm may derive by using the SBU idea.

- A scientific method of grouping the businesses of a multi-business corporation which helps the firm in strategic planning.
- An improvement over the territorial grouping of businesses and strategic planning based on territorial units.

- An SBU is a grouping of related businesses that can be taken up for strategic planning distinct from the rest of the businesses. Products/businesses within an SBU receive same strategic planning treatment and priorities.
- The task consists of analysing and segregating the assortment of businesses/portfolios and regrouping them into a few, well defined, distinct, scientifically demarcated business units. Products/businesses that are related from the standpoint of "function" are assembled together as a distinct SBU.
- Unrelated products/businesses in any group are separated. If they could be assigned to any other SBU applying the criterion of functional relation, they are assigned accordingly; otherwise they are made into separate SBUs.
- Grouping the businesses on SBU lines helps the firm in strategic planning by removing the vagueness and confusion generally seen in grouping businesses; it also facilitates the right setting for correct strategic planning and facilitates correct relative priorities and resources to the various businesses.
- Each SBU is a separate business from the strategic planning standpoint. In the basic factors, viz., mission, objectives, competition and strategy-one SBU will be distinct from another.
- Each SBU will have its own distinct set of competitors and its own distinct strategy.
- Each SBU will have a CEO. He will be responsible for strategic planning for the SBU and its profit performance; he will also have control over most of the factors affecting the profit of the SBU.

The questions posed at the corporate level are, first, whether the corporate body wishes to have a related set of SBUs or not; and if so, on what basis. This issue of relatedness in turn has direct implications on decisions about diversification relatedness might exist in different ways:

- SBUs might build on similar technologies or all provide similar sorts of products or services.
- SBUs might be serving similar or different markets. Even if technology or products differ, it may be that the customers are similar. For example, the technologies underpinning frozen food, washing powders and margarine production may be very different; but all are sold through retail operations, and U nil ever operates in all these product fields.
- Or it may be that other competences on which the competitive advantage of different SBUs are built have similarities. Unilever would argue that the marketing skills associated with the three product markets are similar, for example.

The three most important Characteristics of SBU are:

- It is a single business or a collection of related businesses which offer scope for independent planning and which might feasibly stand alone from the rest of the organization.
- Has its own set of competitors.

- Has a manager who has responsibility for strategic planning and profit performance, and who has control of profit-influencing factors.

The identification of SBUs is a convenient starting point for planning since once the company's strategic business units have been identified, the responsibilities for strategic planning can be more clearly assigned.

The Value Chain Analysis

Value chain analysis has been widely used as a means of describing the activities within and around an organization, and relating them to an assessment of the competitive strength of an organization (or its ability to provide value-for-money products or services). Value analysis was originally introduced as an accounting analysis to shed light on the 'value added' of separate steps in complex manufacturing processes, in order to determine where cost improvements could be made and/or value creation improved. These two basic steps of identifying separate activities and assessing the value added from each were linked to an analysis of an organization's competitive advantage by Michael Porter.

One of the key aspects of value chain analysis is the recognition that organizations are much more than a random collection of machines, money and people. These resources are of no value unless deployed into activities and organised into routines and systems which ensure that products or services are produced which are valued by the final consumer/user. In other words, it is these competences to perform particular activities and the ability to manage linkages between activities which are the source of competitive advantage for organizations. Porter argued that an understandIng of strategic capability must start with an identification of these separate value activities.

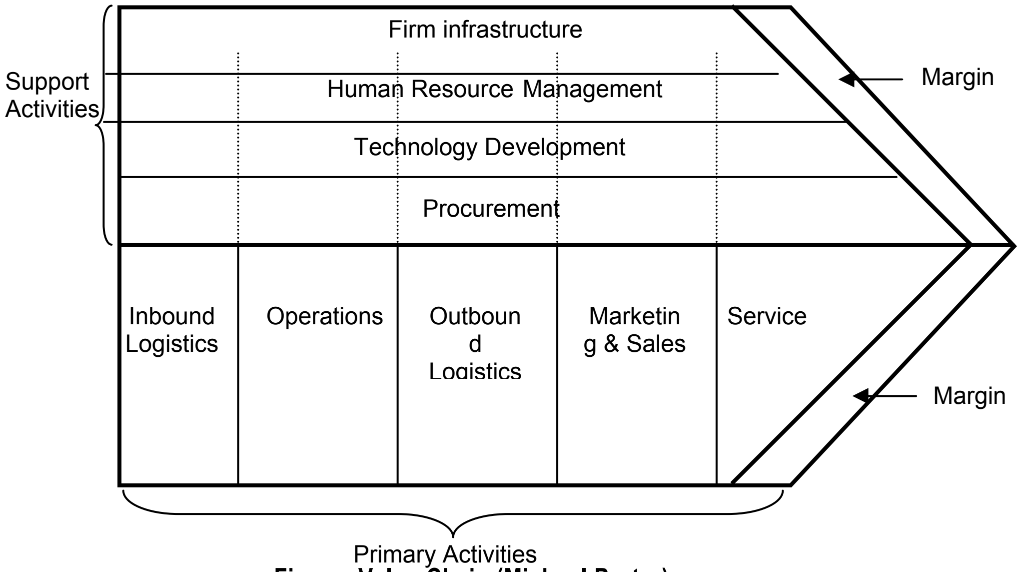

Figure: Value Chain (Michael Porter)

The primary activities of the organization are grouped into five main areas: inbound logistics, operations, outbound logistics, marketing and sales, and service.

- Inbound logistics are the activities concerned with receiving, storing and distributing the inputs to the product/service. This includes materials handling, stock control, transport etc.
- Operations transform these various inputs into the final product or service: machining, packaging, assembly, testing etc.
- Outbound logistics collect, store and distribute the product to customers. For tangible products this would be warehousing, materials handling, transport, etc. In the case of services, it may be more concerned with arrangements for bringing customers to the service if it is a fixed location (e.g. sports events).
- Marketing and sales provide the means whereby consumers/users are made aware of the product/service and are able to purchase it. This would include sales administration, advertising, selling and so on. In public services, communication networks which help users' access a particular service are often important.
- Service are all those activities, which enhance or maintain the value of a product/service, such as installation, repair, training and spares.

Each of these groups of primary activities are linked to support activities. These can be divided into four areas

- *Procurement*: This refers to the processes for acquiring the various resource inputs to the primary activities (not to the resources themselves). As such, it occurs in many parts of the organization.
- *Technology development*: All value activities have a 'technology', even if it is simply know-how. The key technologies may be concerned directly with the product (e.g. R&D product design) or with processes (e.g. process development) or with a particular resource (e.g. raw materials improvements).
- *Human resource management*: This is a particularly important area which transcends all primary activities. It is concerned with those activities involved in recruiting, managing, training, developing and rewarding people within the organization.
- *Infrastructure*: The systems of planning, finance, quality control, information management, etc. are crucially important to an organization's performance in its primary activities. Infrastructure also consists of the structures and routines of the organization which sustain its culture.

Identifying Core Competences

Value chain analysis is useful in describing the separate activities which are necessary to underpin an organization's strategies and how they link together both inside and outside the organization.

Although a threshold competence in all of these activities is necessary to the organization's successful operation, it is important to identify those competences which critically underpin the organization's competitive advantage. These are known as the core competences and will differ from one organization to another depending on bow the company is positioned and the strategies it is pursuing. For example, consider how small shops compete with supermarkets in grocery retailing. All shops need to have a threshold competence in the basic activities of purchasing, stocking, display, etc. However, the major supermarkets are pursuing strategies which provide lower prices to consumers through their core competences in merchandising, securing lower cost supplies and managing in-store activities more efficiently. This gives a supermarket competitive advantage over smaller shops: it is difficult for smaller shops to imitate these competences, since they are underpinned by key resources such as computerised stock/ordering systems and own brand labels. So the typical 'corner shop' grocery store gains competitive advantage over supermarkets by concentrating more on convenience and service through different core competences - the personal service to customers, extended opening hours, informal credit, home deliveries, etc. The key resources for the successful corner shop are the style of the owner and the choice of location. These aspects of service are valued by some consumers and are difficult for the supermarkets to imitate without substantially increasing their costs.

It is also important to understand that those unique resources and core competences which allow supermarkets to gain competitive advantage over corner shops are not unique resources or core competences in the competitive rivalry between supermarkets. They are necessary resources and threshold competences to survive as a supermarket. The competitive rivalry between supermarkets is therefore achieved through other unique resources (perhaps a key site) or core competences (perhaps in the management of 'own brand' supply). In this industry, experience shows that these tend to be easily imitated. So long-term competitive advantage needs to be secured by continually shifting the ground of competition.

The development of global competition in the automobile industry over recent decades also illustrates this issue well. During the 1950s and 1960s, the US giants such as Ford and GM dominated the global market through their market access core competences of establishing dealer networks and later overseas production plants. Meanwhile, Japanese manufacturers were developing competences in defect-free manufacture. By the mid-1970s they were significantly outperforming Ford on quality and reliability - which became critical success factors in allowing them to achieve global sales. By the mid-1980s, both Ford and the major Japanese companies had achieved similar competence in these two areas of global networks and quality. Although maintaining a global network was a critical success factor which continued to distinguish Ford and the Japanese from many European companies such as Peugeot, the production and supplier management activities underpinning quality (reliability) were becoming threshold competences. The competitive arena then switched to competences which would create some uniqueness of product in an increasingly 'commodity-like' industry. The new core competences became the ability to provide unique product designs/features at low volumes of manufacture - the so-called 'lifestyle niche' was produced by companies like Mazda. This agility in design and manufacturing techniques became a new and important core competence in the global competition.

It is important to identify an organization's core competences not only for reasons of ensuring or continuing good 'fit' between these core competences and the changing nature of the markets or environment, as illustrated in this example. Core competences may also be the basis on which the organization stretches into new opportunities. So, in deciding which competences are core, this is another criterion which should be used - the ability to exploit the competence in more than one market or arena. The development of 'added value' services and/or geographical spread of markets are two typical ways in which core competences can be exploited to maintain progress once traditional markets are mature or saturated.

Value chain analysis is a reminder that the long-term competitive position of an organization is concerned with its ability to sustain value for-money products or services, and it can be helpful in identifying those activities which the organization must undertake at a threshold level of competence and those which represent the core competences of the organization. However, in order to do this, it is necessary to identify the basis on which an organization has gained competitive advantage and hence which are the core competences in sustaining this advantage. The subsections which follow look at how different bases of organizational competences can be analysed and understood.

Managing linkages

Core competences in separate activities may provide competitive advantage for an organization, but nevertheless over time may be imitated by competitors. Core competences are likely to be more robust and difficult to imitate if they relate to the management of linkages within the organization's value chain and linkages into the supply and distribution chains. It is the management of these linkages which provides 'leverage' and levels of performance which are difficult to match.

The ability to co-ordinate the activities of specialist teams or departments may create competitive advantage through improving value for money in the product or service. Specialization of roles and responsibilities is common in most organizations and is one way in which high levels of competence in separate activities is achieved. However, it often results in a set of activities which are incompatible – different departments pulling in different directions - adding overall cost and/or diminishing value in the product or service.

This management of internal linkages in the value chain could create competitive advantage in a number of ways:

- There may be important linkages between the primary activities. For example, a decision to hold high levels of finished stock might ease production scheduling problems and provide for a faster response time to the customer. However, it will probably add to the overall cost of operations. An assessment needs to be made of whether the value added to the customer by this faster response through holding stocks is greater than the added cost.
- It is easy to miss this issue of managing linkages between primary activities in an analysis if, for example, the organization's competences in marketing activities and operations are assessed separately. The operations may look good because they are geared to high-volume, low-variety, low-unit-cost production. However, at the same time, the marketing team may be selling speed, flexibility and variety to the customers. So high levels of competence in separate activities are not enough if, as here, the competences are incompatible: that is, they are not related to the same view of what value for money means to the customer.
- The management of the linkages between a primary activity and a support activity may be the basis of a core competence. It may be key investments in systems or infrastructure which provide the basis on which the company outperforms competition. Computer-based systems have been exploited in many different types of service organization and have fundamentally transformed the customer experience. Travel bookings and hotel reservation systems are examples which other services would do well to emulate. They have created within these organizations the competence to provide both a better service and a service at reduced cost. They have allowed the organizations to create genuinely new services from these core competences or to expand rapidly into new markets.
- Linkages between different support activities may also be the basis of core competences. For example, the extent to which human resource development is in tune with new technologies has been a key feature in the implementation of new production and office

technologies. Many companies have failed to become competent in managing this linkage properly and have lost out competitively.

In addition to the management of internal linkage, competitive advantage may also be gained by the ability to complement/co-ordinate the organization's own activities with those of suppliers, channels or customers. Again, this could occur in a number of different ways:

- Vertical integration attempts to improve performance through ownership of more parts of the value system, making more linkages internal to the organization. However, the practical difficulties and costs of co-ordinating a wider range of internal activities can outweigh the theoretical benefits.
- Within manufacturing industry the competence in closely specifying requirements and controlling the performance of suppliers (sometimes linked to quality checking and/or penalties for poor performance) can be critical to both quality enhancement and cost reduction.
- A more recent philosophy has been total quality management, which seeks to improve performance through closer working relationships between the specialists within the value system. For example, many manufacturers will now involve their suppliers and distributors at the design stage of a product or project.
- The merchandising activities which manufacturers undertake with their distributors are now much improved and are an important

6. LEADERSHIP AND STRATEGIC IMPLEMENTATION

Weak leadership can wreck the soundest strategy; forceful execution of even a poor plan can often bring victory.

– Sun Zi

A leader lives in the field with his troops.

– H. Ross Perot

The litany of good strategic management is simple enough: craft a sound strategic plan, implement it, execute it to the fullest, adjust as needed, win! But it's easier said than done. A strategy manager has many different leadership roles to play: visionary, chief entrepreneur and strategist, chief administrator, culture builder, resource acquirer and allocator, capabilities builder, process integrator, crisis solver, spokesperson, negotiator, motivator, arbitrator, policy maker, policy enforcer, and head cheerleader. Sometimes it is useful to be authoritarian and hardnosed; sometimes it is best to be a perceptive listener and a compromising decision maker; sometimes a strongly participative, collegial approach works best; and sometimes being a coach and adviser is the proper role. Many occasions call for a highly visible role and extensive time commitments, while others entail a brief ceremonial performance with the details delegated to subordinates.

For the most part, major change efforts have to be top-down and vision-driven. Leading change has to start with diagnosing the situation and then deciding which of several ways to handle it. Managers have five leadership roles to play in pushing for good strategy execution:

1. Staying on top of what is happening, closely monitoring progress, ferreting out issues, and learning what obstacles lie in the path of good execution.
2. Promoting a culture and esprit de corps that mobilizes and energizes organizational members to execute strategy in a competent fashion and perform at a high level.
3. Keeping the organization responsive to changing conditions, alert for new opportunities, bubbling with innovative ideas, and ahead of rivals in developing competitively valuable competencies and capabilities.
4. Exercising ethics leadership and insisting that the company conduct its affairs like a model corporate citizen.
5. Pushing corrective actions to improve strategy execution and overall strategic performance.

For example:

N. R. Narayan Murthy, Infosys, is a celebrated leader because of the value he has added over his tenure at the company. One of the great legacies he will leave with Infosys is a strong management development program that builds management talent that other companies want and that will fill in managerial gaps after his retirement. Mr. Murthy whom some consider the master strategic leader, truly focuses on developing human capital.

Mr. Dhirubhai Ambani, Reliance Group, was an icon in himself because of his ability to conceptualise and communicate sweeping strategies, knowledge of operations to reach financial goals, and proficiency in implementing a new vision for the company. Mr. Ambani was an excellent strategic leader because he was able to provide clear direction for the company and his strong interpersonal skills that inspire loyalty among employees.

Leadership role in implementation

The changes confronting strategic leaders above provide obvious examples of the importance of strategic leadership, their effects on organizational outcomes, and the great challenges faced by strategic leaders. This indicates that effective strategic leaders must be able to use the strategic management process effectively by guiding the company in ways that result in the formation of strategic intent and strategic mission, facilitating the development of appropriate strategic actions and providing guidance that results in strategic competitiveness and earning above-average returns.

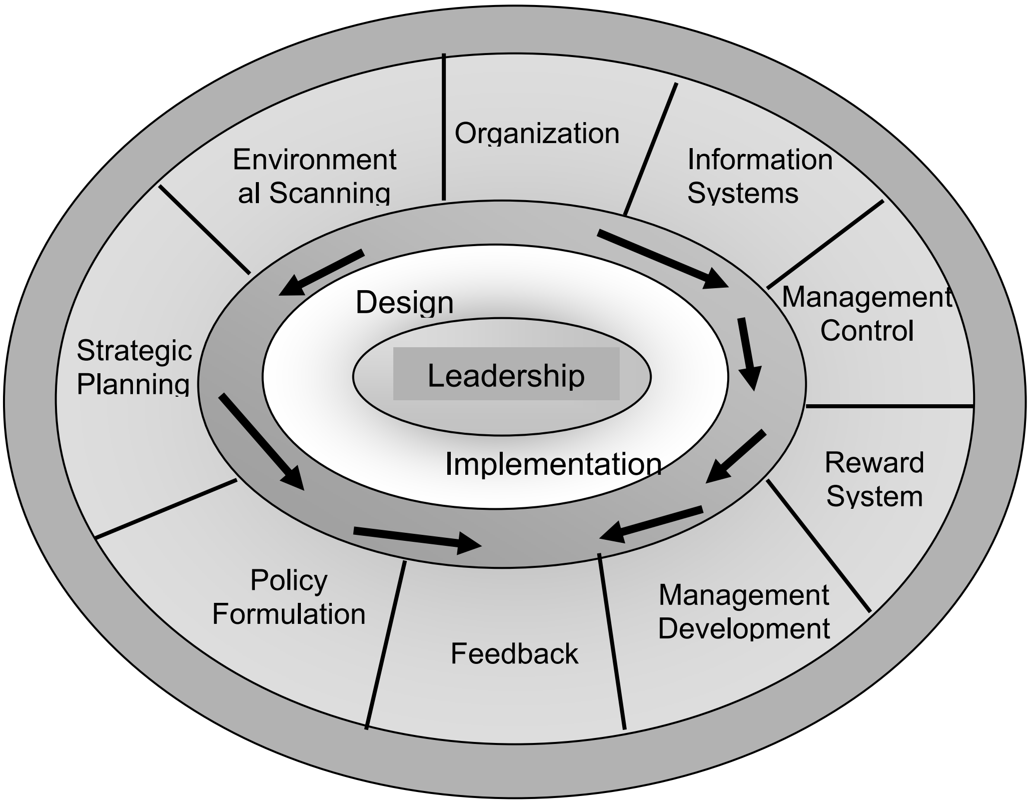

Figure : Strategy Design and Implementation: Interrelationship of Elements

Strategic leadership entails the ability to anticipate, envision, maintain flexibility, and empower others to create strategic change as necessary. In other words, strategic leadership represents a complex form of leadership in companies. A manager with strategic leadership skills exhibits the ability to guide the company through the new competitive landscape by influencing the behaviour, thoughts, and feelings of co-workers, managing through others and successfully processing or making sense of complex, ambiguous information by successfully dealing with change and uncertainty.

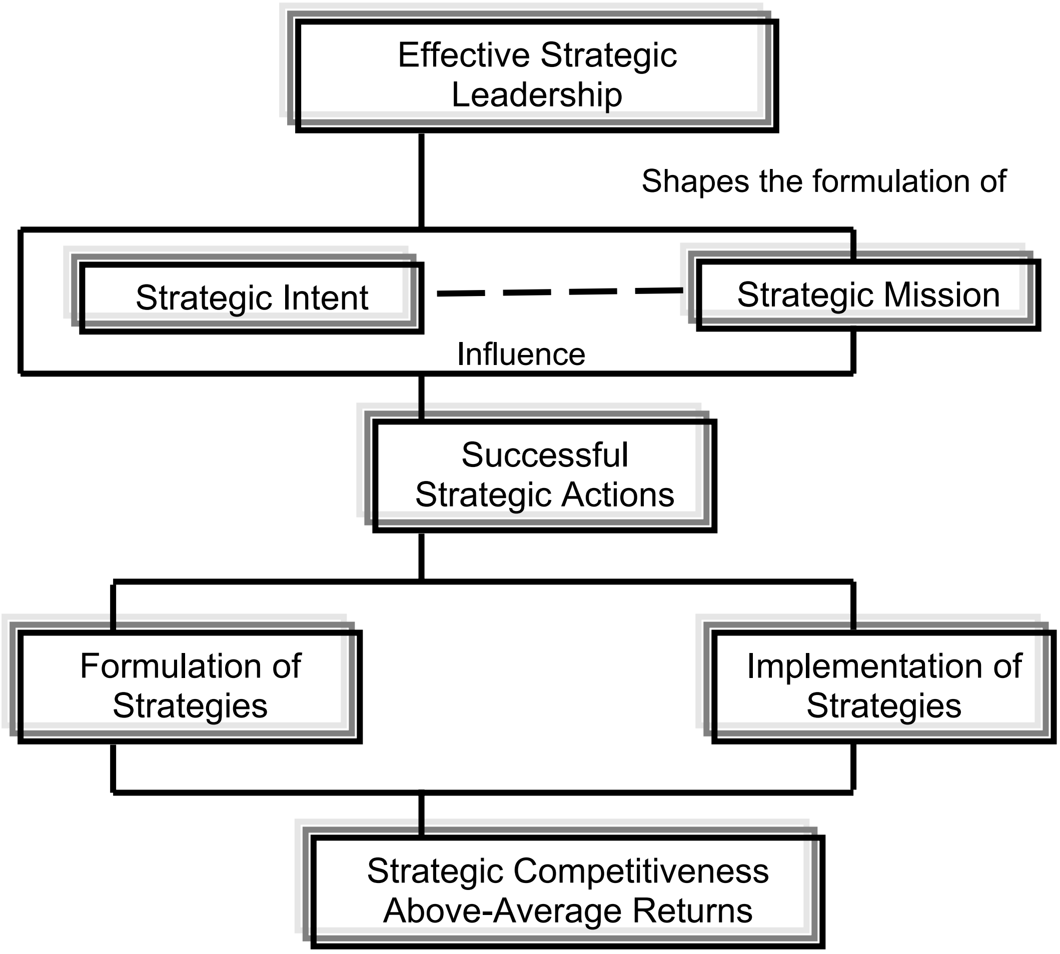

Figure: Effective Strategic Leadership

Strategic leaders are those at the top of the company (in particular, the CEO), but other commonly recognised strategic leaders include members of the board of directors, the top management team, and division general managers. The ability to manage human capital may be the most critical skill that a strategic leader possesses.

In the today's competitive landscape, strategic leaders are challenged to adapt their frames of reference so that they can deal with rapid, complex changes. A managerial frame of reference is the set of assumptions, premises, and accepted wisdom that bounds a manager's understanding of the company, the industry in which it competes, and the core competencies that it exploits in the pursuit of strategic competitiveness (and above-average returns). In other words, a manager's frame of reference is the foundation on which a manager's mindset is built.

The importance of a manager's frame of reference can be seen if we perceive that competitive battles are not between companies or products but between mindsets or managerial frames. This implies that effective strategic leaders must be able to deal with the diverse and cognitively complex competitive situations that are characteristic of today's competitive landscape.

The strategic leader has several responsibilities, including the following:

- Managing human capital (perhaps the most critical of the strategic leader's skills). Effectively managing the company's operations.
- Sustaining high performance over time.
- Being willing to make candid, courageous, yet pragmatic, decisions.
- Seeking feedback through face-to-face communications.
- Having decision-making responsibilities that cannot be delegated.

Thus, the strategic leadership skills of a company's managers represent resources that affect company performance. And these resources must be developed for the company's future benefit.

7. BUILDING A STRATEGY-SUPPORTIVE CORPORATE CULTURE

Every business organisation has a unique organizational culture. Each business has its own philosophy and principles, its own ways of approaching problems and making decisions, its own work climate. A organisation has its own embedded patterns of how to do things. its own ingrained beliefs, behaviour and thought patterns, and practices that define its **corporate culture.**

Corporate culture refers to a company's values, beliefs, business principles, traditions, ways of operating, and internal work environment.

Where Does Corporate Culture Come From?

An organization's culture is bred from a complex combination of socio-logical forces operating within its boundaries. A company's culture is manifested in the values and business principles that management preaches and practices, in its ethical standards and official policies, in its stakeholder relationships (especially its dealings with employees, unions, stockholders, vendors, and the communities in which it operates), in the traditions the organization maintains, in its supervisory practices, in employees' attitudes and behaviour, in the legends people repeat about happenings in the organization, in the peer pressures that exist, in the organization's politics, and in the "chemistry" and the "vibrations" that permeate the work environment. All these sociological forces, some of which operate quite subtly, combine to define an organization's culture, beliefs and practices that become embedded in a company's culture can originate anywhere: from one influential individual, work group, department, or division, from the bottom of the organizational hierarchy or the top

The role of stories: Frequently, a significant part of a company's culture emerges from the stories that get told over and over again to illustrate to newcomers the importance of certain values and beliefs and ways of operating.

Culture: ally or obstacle to strategy execution?

An organization's culture is either an important contributor or an obstacle to successful strategy execution. The beliefs, vision, objectives, and business approaches and practices underpinning a company's strategy may be compatible with its culture or they may not. When they are, the culture becomes a valuable ally in strategy implementation and execution. When the culture is in conflict with some aspect of the company's direction, performance targets or strategy, the culture becomes a stumbling block that impedes successful strategy implementation and execution.

How culture can promote better strategy execution?

Strong cultures promote good strategy execution when there's fit and hurt execution when there's negligible fit. A culture grounded in values, practices, and behavioural norms that match what is needed for good strategy execution helps energize people throughout the company to do their jobs in a strategy-supportive manner, adding significantly to the power and effectiveness of strategy execution. For example, a culture where frugality and thrift are values strongly shared by organizational members is very conducive to successful execution of a low cost leadership strategy. A culture where creativity, embracing change, and challenging the status quo are pervasive themes is very conducive to successful execution of a product innovation and technological leadership strategy. A culture built around such business principles as listening to customers, encouraging employees to take pride in their work, and giving employees a high degree of decision-making responsibility is very conducive to successful execution of a strategy of delivering superior customer service.

A tight culture-strategy alignment acts in two ways to channel behaviour and influence employees to do their jobs in a strategy-supportive fashion.

A work environment where the culture matches the conditions for good strategy execution provides a system of informal rules and peer pressure regarding how to conduct business internally and how to go about doing one's job. Strategy-supportive cultures shape the mood, temperament, and motivation the workforce, positively affecting organizational energy, work habits and operating practices, the degree to which organizational units cooperate, and how customers are treated.

A strong strategy-supportive culture nurtures and motivates people to do their jobs in ways conducive to effective strategy execution; it provides structure, standards, and a value system in which to operate; and it promotes strong employee identification with the company's vision, performance targets, and strategy. All this makes employees feel genuinely better about their jobs and work environment and the merits of what the company is trying to accomplish. Employees are stimulated to take on the challenge of realizing the company's vision, do their jobs competently and with enthusiasm, and collaborate with others as needed to bring the strategy to fruition.

The Perils of Strategy-Culture Conflict

When a company's culture is out of sync with what is needed for strategic success, the culture has to be changed as rapidly as can be managed – this, of course, presumes that it is one or more aspects of the culture that are out of whack rather than the strategy. While correcting a strategy-culture conflict can occasionally mean revamping strategy to produce cultural fit, more usually it means revamping the mismatched cultural features to produce strategy fit. The more entrenched the mismatched aspects of the culture, the greater the difficulty of implementing new or different strategies until better strategy-culture alignment emerges. A sizable and prolonged strategy-culture conflict weakens and may even defeat managerial efforts to make the strategy work.

Creating a strong fit between strategy and culture

It is the strategy maker's responsibility to select a strategy compatible with the "sacred" or unchangeable parts of prevailing corporate culture. It is the strategy implementer's task, once strategy is chosen, to change whatever facets of the corporate culture hinder effective execution. Once a culture is executed, it is difficult to change.

Changing a problem culture

Changing a company's culture to align it with strategy is among the toughest management tasks--easier to talk about than do. Changing problem cultures is very difficult because of the heavy anchor of deeply held values and habits-people cling emotionally to the old and familiar. It takes concerted management action over a period of time to replace an unhealthy culture with a healthy culture or to root out certain unwanted cultural obstacles and instil ones that are more strategy-supportive.

The first step is to diagnose which facets of the present culture are strategy supportive and which are not. Then, managers have to talk openly and forthrightly to all concerned about those aspects of the culture that have to be changed. The talk has to be followed swiftly by visible, aggressive actions to modify the culture-actions that everyone will understand are intended to establish a new culture more in tune with the strategy. The menu of culture-changing actions includes revising policies and procedures in ways that will help drive cultural change, altering incentive compensation (to reward the desired cultural behaviour), visibly praising and recognizing people who display the new cultural traits, recruiting and hiring new managers and employees who have the desired cultural values and can serve as role models for the desired cultural behaviour, replacing key executives who are strongly associated with the old culture, and taking every opportunity to communicate to employees the basis for cultural change and its benefits to all concerned.

Culture-changing actions

While being out front personally and symbolically leading the push for new behaviours and communicating the reasons for new approaches is crucial, strategy implementers have to convince all those concerned that the culture-changing effort is more than cosmetic. Talk and symbolism have to be complemented by substantive actions and real movement. The actions taken have to be credible, highly visible, and unmistakably indicative of the seriousness of management's commitment to new strategic initiatives and the associated cultural changes. There are several ways to accomplish this. One is to engineer some quick successes that highlight the benefits of strategy-culture changes, thus making enthusiasm for the changes contagious. However, instant results are usually not as important as having the will and patience to create a solid, competent team psychologically committed to pursuing the strategy in a superior fashion. The strongest signs that management is truly committed to creating a new culture include replacing old-culture traditionalist managers with "new-breed" managers, changing long-standing policies and operating practices that are dysfunctional or that impede new initiatives, undertaking major reorganization moves that bring structure into better alignment with strategy, tying compensation incentives directly to the new measures of strategic predominance, and making major budgetary reallocations that shift substantial resources from old-strategy projects and programs to new-strategy projects and programs.

Implanting the needed culture-building values and behaviour depends on a sincere, sustained commitment by the chief executive coupled with extraordinary persistence in reinforcing the culture at every opportunity through both word and deed. Neither charisma nor personal magnetism is essential. However, personally talking to many departmental groups about the reasons for change *is* essential; organizational changes are seldom accomplished successfully from an office. Moreover, creating and sustaining a strategy-supportive culture is a job for the whole management team. Major cultural change requires many initiatives from many people. Senior officers, department heads, and middle managers have to reiterate values, "walk the talk," and translate the organization's philosophy into everyday practice. In addition, for the culture-building effort to be successful, strategy implementers must enlist the support of first line supervisors and employee opinion leaders, convincing them of the merits of practicing and enforcing cultural norms at the lowest levels in the organization. Until a big majority of employees join the new culture and share an emotional commitment to its basic values and behavioural norms, there's considerably more work to be done in both instilling the culture and tightening the culture strategy fit.

The task of making culture supportive of strategy is not a short-term exercise. It takes time for a new culture to emerge and prevail; it's unrealistic to expect an overnight transformation. The bigger the organization and the greater the cultural shift needed to produce a culture-strategy fit, the longer it takes. In large companies, changing the corporate culture in significant ways can take two to five years. In fact, it is usually tougher to reshape a deeply ingrained culture that is not strategy-supportive than it is to instill a strategy-supportive culture from scratch in a brand-new organization.

SELF-EXAMINATION QUESTIONS

Multiple Choice Questions

1. Select a distinguishing feature between divisional and functional structure?

   (a) Both functional departments and divisional process departments are accountable for profits or revenues.

   (b) Functional departments are not accountable for profits or revenues, whereas divisional process departments are evaluated on these criteria.

   (c) None of functional departments and divisional process departments are accountable for profits or revenues.

   (d) Both the structures are same.

2. Strategy formulation is primarily an _______________ process and strategy implementation is primarily an _____________ process.

   (a) intellectual, operational

   (b) operational, intellectual

   (c) intelligent; interim

   (d) intellectual; intellectual

3. When strategic management is ineffective and operational management is efficient, organization will:

   (a) Thrive.

   (b) Survive.

   (c) Die Slowly.

   (d) Die Quickly.

4. When a set of product groups are superimposed across functional departments, this creates a ________ type of organization design.

   (a) Matrix

   (b) M-form

(c) U-form

(d) Virtual

5. Strategic implementation activities include:

(a) Accomplishing annual objectives

(b) Measuring performance

(c) Preparing a TOWS matrix

(d) Conducting research

6. For a new product, an organization may chose:

(a) Skimming pricing strategy

(b) Penetration pricing strategy

(c) Both (a) and (b)

(d) None of these

7. An strategic business units is a grouping of ________ businesses.

(a) unrelated

(b) differentiated

(c) related

(d) None of these.

Objective type question

State with reasons which of the following statements are correct/incorrect:

(a) Core competences in separate activities may provide competitive advantage for an organization.

(b) Strong cultures promote good strategy execution.

(c) Modern Marketing is highly promotional oriented.

Short answer questions

1. What is corporate culture?

2. Compare newer form of organisational structure with the traditional structure.

3. Explain the concept of backward linkages in strategy formulation and implementation.

Essay type questions

1. What is strategic implementation? How far is it different from strategy formulation?
2. What is a Strategic Business Unit?
3. Explain the concept of Value Chain Analysis.

Case Study

Speed Technologies is an Indian company with three major divisions: (1) notebooks, (2) desktops and (3) accessories. Its total revenue for the last year approximated Rs. 1130 crores, and its net operating income was Rs. 53 crores.

The organizational structure of the company is considered to be quite formal. Each division operates as an independent unit and is responsible for its own activities, with only modest direction from the corporate office. It also has offices located in Nepal and Sri Lanka. These offices function as liaising office for local importers. The monthly requisitions from the importers are directly despatched by the corporate office. The sales of the company from these two countries is marginal and their market share in markets is also low. However, there is huge potential. Considering this, the company intends to expand its network in both the countries with little control from the head office. It intends to increase the workforce and setup local assembling units.

(a) Is the present structure of Speed Technologies functional or divisional? Discuss.

(b) What kind of structure will you suggest in two countries?

Answers – Multiple Choice Questions

1. (b), **2.** (a), **3.** (c), **4.** (a), **5.** (a), **6.** (c), **7.** (c)

CHAPTER 7

REACHING STRATEGIC EDGE

LEARNING OBJECTIVES

- Learn how Business Process Reengineering can be used as a strategic tool.
- Learn basic of TQM and how it leads to organizational success.
- Learn the concept of six sigma quality standards
- Have an overview of some of contemporary issues in strategic management.

Even if you're on the right track, you'll get run over if you just sit there.

– Will Rogers, Humorist

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1. INTRODUCTION

Business organizations evolve different kind of strategies in response to the environmental forces. There was a time when diversification was strategic buzzword and different organizations believed in entering into newer business irrespective of any relationship with their existing business. Then the basic ideology of businesses shifted from diversification to core-competencies. There are several such changes in strategic ideology. With the changes in the environment of the business, strategic management is also evolving. In this chapter we will discuss some of the recent and evolving issues in the subject.

2. BUSINESS PROCESS REENGINEERING

Waiting in a queue in a post office or bank, a person may feel need for improvement in processes. In case of queue the process begins with your stepping into the queue, and ends with receiving the desired items or service and leaving the place. The steps of the process are the activities that you and the personnel providing services perform to complete the transaction.

Buying a ticket is a simple business process. There are other business processes such as purchasing raw material, logistic movements of finished products, developing new products, etc. that are much more tricky to deal with. Business processes are simply a set of activities that transform a set of inputs into a set of outputs for another person or process.

In order to have a better appreciation of what Business Process Reengineering (BPR) really means it would be pertinent to have preliminary knowledge of business processes. What is a business process and how it differs from other processes is question that may come to mind. Business process or business activities are not discrete or unrelated pieces of work. They are parts of recurrent work processes within which they are located, sequenced and organized.

What is a Business Process? A process is a set of logically related tasks or activities oriented towards achieving a specified outcome. "A process is a collection of activities which creates an output of value to the customer and often transcends departmental or functional boundaries. For example, one common process found almost in every organization is the order fulfilment. Order fulfilment begins with procuring an order and ends with delivery of goods to the customer. It also includes all other related activities in between. Likewise other basic processes may include developing a new product or service, launching a new product in the market, procuring goods from suppliers, preparing the organization's budget, processing and paying insurance claims, and so on.

A business process comprises a combination of number of such independent or interdependent processes as:

- Developing new product
- Customer order processing
- Bill payment system

Typically a business process involves a number of steps performed by different people in different departments. The structural elements that constitute a process provide the basis for its analysis, appraisal, and redesign for achieving higher levels of efficiency and effectiveness, economy and speed, and quality and output.

A set of interconnected processes comprise a business system. The performance of business firm is, thus, the outcome of the interrelated operation of its constituent work processes. The redesign of processes, therefore, provides a powerful basis for improving the performance of a business enterprise.

Some processes turn out to be extremely critical for the success and survival of the enterprise. BPR focuses on such critical business processes out of the many processes that go on in any company. These are the core business processes of the company. A core business process creates value by the capabilities it provides to the competitiveness. Core business processes are critical in a company's evaluation by its customers. They are vital for success in the industry sector within which the company is positioned. They are crucial for generating competitive advantages for a firm in the marketplace.

While some core business processes are easily identifiable, some core Business processes may not always be immediately apparent. The following instances serve to show that core processes need to be identified carefully in terms of their bearing on a firms competitiveness:

- In the insurance industry, the actual work that leads to a balance of competitive premium for customers, and profit after claims for the company, is a core business process.
- In the banking industry, the activities that help mobilise deposits and generate funds for advances to customers, is a core business process.
- In a fast moving consumer goods industry marketing and brand management is a core process.
- In the electronics and semi-conductor industries, new product development is a core process.

The core processes of a company may change over a period of time according to the shifting requirements of its competitiveness. Since the objective of reengineering is to provide competitive advantage to the enterprise, it is extremely important to identify those core processes which need to be focussed for achieving excellence. In order to do this we have to necessarily start from the organization's business vision, and drive from there the processes that have to be best in the world in order to realize that vision.

One of the reason for which an imperative need is felt for process change is that most of the processes that the organizations are engaged in might have been developed by their functional units over a period of time and might have been evolved based on a series of unplanned decisions. Seldom there has been any serious effort to systematically analyse the processes and measure their effectiveness towards the organizational efficiency. Quite often the individual departments or units of a company aim at optimising their own performance disregarding the resultant effect on other areas of operation. This may result in a sub-optimal performance for the organization as a whole. The overall business processes in an organization extending over several departments may be quite lengthy, time consuming, costly and inefficient. Also "the existing business processes and work patterns are largely obsolete and irrational.

Fragmentation of work processes makes it difficult to improve the quality of work performance and also develops a narrow vision among the employees. As a result the employees tend to focus more on the narrow goals of their own department at the cost of larger goals of the organization as a whole. This results in piecemeal accomplishment of tasks without looking at the overall goal. As the small fragments of work move from person to person and from unit to unit, delays keep on mounting and it enhances the chances of errors. In such a situation, the emerging critical issues often remain unattended as they do not fit into the narrow definitions of tasks or roles of an individual department.

We must remember that, most of the existing work processes were developed before the advent of computers and IT revolution. Even after the massive penetration of information technology, most organizations have usually applied the technology only in a limited way to automate their existing work methods or to speed up the isolated or narrow components of a larger existing work process. This has resulted only in some sort of mechanization of the existing work methods without bringing in any appreciable change in the process and output. Examples from established Japanese industries as well as new entrepreneurial ventures in Japan proves that it is possible to achieve a much higher level of process performance by redesigning the process. It has been possible to double the speed of normal production, utilize assets several times more productively and respond to customers' needs and expectations much more rapidly. This could be achieved by effecting a total change in the process instead of a piecemeal change. It is, therefore, imperative that for many organizations on the decline, changing the process or redesigning the process may be the only viable alternative for turnaround. They must break themselves free from their primitive and archaic work processes that drag them down. Issues that emerge from the foregoing discussions on the need for change form the underlying premises of Business Process Reengineering (BPR). They may be briefly outlined as follows:

- The operational excellence of a company is a major basis for its competitiveness.
- The business strategy of a company should be oriented towards leveraging its operational excellence into the marketplace.
- A customer-focussed organization needs to be realigned in terms of a process orientation.
- Process need to managed, not functions.
- For considering totally new ways of redesigning processes, each and every concept, assumption, purpose, and principle, needs to abandoned temporarily.
- Continuous improvement is a deficient approach when a company is far behind the industry standards, and needs rapid quantum leaps in performance.
- Dramatic improvement in performance is the prerequisite for overcoming competition.
- How to compete is more important than deciding about where to compete.

Definition of BPR

Business Process Reengineering (BPR) refers to the analysis and redesign of workflows and processes both within and between the organizations. The orientation of the redesign effort is radical, i.e., it is a total deconstruction and rethinking of a business process in its entirety, unconstrained by its existing structure and pattern. Its objective is to obtain quantum gains in the performance of the process in terms of time, cost, output, quality, and responsiveness to customers. The redesign effort aims at simplifying and streamlining a process by eliminating all redundant and non-value adding steps, activities and transactions, reducing drastically the number of stages or transfer points of work, and speeding up the work-flow through the use of IT systems.

BPR is an approach to unusual improvement in operating effectiveness through the redesigning of critical business processes and supporting business systems. It is revolutionary redesign of key business processes that involves examination of the basic process itself. It looks at the minute details of the process, such as why the work is done, who does it, where is it done and when it is done. BPR focuses on the process of producing the output and output of an organization is the result of its process.

"Business process reengineering means starting all over, starting from scratch." Reengineering, in other words, means pulling aside much of the age-old practices and procedures of doing a thing developed over hundred years of management experience. It implies forgetting how work has been done so far, and deciding how it can best be done now.

Reengineering begins with a fundamental rethinking. In doing reengineering people must ask some most basic questions about their organizations and about their operations. They try to find out answers to such questions like "Why do we do what we do? And why do we do it the way we do?" An attempt to find out answers to such questions may startlingly reveal certain rules, assumptions and operational processes as obsolete and redundant. Reengineering does not begin with anything given or with any assumptions. The thinking process in reengineering begins with a totally free state of mind without having any preconceived notion. Reengineering first determines what a company must do. And then it decides on how to do it. Reengineering ignores what the existing process is and concentrates on what it should be. If something is not required to be done it is outright discarded.

Another key element in the reengineering involves radical redesigning of process. Radical redesigning means going to the root of the problem areas and not attempting to make any superficial changes. Radical redesign involves completely discarding all existing structures and procedures and evolving completely new ways of doing the work. "Reengineering is about business reinvention – not business improvement, business enhancement, or business modification."

The next key concept that lies behind reengineering is that it aims at achieving dramatic improvement in performance. If an organization feels the need for marginal improvement in any area of operation at any point of time, the same can be achieved by conventional methods of adjustments in operating processes and reengineering is not the answer. Reengineering is meant for replacement of the old process by altogether new one to achieve dramatic improvement in the performance.

It follows from the above and also from the characteristics of the definition of reengineering that its main focus is on the process. In an attempt to improve performance. Most people in business focus their attention on tasks, jobs, people, structure, but fail to pay adequate attention on the process. Business process, as already mentioned earlier, has been defined as the series of activities that utilizes various inputs to create output that are valued by customers. Not all the processes in an enterprise enjoy equal importance in creating customers value. In order to improve its competitive position a firm must try to identify the generic business processes which significantly add to the value for its output to the customer and should try to focus on reengineering these processes first. “The generic business processes of a firm needing redesign may be classified into three broad categories as follows:

- Processes pertaining to development and delivery of product(s) and/or services. These may include research, design, engineering, manufacturing, and logistics, besides purchasing / procurement and materials management.
- Process involving interface(s) with customers. These usually include marketing, advertising, order fulfilment, and service.
- Process comprising management activities: These include strategy formulation, planning and budgeting, performance measurement and reporting, human resource management, and building infrastructure.

In the context of these generic business processes, BPR may be viewed as a means of solving business problem through an imaginative leveraging of IT capabilities.

Rationale of BPR

Improving business processes is paramount for businesses to stay competitive in today’s marketplace.

Over the last decade several factors have accelerated the need to improve business processes. The most obvious is technology. New technologies (like Information Technology) are rapidly bringing new capabilities to businesses, thereby raising the strategical options and the need to improve business processes dramatically.

After opening up of Indian economy companies have been forced to improve their business processes because of increased competition. More companies have entered the market place, and competition has become harder and harder. In today’s market place, major changes are required to just stay even. It has become a matter of survival for most companies.

Customers are also demanding better products and services. If they do not receive what they want from one supplier, they have many others to choose from. They are ready to try new brands.

Implementing BPR in organizations

In a crude sense, companies began business process improvement with a continuous improvement model. This model attempts to understand and measure the current processes, and make performance improvements. However, some companies make reengineering efforts under the assumption that the current processes are wrong and irrelevant. Under such perspectives designers of business process disassociate themselves from existing processes. This helps in looking at the problem with a clean mind, free of any biases.

The approach to BPR begins with defining the scope and objectives of the reengineering project. Persons entrusted with the tasks of BPR have to undertake research in the light of scope and objectives. They have to go through a learning process. They have to research customers, employees, competitors, new technology, etc. With the help of this research base BPR designers are in a position to create a vision for the future and design new business processes. They also create a plan of action based on the gap between the current and proposed processes, technologies and structures. Steps in BPR are as follows:

Determining objectives and Framework: Objectives are the desired end results of the redesign process which the management and organization attempts to realise. This will provide the required focus, direction, and motivation for the redesign process. It helps in building a comprehensive foundation for the reengineering process.

Identify Customers and Determine their Needs: The designers have to understand customers - their profile, their steps in acquiring, using and disposing a product. The purpose is to redesign business process that clearly provides added value to the customer.

Study the Existing Process: The existing processes will provide an important base for the redesigners. The purpose is to gain an understanding of the 'what', and 'why' of the targeted process. However, as discussed earlier, some companies go through the reengineering process with clean perspective without laying emphasis on the past processes.

Formulate a redesign process plan: The information gained through the earlier steps is translated into an ideal redesign process. Formulation of redesign plan is the real crux of the reengineering efforts. Customer focussed redesign concepts are identified and formulated. In this step alternative processes are considered and the best is selected.

Implement the redesign: It is easier to formulate new process than to implement them. Implementation of the redesigned process and application of other knowledge gained from the previous steps is key to achieve dramatic improvements. It is the joint responsibility of the designers and management to operationalise the new process.

The Role of Information Technology in BPR

The accelerating pace at which information technology has developed during the past few years had a very large impact in the transformation of business processes. Various studies have conclusively established the role of information technology in the transformation of business processes. That information technology is going to play a significant role in changing the business processes during the years to come, has been established beyond doubt.

A reengineered business process, characterised by IT-assisted speed, accuracy, adaptability and integration of data and service points, is focussed on meeting the customer needs and expectation quickly and adequately, thereby enhancing his/her satisfaction level.

Globalization and competition call for better management, faster response to change and adherence to globally accepted standards of quality and services.

- Impact of IT-systems are identified as:
- Compression of time
- Overcoming restrictions of geography and/or distance
- Restructuring of relationships.

IT-initiatives, thus, provide business values in three distinct areas:

- Efficiency – by way of increased productivity,
- Effectiveness – by way of better management,
- Innovation – by way of improved products and services

All these can bring about a radical change in the quality of products and services, thereby improving the competitiveness and customer satisfaction. Information technology (IT) is a critical factor in the success of bringing this change.

Central Thrust of BPR:

Improvement on quality and cost follows after improvement on thrust area. BPR is continuous improvement process. Although BPR is a multi-dimensional approach in improving the business performance it's thrust area may be identified as "the reduction of the total cycle time of a business process." BPR aims at reducing the cycle time of process by eliminating the unwanted and redundant steps and by simplifying the systems and procedures and also by eliminating the transit and waiting times as far as possible. Even after redesigning of a process, BPR maintains a continuous effort for more and more improvement.

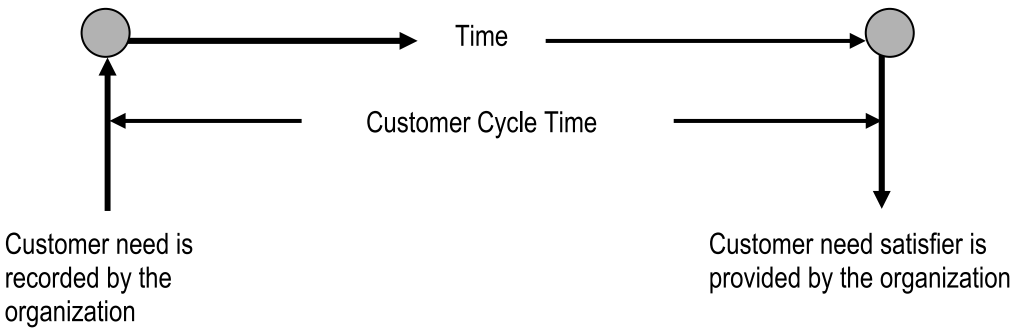

Figure : Customer Time cycle

Reengineering does not mean any partial modification or marginal improvement in the existing work processes. Reengineering is a revolutionary approach towards radical and total redesigning of the business processes. While reengineering may lead to restructuring of organization, any restructuring does not necessarily mean reengineering. The basic principles that differentiate reengineering from any other drive on improving organizational efficiency may be briefly summarized as follows :

- At the core of reengineering lies the concept of discontinuous thinking. Reengineering does not have any scope for any partial modification or marginal improvement in the existing business processes. It aims at achieving excellence and a breakthrough in performance by redesigning the **process** entirely and radically. Obviously it requires challenging the necessity of existing rules and procedures and discarding the same to evolve altogether new processes.
- BPR approach recognizes that most of the existing rules and procedures of work methods are based on certain assumptions about technology, people and the goals of the organization. These assumptions may not be valid any more. Besides many of these systems and procedures have failed to reap the benefit of massive development of information technology during the past few years. BPR recognizes "the" vast and expanding potential of IT for the most rational, simple, and efficient redesign of work structure." BPR aims at utilizing information technology for evolving a new process, instead of automating the existing process.
- While reengineering starts with the process it does not end there. The fundamental and radical changes that takes place while reengineering the process has its own implication on other parts of the organization – almost on every part of it. Reengineering requires viewing a process from cross-functional perspective. Reengineering effort, therefore, focuses on a multidimensional approach disregarding the constraints of organizational structure departmental boundaries.
- "BPR efforts involves managing massive organizational change." Reengineering is not just changing the process. The change in process is almost always accompanied by a whole lot of changes in other areas too. Work changes from task oriented to process oriented. People have the choice of making their own decisions instead of being directed. "Functional departments find their existence as redundant. Practically every aspect of the organization changes beyond recognition."

In view of the massive organizational changes involved in reengineering, it is imperative that a reengineering drive is supported by the vision and commitment of the organizations top leadership to see through its successful completion.

Also faster and efficient redesigned business processes provide a firm with many more opportunities for trying, testing, modifying and learning.

Problems in BPR

Reengineering is a major and radical improvement in the business process. Only a limited number of companies are able to have enough courage for having BPR because of the challenges posed. It disturbs established hierarchies and functional structures and creates serious repercussions and involves resistance among the work-force. Reengineering takes time and expenditure, at least in the short run, that many companies are reluctant to go through the exercise. Even there can be loss in revenue during the transition period. Setting of targets is tricky and difficult. If the targets are not properly set or the whole transformation not properly carried out, reengineering efforts may turn-out as a failure.

3. BENCHMARKING

Two men were passing through a jungle. They saw a tiger at a distance. One of them immediately started running away. 'No use' the other claimed 'We cannot outrun him. We are sure to be killed'. The first person replied 'I need to outrun you and not him'.

Similarly, in cut-throat competition it is important for organizations to gain an edge over their competitors. Benchmarking helps organization to get ahead of competition. The organizations possess a large amount of information that helps them in taking strategic and other important decisions. Companies that translate this information to knowledge and use it in their planning and decision making are the winners.

Dictionary defines a benchmark as a standard or a point of reference against which things may be compared and by which something can be measured and judged. In this sense, at a naïve level, it may be compared to the concept of control as the similarities do exist. However, the concept of benchmarking is much broader than mere controlling as there are major strategic dimensions involved. The term has presumably been adapted from physical sciences wherein it refers to a surveyor's mark made on a stationary object at previously determined position and elevation and used as a reference point to measure altitudes.

The scientific studies conducted by Frederick Taylor in the latter part of the nineteenth century represent an early use of the benchmarking concept. However, the term got popularity much later in the seventh decade of twentieth century. Initially, the concept evolved in companies operating in an industrial environment. Over a period of time it covered other spheres of business activity. In recent years, different commercial and non-commercial organizations are discovering the value of benchmarking and are applying it to improve their processes and systems.

What is Benchmarking?

In simple words, benchmarking is an approach of setting goals and measuring productivity based on best industry practices. It developed out of need to have information against which performances can be measured. For example, a customer support engineer of a television manufacturer attends a call within forty-eight hours. If the industry norm is that all calls are attended within twenty-four hours, then the twenty-four hours can be a benchmark. Benchmarking helps in improving performance by learning from best practices and the processes by which they are achieved. It involves regularly comparing different aspects of performance with the best practices, identifying gaps and finding out novel methods to not only reduce the gaps but to improve the situations so that the gaps are positive for the organization.

Benchmarking is not a panacea for all problems. Rather, it studies the circumstances and processes that help in superior performance. Better processes are not merely copied. Efforts are made to learn, improve and evolve them to suit the organizational circumstances. Further, benchmarking exercises are also repeated periodically so that the organization does not lag behind in the dynamic environment.

Benchmarking is a process of continuous improvement in search for competitive advantage. It measures a company's products, services and practices against those of its competitors or other acknowledged leaders in their field. Xerox pioneered this process in late 70's by benchmarking its manufacturing costs against those of domestic and Japanese competitors and got dramatic improvement in the manufacturing cost. Subsequently ALCOA, Eastman Kodak, IBM adopted benchmarking. Firms can use benchmarking process to achieve improvement in diverse range of management function like:

- Maintenance operations
- Assessment of total manufacturing costs
- Product development
- Product distribution
- Customer services
- Plant utilization levels
- Human resource management

The Benchmarking Process

Benchmarking processes lack standardization. However, common elements are as follows:

(1) *Identifying the need for benchmarking and planning:* This step will define the objectives the benchmarking exercise. It will also involve selecting the type of benchmarking. Organizations identify realistic opportunities for improvements.

(2) *Clearly understanding existing business processes:* This step will involve compiling information and data on performance. This will include mapping processes. Information and data is collected by different methods for example, interviews, visits and filling of questionnaires.

(3) *Identify best processes:* Within the selected framework, best processes are identified. These may be within the same organization or external to them.

(4) *Compare own processes and performance with that of others:* While comparing gaps in performance between the organization and better performers is identified. Further, gaps in performance is analysed to seek explanations. Such comparisons have to be meaningful and credible. Feasibility of making the improvements in the light of the conditions that apply within the organization is also examined.

(5) *Prepare a report and Implement the steps necessary to close the performance gap:* A report on the Benchmarking initiatives containing recommendations is prepared. Such a report includes the action plan(s) for implementation.

(6) *Evaluation:* Business organizations evaluate the results of the benchmarking process in terms of improvements vis-à-vis objectives and other criteria set for the purpose. It also periodically evaluates and reset the benchmarks in the light of changes in the conditions that impact the performance.

4. TOTAL QUALITY MANAGEMENT (TQM)

The Total Quality Management movement (or simply TQM, as it is more commonly known) has caught on in essentially every corner of industry. The TQM philosophy is a guiding force in all industrialized nations like USA, European nations, Japan, etc.

What is TQM? A definition of total quality was endorsed in 1992 by the chairs and CEOs of nine major U.S. corporations in cooperation with deans of business and engineering departments of major universities and recognized consultants:

Total Quality Management (TQM) is a people-focused management system that aims at continual increase in customer satisfaction at continually lower real cost.

TQM is a total system approach (not a separate area or program) and an integral part of high-level strategy; it works horizontally across functions and departments, involves all employees, top to bottom, and extends backward and forward to include the supply chain and the customer chain. TQM stresses learning and adaptation to continual change as keys to organizational success.

To understand this concept fully, it makes sense first to understand some of the underlying concepts of quality management that have guided industrial development. The concept of quality control as a distinct discipline emerged in the United States in the 1920s. At the time, quality control was intended simply to control, or limit, the creation of defective items in industrial processes. There are numerous disadvantages to this sorting process, especially if the sorting is performed by different people from those manufacturing the product, Pioneering work by Shewhart, Deming, Juran, Feigenbaum, Crosby, and others indicated that perhaps better ways to approach the quality control concept existed. Perhaps simply sorting good products from bad, they reasoned, was not the most efficient way to assure a quality output. A more effective management philosophy might focus on actions to prevent a defective product from ever being created, rather than simply screening it out. Also, these and other men soon recognized that the concept of quality control need not be restricted only to manufacturing processes. The idea of assuring quality could also be applied to administrative processes service industries and all sphere of organization activity.

The TQM philosophy greatly emerged under Deming's guidance, who is regarded by many as the father of TQM. Interestingly, Deming's quality management philosophies were first developed in the years prior to World War II. Deming believed quality management should be pervasive, and should not focus on merely sorting good products from bad. He believed that the responsibility for quality should be shared by everyone in an organization. Perhaps most significantly, Deming recognized that most quality problems were system-induced and were therefore not related to workmanship. But Deming's work only saw limited application in the United States prior to World War II, Subsequently Deming was brought to Japan by General Douglas MacArthur to serve as a management consultant to the Japanese as they rebuilt their industrial base. Deming's message had essentially fallen on deaf ears in the United States, but not so in Japan.

Japan, then as now, was an island nation that had to import all its raw materials. But Japan, as a formerly industrialized nation, had to rebuild its industrial base from essentially nothing. The Japanese had no preconceived approaches about sorting defective products from acceptable ones. They were willing to learn. What followed in Japan during the ensuing decades has been well studied and is now well known. The Japanese dominated almost every market they chose to enter: electronics, cameras, automobiles, steel, shipbuilding, motorcycles, and several others. Superior quality became a common theme of Japanese market dominance. Much of the Japanese quality superiority occurred as a result of statistical manufacturing methods and other management philosophies now recognized as Total Quality Management. The Japanese made additional contributions to the TQM philosophy, most notably in the areas of variability reduction, problem solving, teamwork, and defining and satisfying customer expectations: Taguchi and Ishikawa contributed heavily to these disciplines.

4.1 Principles guiding TQM

Implementing TQM requires organization wide support. There are several principles that guide success of TQM. Various principles that guide the total quality management philosophy are as follows:

- **A sustained management commitment to quality**: An organization's personality and culture will ultimately reflect its senior management's values. If an organization is serious about implementing TQM, the commitment to do so has to start at the top, and the organization's senior management has to be unwavering in its commitment to quality.

Almost any organization's senior managers will claim they are committed to quality, but how they act at the end sets the tone for the entire organization. If management allows a defective product leave the premises of the organisation in order to make sales, then all the talk about quality won't make a difference to the people making the product. If management is willing to take a sales hit if quality levels are not up to requirements, the rest of the organization will understand the commitment to quality is real.

- **Focusing on the customer:** According to Lee Iacocca had only three rules: Satisfy the customer, satisfy the customer, and satisfy the customer. This sums up the importance of customer focus in the TQM philosophy. Ultimately it the satisfaction of the customers that determines the success of an organisation.

- **Preventing rather than detecting defects:** TQM is a management philosophy that seeks to prevent poor quality in products and services, rather than simply to detect and sort out defects. "An ounce of prevention is worth a pound of cure." A little precaution before a crisis occurs is preferable to a lot of fixing up afterward. This also saves cost and time.

- **Universal quality responsibility:** Another basic TQM precept is that the responsibility for quality is not restricted to an organization's quality assurance department, but is instead a guiding philosophy shared by everyone in an organization. TQM requires that everyone takes responsibility for quality. As quality improves, the quality assurance department gets smaller. In fact, world over, a few companies fully committed to TQM have done' away completely with their quality assurance organizations.

  Quality measurement: The quality measurement aspect of TQM asks the question: Where are we and where are we going? A basic TQM concept is that quality is a measurable commodity, and in order to improve, we need to know where we are (or stated differently, what the current quality levels are), and we need to have some idea where we are going (or what quality levels we aspire to). This is an extremely important concept

- **Continuous improvement and learning:** TQM espouses a philosophy of continuous improvement in all areas of an organization. This philosophy ties in closely with the quality measurement and universal quality responsibility concepts mentioned above. Quality measurement is needed in order to focus improvement efforts appropriately.

  Continuous improvement is part of the management of all systems and processes. Achieving the highest levels of performance requires a well-defined and well-executed approach to continuous improvement and learning. "Continuous improvement" refers to both incremental and "breakthrough" improvement. Improvements may be of several types:

  - Enhancing value to the customer through new and improved products and services;
  - Developing new business opportunities;

- Reducing errors, defects, and waste;
- Improving responsiveness and cycle time performance; and
- Improving productivity and effectiveness in the use of all resources.

"Learning" refers to adaptation to change, leading to new goals or approaches. Improvement and learning need to be embedded in the way an organization operates. This means they should be a regular part of daily work, seek to eliminate problems at their source, and be driven by opportunities to do better as well as by problems that need to be corrected.

- **Root cause corrective action:** Most of us have experienced instances in which problems we thought were corrected continued to occur. TQM seeks to prevent this by identifying the root causes of problems, and by implementing corrective actions that address problems at the root cause level.
- **Employee involvement and empowerment:** Another fundamental TQM concept is that employees must be involved and empowered. Employee involvement means every employee is involved in running the business and plays an active role in helping the organization meet its goals. Employee empowerment means employees and management recognize that many obstacles to achieving organizational goals can be overcome by employees who are provided with the necessary tools and authority to do so.
- **The synergy of teams:** In addition to the TQM concepts of empowerment and involvement of employees, taking advantage of the synergy of teams is an effective way to address the problems and challenges of continuous improvement. Dr. Kaoru Ishikawa first formalized the teams concept as part of the TQM philosophy by developing quality circles in Japan.
- **Thinking statistically:** Statistical thinking is another basic TQM philosophy. Quality efforts often require reducing process or product-design variation, and statistical methods are ideally suited to support this objective.
- **Inventory reduction:** Largely in response to their lack of natural resources (as well as the 1970s worldwide oil shortages), the Japanese pioneered the concept of reducing inventories. This management philosophy became known as Just-in- Time (or JIT, for short) inventory management. The Japanese JIT inventory management concepts caught on in the United States and other nations. Although the concept was originally intended to address material shortages, an interesting side effect immediately emerged: As inventories grew smaller, quality improved.
- **Value improvement:** The linkage between continuous improvement and value improvement is simultaneously obvious and subtle. This linkage becomes apparent when one considers the definition of quality, which is the ability to meet or exceed customer

requirements and expectations. The essence of value improvement is the ability to meet or exceed customer expectations while removing unnecessary cost. But simply cutting costs, however, will not improve value if the focus does not remain on satisfying customer requirements and expectations.

- **Supplier teaming:** Another principle of the TQM philosophy is to develop long-term relationships with a few high-quality suppliers, rather than simply selecting those suppliers with the lowest initial cost.
- **Training:** Training is basic to the TQM process. The concept is based on of empowering employees by providing the tools necessary for continuous improvement. One of the most basic tools is training.

"TQM is a management philosophy, an abstract entity!"

But TQM is not an overnight cure for an organization's quality problems. The TQM implementation process is not a program. A TQM implementation effort has a beginning, but if implemented properly, it does not have an ending. The continuous improvement process continues indefinitely in organizations that successfully implement TQM. TQM requires patience when embarking on its journey.

4.2 TQM and traditional management practices

TQM is quite different from traditional management practices, requiring changes in organizational processes, beliefs and attitudes, and behaviours. "Traditional management" means the way things are usually done in most organizations in the absence of a TQM focus. Many "traditional" organizations have been applying TQM principles all along, so not all of these comments pertain to every organization. The nature of TQM differs from common management practices in many respects. Some of the key differences are as follows:

- **Strategic Planning and Management:** Quality planning and strategic business planning are indistinguishable in TQM. Quality goals are the cornerstone of the business plan. Measures such as customer satisfaction, defect rates, and process cycle times receive as much attention in the strategic plan as financial and marketing objectives.
- **Changing Relationships with Customers and Suppliers:** In TQM, quality is defined as products and services beyond present needs and expectations of customers. Innovation is required to meet and exceed customers' needs. Traditional management places customers outside of the enterprise and within the domain of marketing and sales. TQM views everyone inside the enterprise as a customer of an internal or external supplier, and a supplier of an external or internal customer. Marketing concepts and tools can be used to assess internal customer needs and to communicate internal supplier capabilities.
- **Organizational Structure:** TQM views the enterprise as a system of interdependent processes, linked laterally over time through a network of collaborating (internal and

external) suppliers and customers. Each process is connected to the enterprise's mission and purpose through a hierarchy of micro- and macro-processes. Every process contains sub-processes and is also contained within a higher process. This structure of processes is repeated throughout the hierarchy.

- **Organizational Change:** In TQM the environment in which the enterprise interacts is considered to be changing constantly. Management's job, therefore, is to provide the leadership for continual improvement and innovation in processes and systems, products, and services. External change is inevitable, but a favourable future can be shaped.
- **Teamwork:** In TQM individuals cooperate in team structures such as quality circles, steering committees, and self-directed work teams. Departments work together toward system optimization through cross-functional teamwork.
- **Motivation and Job Design:** TQM managers provide leadership rather than overt intervention in the processes of their subordinates, who are viewed as process managers rather than functional specialists. People 'are motivated to make meaningful contributions to what they believe is an important and noble cause, of value to the enterprise and society. The system enables people to feel like winners.

5. SIX SIGMA AND MANAGEMENT

Six sigma is often related to Motorola, the company that has invented it. In the eighth decade of the 20th century, Motorola's significantly changed the discussion of quality from one where quality levels were measured in percentages (parts per hundred) to parts per million or even parts per billion. It pointed out that modern technology was so complex that old ideas about acceptable quality levels are no longer acceptable. The success of Motorola effectively changed the focus of quality worldwide. Many giants like Xerox, Boeing, GE, Kodak followed Motorola's lead. In India also Tata's, WIPRO and Bharti's and others are effectively reaping the benefits of six-sigma.

Human quest for better quality is unending. With the help of technology and newer tools organizations enhance quality of their products that are seemingly of very good quality. Quality refers to the degree of excellence and standard. Better quality is often correlated with superior processes and products.

Strategically, a product of good quality should be able to meet the specifications of customer and should be able to satisfy him. If battery of a wristwatch lasts for eight months, but is expected to last for a year by the customer, then the product battery is not of desired quality. Good quality should not always be associated with good products.

Another dimension of quality is that it should not be restricted to satisfying the existing desires of customers. It should not put a boundary on quality by limiting it to the current information and perspective of customers. Rather it should be futuristic, i.e., in addition to meeting customer's present expectations, it should be able to improve them.

5.1 What is Six Sigma?

Primarily Six Sigma means maintenance of the desired quality in processes and end products. It means taking systemic and integrated efforts toward improving quality and reducing cost.

It is a highly disciplined process that helps in developing and delivering near-perfect products and services. It strives to meet and improve organizational goals on quality, cost, scheduling, manpower, new products and so on. It works continuously towards revising the current standards and establishing higher ones.

Six Sigma has its base in the concept of probability and normal distribution in statistics. Six Sigma strives that 99.99966% of products manufactured are defect free. Six Sigma is a smarter way to manage a business or a department. Six Sigma puts the customer first and uses facts and data to drive better solutions.

Six Sigma efforts target three main areas:

- Improving customer satisfaction
- Reducing cycle time
- Reducing defects

Improvements in these areas usually represent dramatic cost savings to businesses, as well as opportunities to retain customers, capture new markets, and build a reputation for top performing products and services.

Although it involves measuring and analyzing an organization's business processes, Six Sigma is not merely a quality initiative; it is a business initiative. Achieving the goal of Six Sigma requires more than small, incremental improvements; it requires breakthroughs in every area of an operation. In statistical terms, "reaching Six Sigma" means that your process or product will perform with almost no defects.

But the real message of Six Sigma goes beyond statistics. Six Sigma is a total management commitment and philosophy of excellence, customer focus, process improvement, and the rule of measurement rather than gut feel. Six Sigma is about making every area of the organization better able to meet the changing needs of customers, markets, and technologies - with benefits for employees, customers, and shareholders.

The background of Six Sigma stretches back eighty-plus years, from management science concepts developed in the United States to Japanese management breakthroughs to "Total Quality" efforts in the 1970s and 1980s. But its real impact can be seen in the waves of change and positive results sweeping such companies as GE, Motorola, Johnson & Johnson, and American Express.

GE's Key Concepts of Six Sigma	
At its core, Six Sigma revolves around a few key concepts.	
Critical to Quality:	Attributes most important to the customer
Defect:	Failing to deliver what the customer wants
Process Capability:	What your process can deliver
Variation:	What the customer sees and feels
Stable Operations:	Ensuring consistent, predictable processes to improve what the customer sees and feels
Design for Six Sigma:	Designing to meet customer needs and process capability

Source: http://www.ge.com/sixsigma/sixsigstrategy.html

5.2 Six sigma methodology

For implementing six sigma there are two separate key methodologies for existing and new processes. Conceptually there is some overlapping between the two. The two methodologies as follows:

1. **DMAIC**: DMAIC methodology is an acronym for five different steps used in six sigma directed towards improvement of existing product, process or service. The five steps are as follows:

   - *Define*: To begin with six sigma experts define the process improvement goals that are consistent with the strategy of the organization and customer demands. They discuss different issues with the senior managers so as to define what needs to done.
   - *Measure*: The existing processes are measured to facilitate future comparison. Six sigma experts collect process data by mapping and measuring relevant processes.
   - *Analyze*: Verify cause-and-effect relationship between the factors in the processes. Experts need to identify the relationship between the factors. They have to make an comprehensive analyses to identify hidden or not so obvious factor.
   - *Improve*: On the basis of the analysis experts make a detailed plan to improve.
   - *Control*: Initial trial or pilots are run to establish process capability and transition to production. Afterwards continuously measure the process to ensure that variances are identified and corrected before they result in defects.

2. **DMADV:** DMADV is again acronym for the steps followed in implementing six sigma. It is a strategy for designing new products, processes and services.

   - *Define:* As in case of DMAIC six sigma experts have to formally define goals of the design activity that are consistent with strategy of the organization and the demands of the customer.
   - *Measure:* Next identify the factors that are critical to quality (CTQs). Measure factors such as product capabilities and production process capability. Also assess the risks involved.
   - *Analyze:* Develop and design alternatives. Create high-level design and evaluate to select the best design.
   - *Design:* Develop details of design and optimise it. Verify designs may require using techniques such as simulations.
   - *Verify:* Verify designs through simulations or pilot runs. Verified and implemented processes are handed over to the process owners.

5.3 What's New About Six Sigma?

In the 1980s, Total Quality Management (TQM) was popular. It too was an improvement-focused program, but it ultimately died a slow and silent death in many companies. What makes Six Sigma different?

Three key characteristic separate Six Sigma from other quality programs of the past. .

1. *Six Sigma is customer focused.* It's almost an obsession to keep external customer needs in plain sight, driving the improvement effort. (External customers are mostly those who buy business's products and services.)
2. *Six Sigma projects produce major returns on investment.* GE's CEO, Jack Welch, wrote in the annual report that in just three years, Six Sigma had saved the company more than $2 billion.
3. *Six Sigma changes how management operates.* Six Sigma is much more than improvement projects. Senior executives and leaders throughout a business are learning the tools and concepts of Six Sigma: new approaches to thinking, planning, and executing to achieve results. In a lot of ways, Six Sigma is about putting into practice the notions of working smarter, not harder.

Six Sigma has produced some impressive numbers. But reaching them requires a great deal of organizational teamwork. It means having the systems to provide customers what they want when they want it. It means providing employees with the time and training to tackle work challenges with some basic, and some sophisticated, analytical tools.

When a business violates important customer requirements, it is generating defects, complaints, and cost. The greater the number of defects that occur, the greater the cost of correcting them, as well as the risk of losing the customers. Ideally, your company wants to avoid any defects and the resulting cost in money and customer satisfaction.

But if a company have lots of customers, some defects are bound to slip through, right? The problem is that even a seemingly low percentage of defects can mean a lot of unhappy customers. If company processed 250,000 credit card bills a month and operated at 99.38 percent accuracy (4 sigma), we would have about 1,550 unhappy customers every month.

The goal of Six Sigma is to help people and processes aim high in aspiring to deliver defect-free products and services. The notion of zero defects is not at work here; Six Sigma recognizes that there's always some potential for defects, even in the best run processes or best-built product. But at 99.9997 percent performance, Six Sigma sets a performance target where defects in many processes and products are almost nonexistent.

Also defects can lead to lost customers, and turned-off customers tell others about their experiences, making it that much more difficult to recover from defects. As customers get more and more demanding and impatient, these high levels of defects put a company in serious risk. But keeping customers happy is good and profitable for the business. A 5 percent increase in customer retention has been shown to increase profits more than 25 percent. It is estimated that companies lose 15 percent to 20 percent of revenues each year to ineffective, inefficient processes-although some might suggest that it's even higher. Six Sigma provides a goal that applies to both product and. service activities and that sets attainable, short-term goals while striving for long-range business objectives.

5.4 Six Sigma as a system of management

A significant difference between Six Sigma and seemingly similar programs of past years is the degree to which management plays a key role in regularly monitoring program results and accomplishments. When Jack Welch introduced the Six Sigma program at GE, he told senior executives that 40 percent of their annual bonus would be based on their involvement and success in implementing Six Sigma.

That focused executive attention on turbo-charging Six Sigma in their individual divisions. Training in GE was given a huge boost, and thousands of teams were trained in large sessions. At the same time, executives throughout GE participated in days and sometimes weeks of Six Sigma training.

But training alone is not a management system. A management system involves accountability for results and ongoing reviews to ensure results. With both accountability and regular reviews, managers can begin to use Six Sigma as a guide to leading their businesses.

As a management system, though, Six Sigma is not owned by senior leaders (although their role is critical) or driven by middle management (although their participation is key). The ideas, solutions, process discoveries, and improvements that arise from Six Sigma take place at the front lines of the organization. Six Sigma companies are striving to put more responsibility into the hands of the people who work directly with customers.

In short, Six Sigma is a system that combines both strong leadership and grassroots energy and involvement. In addition, the benefits of Six Sigma are not just financial. People at all levels of a Six Sigma company find that better understanding of customers, clearer processes, meaningful measures, and powerful improvement tools make their work more rewarding.

5.5 Six Themes of Six Sigma

The critical elements of Six Sigma can be put into six themes as follows:

Theme one – genuine focus on the customer: Companies launching Six Sigma have often been appalled to find how little they really understand about their customers. In Six Sigma, customer focus becomes the top priority. For example, the measures of Six Sigma performance begin with the customer. Six Sigma improvements are defined by their impact on customer satisfaction and value.

Theme two – data and fact-driven management: Six Sigma takes the concept 'of "management by fact" to a new, more powerful level. Despite the attention paid in recent years to improved information systems, knowledge management, and so on, many business decisions are still being based on opinions and assumptions. Six Sigma discipline begins by clarifying what measures are key to gauging business performance and then gathers data and analyzes key variables. Then problems can be much more effectively defined, analyzed, and resolved-permanently. At a more down-to-earth level, Six Sigma helps managers answer two essential questions to support data-driven decisions and solutions.

- What data/information do I really need?
- How do we use that data/information to maximum benefit?

Theme three – processes are where the action is: Whether focused on designing products and services, measuring performance, improving efficiency and customer satisfaction, or even running the business, Six Sigma positions the process as the key vehicle of success. One of the most remarkable breakthroughs in Six Sigma efforts to date has been convincing leaders and managers-particularly in service-based functions and industries-that mastering processes is a way to build competitive advantage in delivering value to customers.

Theme four – proactive management: Most simply, being proactive means acting in advance of events rather than reacting to them. In the real world, though, proactive management means making habits out of what are, too often, neglected business practices: defining ambitious goals and reviewing them frequently, setting clear priorities, focusing on problem prevention rather than fire-fighting, and questioning why we do things instead of blindly defending them.

Far from being boring or overly analytical, being truly proactive is a starting point for creativity and effective change. Six Sigma, encompasses tools and practices that replace reactive habits with a dynamic, responsive, proactive style of management.

Theme five – boundaryless collaboration: "Boundarylessness" is one of Jack Welch's mantras for business success. Years before launching Six Sigma, GE's chairman was working to break barriers and to improve teamwork up, down, and across organizational lines. The opportunities available through improved collaboration within companies and with vendors and customers are huge. Billions of dollars are lost every day because of disconnects and outright competition between groups that should be working for a common cause: providing value to customers.

Theme six – drive for perfection; tolerate failure: How can you be driven to achieve perfection and yet also tolerate failure? In essence, though, the two ideas are complementary. No company will get even close to Six Sigma without launching new ideas and approaches-which always involve some risk. If people who see possible ways to be closer to perfect are too afraid of the consequences of mistakes, they'll never try.

Finally we must bear in mind that Six Sigma is a gradual process. It starts with a dream or a vision:

6. CONTEMPORARY STRATEGIC ISSUES

If we want to stay competitive, we need to be in e-commerce

– Jessica Chu, Marketing manager, Aaeon Technology, Taiwan

Our strategy is to integrate the internet into all of our core business.

– Thomas Middelhoff, CEO, Bertelsmann AG, Germany

6.1 Strategies for Internet Economy

The impact of the Internet and the rapidly emerging e-commerce environment is profound. The advent of the Internet and online networks changes everything. There can be no doubt that the Internet is a driving force of historical and revolutionary proportions. The coming of e-commerce has changed the character of the market, created new driving forces and key success factors and bred the formation of new strategic groups. The creativeness with which a company incorporates e-commerce practices holds enormous potential for reconfiguring its value chain and affecting its company's competitiveness. Also the Internet economy presents opportunities and threats that demand strategic response and that require managers to craft bold new strategies.

What is Internet Technology?

The Internet is an integrated network of banks of servers and high-speed computers, digital switches and routers, telecommunications equipment and lines, and individual users' computers. The backbone of the Internet consists of telecommunications lines (fibre optic lines, high-capacity telephone lines) criss-crossing countries, continents, and the world that allow computers to transfer data in digital form at very high speed. The bandwidth of the line determines the capacity or speed of the data transfer. These lines are connected to computer like digital switches that move traffic along the backbone lines; many of these switches act as routers, deciding which way to direct the traffic and how to handle the requests of users' computers to send or obtain data based on the destinations and line congestion.

Users gain access to the network via a local area network (LAN) server or an Internet service provider's computerized switch that has the capability to route traffic to and from end users directly connected to it. Many different types of specialized software are required to make the Internet function and infuse it with attractive e-commerce capabilities.

Strategy-shaping characteristics of the E-Commerce environment

We need to understand how growing use of the Internet by businesses and consumers reshapes the economic landscape and alters traditional industry boundaries. The following features stand out:

- **The Internet makes it feasible for companies everywhere to compete in global markets:** This is true especially for companies whose products are of good quality and can be shipped economically. In retailing, the Internet opens up a much bigger geographic market than a traditional brick-and-mortar retailer could otherwise reach. e-commerce escalates rivalry among sellers in different geographic areas to a whole new level.

- **Competition in an industry is greatly intensified by the new e-commerce strategic initiatives of existing rivals and by the entry of new, enterprising e-commerce rivals:** Not only is the Internet an important new distribution channel that allows sellers to reach vast numbers of buyers relatively inexpensively but the use of online systems afforded by the Internet also holds considerable potential for improving business efficiency and lowering operating costs. Hence, innovative use of the Internet adds a valuable weapon to the competitive arsenal of rival sellers, giving them yet another way to jockey for market position and manoeuvre for competitive advantage.

- **Entry barriers into the e-commerce world are relatively low:** Many of the activities comprising the value chains of e-commerce businesses can be outsourced. The software necessary for establishing a Web site is readily available (if entrepreneurs do not wish to develop their own), and the costs of using a Web hosting company to manage the servers and maintain the site are relatively modest. Relatively low entry barriers explain why there are already hundreds of thousands of newly formed e-commerce firms, with perhaps millions more to spring up around the world in years to come. In many markets and industries, entry barriers are low enough to make additional entry both credible and likely.

- **Online buyers gain bargaining power because they confront far fewer obstacles to comparing the products, prices, and shipping times of rival vendors:** Vendor Web sites are only a few clicks apart and are open for business 24 hours a day, every day of the year, giving buyers unprecedented ability to compare offerings and find the best value. Using online networks, a multinational manufacturer's geographically scattered purchasing groups can easily pool their orders with parts and components suppliers and bargain for volume discounts. Likewise, it is feasible for wholesalers to use online systems to research the products, prices, and features of competing manufacturers and for retailers to shop around and bargain for the best deals from manufacturers and distributors who supply them. Individual consumers can readily get reviews of products, compare the features and prices of rival brands, and put up bids for how much they are willing to pay for items. The Internet eliminates the geographic protection of distance that has traditionally given small-town businesses the advantage of being the only source within reasonable driving distance. Using the Internet, buyers can readily negotiate car purchases with dealers hundreds of miles away.
- **The Internet makes it feasible for companies to reach beyond their borders to find the best suppliers and, further, to collaborate closely with them to achieve efficiency gains and cost savings:** In an e-commerce environment companies can use the Internet to integrate foreign suppliers into their supply chain networks more tightly, boosting savings and speeding new products to market. All companies can extend their geographic search for suppliers and can collaborate electronically with chosen suppliers to streamline ordering and shipping of parts and components, improve just-in-time deliveries, work in parallel on the designs for new products, and communicate speedily and efficiently. But the chief point here is that new competitive pressures can spring from the e-commerce relationships between companies and their suppliers-companies not only gain added bargaining power over their suppliers but efficient online collaboration with chosen suppliers can also be a basis for gaining an edge over rivals.
- **Internet and PC technologies are advancing rapidly, often in uncertain and unexpected directions:** For example, a few years ago, both Intel and Microsoft were focusing all their energies on expanding the role of the personal computer as a multifunctional appliance in both business significance of the internet and bad to initiate crash programs to redirect their efforts.
- **The internet results in much faster diffusion of new technology and new idea across the world:** Companies in emerging countries and elsewhere can use the internet to monitor the latest technological developments and to stay abreast of what is transpiring in the markets of Europe, Japan, and North America and what the leading companies in these areas are doing.
- **The e-commerce environment demands that companies move swiftly:** In the exploding e-commerce world, speed is a condition of survival. New developments on first

one front and then another occur daily. Market and competitive conditions change very quickly. Late movers are doomed.

- **E-commerce technology opens up a host of opportunities for reconfiguring industry and company value chains:** Using the internet to link the orders of customers with the suppliers of components enables just-in-time delivery to manufacturers, slicing inventory costs and allowing production to match demand. It allows more accurate demand forecasting. Tight supply chain management starting with customer orders and going all the way back to components production, coupled with the use of enterprise resource planning (ERP) software and manufacturing execution system (MES) software, can make custom manufacturing just as cheap as mass production, and sometimes cheaper. The impact of e-commerce technology on industry and company value chains is profound, paving the way for fundamental changes in the ways business is conducted both internally and with suppliers and customers.

- **The Internet can be an economical means of delivering customer service***:* The Internet provides innovative opportunities for handling customer service activities. Companies are discovering ways to deliver service online, thus curtailing the need to keep company personnel at the facilities of major customers, reducing staffing levels at telephone call centers, and cutting the time required for service technicians to respond to customer faxes and e-mail messages.

- **The capital for funding potentially profitable e-commerce businesses is readily available**: In the Internet age, e-commerce businesses have found it relatively easy to raise hundreds of millions, even billions, of dollars to fund a promising new venture. Venture capitalists are quite willing to fund start-up enterprises provided they have a promising technology or idea, an attractive business model, and a well thoughtout strategic plan

- **The needed e-commerce resource in short supply is human talent-in the form of both technological expertise and managerial know-how:** While some e-commerce companies have their competitive advantage lodged in patented technology or unique physical assets or brand-name awareness, many are pursuing competitive advantage based on the expertise and intellectual capital of their personnel and on their organizational competencies and capabilities. Two of the most valuable competitive assets a company can have are dominating depth in a particular technology and a workforce with exceptional know-how and experience that gives a firm uniquely strong skills and competitive capabilities. E-commerce firms are thus competing aggressively for talent and intellectual capital; individuals with attractive qualifications and know-how can command premium compensation, including equity ownership or lucrative stock options in start-up enterprises.

It is that growing use of e-commerce technology can produce important shifts in an industry's competitive forces – intensified rivalry, greater entry threats, a blurring of traditional industry and geographic boundaries, shifts in the balance of bargaining power both between sellers and their suppliers and between sellers and their customers, and incentives for all kinds of seller-supplier and seller-customer collaboration.

Internet technology and newly emerging products and services that enable e-commerce further have the effects of altering industry value chains, spawning substantial opportunities for increasing efficiency and reducing costs, and affecting a company's resource strengths and weaknesses. Moreover, the pace of technological change is rapid and its direction is often uncertain. Market developments occur swiftly, compelling companies to make decisions at Internet speed or risk getting left behind in the dust.

6.2 Strategic management in non-profit and government organization

Business organization can be classified as commercial or non-commercial on the basis of the interest they have. A commercial organization has profit as its main aim. We can find many organizations around us, which do not have any commercial objective of making profits. Their genesis may be for social, charitable, or educational purposes. Examples of non-commercial organizations can be The Institute of Chartered Accountants of India, municipal corporations, non-governmental organizations such as Help-Age or Child Relief and You. Their main aim is to provide services to members, beneficiaries or public at large. A non-commercial organization comes to existence to meet the needs not met by business enterprises. These organizations may not have owners in true sense.

The strategic-management process is being used effectively by countless non-profit governmental organizations. Many non-profit and governmental organizations outperform private firms and corporations on innovativeness, motivation, productivity, and strategic management.

Compared to for-profit firms, non-profit and governmental organizations often function as a monopoly, produce a product or service that offers little or no measurability of performance, and are totally dependent on outside financing. Especially for these organizations, strategic management provides an excellent vehicle for developing and justifying requests for needed financial support.

Educational institutions

Educational institutions are using strategic-management techniques and concepts more frequently. Richard Cyert, president of Carnegie-Mellon University, says, "I believe we do a far better job of Strategic management than any company I know ". The significant change in the competitive climate has taken place in the educational environment. Hence, they are adopting different strategies for attracting best students.

The academic institutions have also joined hands with industries in order to deliver education to make graduates more employable. The educational delivery system has also undergone considerable changes with the introduction of computers and internet technologies. The first all-Internet law school, Concord University School of Law, boasts nearly two hundred students who can access lectures anytime and chat at fixed times with professors. Online college degrees are becoming common and represent a threat to traditional Colleges and universities.

Medical organizations

Hospitals are creating new strategies today as advances in the diagnosis and treatment of chronic diseases are undercutting that earlier mission. Hospitals are beginning to bring services to the patient as much as bringing the patient to the hospital. Pathological laboratories have started collecting door-to-door samples. Chronic care will require day-treatment facilities, electronic monitoring at home, user-friendly ambulatory services, decentralized service networks, and laboratory testing.

A successful hospital strategy for the future will require renewed and deepened collaboration with physicians, who are central to hospitals' well being, and a reallocation of resources from acute to chronic care in home and community settings.

Backward integration strategies that some hospitals are pursuing include acquiring ambulance services, waste disposal services, and diagnostic services. Millions of persons research medical ailments online, which is causing a dramatic shift in the balance of power between doctor, patient, and hospitals.

The whole strategic landscape of healthcare is changing because of the Internet. Intel recently began offering a new secure medical service whereby doctors and patients can conduct sensitive business on the Internet, such as sharing results of medical tests and prescribing medicine. The ten most successful hospital strategies today are providing free-standing outpatient surgery centers, outpatient surgery and diagnostic centers, physical rehabilitation centers, home health services, cardiac rehabilitation centers, preferred provider services, industrial medicine services, women’s medicine services, skilled nursing units, and psychiatric services.

Governmental agencies and departments

Central, state, municipal agencies, Public Sector Units, departments are responsible for formulating, implementing, and evaluating strategies that use taxpayers' money in the most cost-effective way to provide services and programs. Strategic-management concepts increasingly are being used to enable some organizations to be more effective and efficient.

But strategists in governmental organizations operate with less strategic autonomy than their counterparts in private firms. Public enterprises generally cannot diversify into unrelated businesses or merge with other firms. Governmental strategists usually enjoy little freedom in altering the organizations' missions or redirecting objectives. Legislators and politicians often have direct or indirect control over major decisions and resources. Strategic issues get discussed and debated in the media and legislatures. Issues become politicized, resulting in fewer strategic choice alternatives.

But in government agencies and departments are finding that their employees get excited about the opportunity to participate in the strategic-management process and thereby have an effect on the organization's mission, objectives, strategies, and policies. In addition, government agencies are using a strategic management approach to develop and substantiate formal requests for additional funding.

SELF-EXAMINATION QUESTIONS

Multiple – Choice Questions

1. BPR stands for:
   - (a) Business practices reinstatement.
   - (b) Business process removal.
   - (c) Better process reaffirmation.
   - (d) Business process reengineering.
2. With reference to benchmarking select the correct statement out of the following:
   - (a) The focus of benchmarking is to study existing processes and eliminate the ones that are redundant.
   - (b) Traditional controlling is same as benchmarking.
   - (c) Benchmarking helps in setting goals and measuring productivity based on best industry practices.
   - (d) Benchmarking solves all business problems.
3. The following statistical technique forms base of six sigma:
   - (a) Mean and Median.
   - (b) Correlation.
   - (c) Index Numbers
   - (d) Probability and normal distribution.
4. The focus of six sigma is on:
   - (a) Customer.
   - (b) Supplier.

(c) Shareholders.

(d) Government.

5. Which of the following statements is true:

   (a) Internet has no strategic relation with an organisation engaged in manufacturing.

   (b) Internet has no strategic relation with an organisation in service sector.

   (c) Internet has opened up new opportunities for organisations engaged in manufacturing activities.

   (d) Use of Internet is restricted to sending and receiving mails in business organisations.

6. BPR is an unusual improvement in operating effectiveness through the redesigning of ________ business process and supporting business systems.

   (a) usual

   (b) common

   (c) critical

   (d) none of these

7. BPR is a multi-dimensional approach in improving the business performance, but its thrust area is:

   (a) improvement on quality of product/service

   (b) reducing the costs

   (c) reducing the cycle time

   (d) All the above

8. Reengineering means:

   (a) partial modifications

   (b) marginal improvement

   (c) restructuring with slight changes

   (d) redesigning with a revolutionary approach

9. Six sigma can implement in:

   (a) improving the existing product, process or service.

   (b) designing the new products, processor service.

(c) Both (a) and (b)

(d) none of these

Objective type question

State with reasons which of the following statements are correct/incorrect:

(a) Reengineering has no relation with strategic management

(b) E–Commerce has intensified competition.

Short answer questions

1. Define process.
2. What is product development?
3. Explain dogs in BCG matrix?

Essay type questions

1. What is TQM? Compare it with traditional management practices.
2. Explain business process reengineering. How can it be implemented?

Case Study

High Growth Enterprises, a business owned by Ram Swaroop and his brothers posted a two fold rise in net profit at Rs. 60 crore in the third quarter of the current financial year as against Rs. 20 crore during the corresponding period last year. Sales during the period climbed 90 per cent at Rs. 663 crore. The company in the first nine months of the current year posted a net profit of Rs. 145.7 crore.

Ram Swaroop attributed the good performance and ongoing improvement in quality in manufacturing processes. His younger brother Vinod Swaroop displayed his happiness on the performance and said that we can further improve the performance by using six sigma methodology.

Ram Swaroop felt that the existing focus on quality is good enough as it was giving good results.

(a) Do you agree with Ram Swaroop to keep focus on quality? Why.

(b) What is six sigma? How can it be useful to the company?

Answers - Multiple Choice Questions

1. (d), **2.** (c), **3.** (d), **4.** (a), **5.** (c), **6.** (c), **7.** (c), **8.** (d), **9.** (c)

APPENDIX – CASES

In the study material of strategic management the theory that you study helps you in acquiring sound educational base. At the end of each chapter a small case has also been included. In this subject the learning can be reinforced, made more meaningful and given practical dimensions with the help of practical cases. In management schools it is normal practice to teach this subject largely with the help of cases. Therein students interact amongst themselves and with subject experts to discuss cases and find solutions to the case problems and other questions. However, your course on account of being distance education course makes it difficult to follow such a methodology. You have to evolve an ideal strategy for yourselves to assimilate this subject as intended. You can have following approach.

The first and foremost important thing in a case analyses is not to look for ideal solutions. There cannot be any one best answer to questions that are in the nature of a case study. Case must be analysed and answers written on the basis of the subject matter covered, the interpretation of the facts, and the conclusions that can be drawn logically. Any answer with sound reasoning can be appropriate.

Thus, you should also try to answer them on your own. Analysing cases and writing their solutions require certain abilities that would be generated only when you actually do them. In examinations it is improbable to get the cases that are available in this study material or in other books. Thus you need to develop abilities to analyse cases and write answers to the questions posed, rather than knowing suggested solutions.

You can also form a group of likeminded friends and discuss cases extensively. We suggest that you form a small group to discuss cases and other issues in this subject. In a group you will be able to identify different issues. But at the end do write the answers with pen on paper.

What is case study?

Case study method was first developed in the 1871 by Christopher Langdell at the Harvard Law School to keep students to learn for themselves by independent thinking and by discovering in the ever tangled skein if human affairs, principles and ideas which have lasting validity and general applicability. A collateral object is to keep them to develop skills in using their knowledge.

The method is based upon the belief that managerial competence can best be attained through the study, contemplation and discussion of concrete cases. The case method is indeed learning by doing. Cases offer a viable substitute by bringing a variety of business organisational problems and permitting students to assume the managers role. Cases, therefore, provide the readers with a kind of experimental exercise through which they enhance their ability to apply textbook knowledge.

'Case' is a written description that presents issues and problems calling for solutions or actions on the part of students. When the case is given, students are asked to analyse, identify the problems and to recommend tentative solutions for the same. This method offers to them matter for reflection and brings home to them a sense of complexity of life as opposed to theoretical simplifications and practices in decision-making process. It diagnoses and deals with real life situations. A case study is primarily useful as a technique of developing decision-making skills as well as communication skills and for broadening the perspective of students.

In case study method students are expected to:

1. Master the facts of the case.
2. Define the objectives sought in dealing with the issues in the case.
3. Identify the problems in the case and uncover their probable causes.
4. Develop alternative courses of action.
5. Screen the alternatives using the objectives as the criteria.
6. Select the alternative that is most suitable in keeping with stated objectives.
7. Define the controls needed to make the action effective.
8. To 'role play' the action to test its effectiveness.

OBJECTIVE OF THE CASE METHOD

Case studies provide an excellent opportunity of developing confidence in problem solving amongst the students. It serves following objectives :

1. It helps the students/trainees to acquire the skills of putting textbook knowledge about strategic management in practice.
2. Getting them out of the habit of being receiver of facts and get into the habit of diagnosing problems, analysing and evaluating alternatives and formulating workable solutions.
3. It trains them to work out answers and solutions, as opposed to rely upon others.
4. Provides them with exposure to a range of practical situations thus offering them a basis for comparison when they begin their own career.

If they understand that these are the objectives of the case method of study, then they are not likely to be bothered by something that puzzles some of them - '**What is the answer to this case?**'. Thus the *purpose of cases is not to learn specific answers but to become skilled in the process of designing a workable and hopefully effective plan of action after evaluating various alternatives and approaches.*

Briefly stated the purpose of case method is to inculcate in students ways of thinking strategically and exercising responsible judgement.

PREPARING A WRITTEN CASE ANALYSIS

There is no iron-clad procedure for preparing a written case analysis. With a bit of exposure students can arrive at their own preferred method of writing up a case and learn to adjust their approach to the unique aspects that each case presents. However it is typical for a comprehensive written case analysis to emphasise three points :

Identification: It is essential that answers reflect a sharply focused diagnoses of strategic issues and key problems and further demonstrate good business judgement in sizing up the present situation.

Analysis and evaluation : This is the most significant and difficult part. Analysis is hard work. In doing this students should bear in mind the following points:

1. They must offer supporting evidence for their views and judgements. They should not rely upon unsupported opinions and over generalisations.
2. They should point out key factors which are crucial.
3. Some information in the case is well established fact, some may be in the form of opinions, judgements and beliefs. Some may be inaccurate. You are expected to assess the correctness/validity of such information.
4. Students should clearly demonstrate that their interpretation of the evidence is reasonable, logical and objective.

Recommendations : The last part in written cases should consist of recommendations or plan of action. The recommendations should be logical and consistent with the analysis and make sure that the company is financially sound to carry out what has been recommended. Furthermore recommendations should be in detail to be meaningful. Finally, students should indicate how their plan should be implemented. Here they may give some attention to leadership styles, psychological approaches, motivation and incentive which may bring desired result.

Students should give special attention to the points given below to avoid common errors in the Case Analysis :

1. *Inadequate definition of the problem* : Students must begin with a focus on key issues

and problems. Do not make the error of analysing symptoms without determining and defining the root problems.

2. *Search for the answer* : Remember there is no one 'correct' answer to a case. There are always several reasonable alternative solutions.
3. *Avoid generalities* : In answering specific recommendations, use of generalities should be avoided. Try to be specific.
4. *Narrow vision*: Cases are often classified as a specific type such as 'Manpower Planning', 'Recruitment', 'Job Evaluation', 'Leadership Style' etc. But it should not mean that other human variables should be ignored.
5. *Unrealistic solution*: Solutions should not be unrealistic. Such as a wage increase is suggested which is beyond the capacity of the company.
6. *Rehashing the case material*: Students waste time and effort in rewriting unnecessary long history of the company as given in the case. This should be avoided as it is superfluous.
7. *Hasty conclusions* : Students jump to the conclusion after the first reading of the case. This is not correct.

SOLVED CASES

Case 1

Read the following case and answer the questions given at the end:

Indian Railways (IR), the monopoly provider of Cargo and passenger services by Rail in India, is a departmental undertaking under the Ministry of Railways, Government of India. IR, "which was declared to be heading towards bankruptcy as per the Expert Group on Indian Railways in 2001, is today the Second largest profit making Public Sector Undertaking after ONGC. The fund balance (i.e., net revenue) crossed Rs. 12,000 crores in 2005-06, which had reached a low of just Rs. 149 in 1990-2000." The net revenue is to increase to Rs. 15,000 crores in 2006-07 and is estimated at Rs. 16,022 crores for 2007-08.

Mr. Lalu Yadav (a turnaround specialist), Minister for Railways, presented the budget of IR for the year 2007-08 on 26th February, 2007 in the Parliament (fourth in a row). It was the time when-Bofors issue came back to limelight, the UPA was to lost elections in Punjab and Uttarakhand (and did lost the next day), inflation was causing sleepless nights to the Government, and crucial State elections were to take place in Uttar Pradesh, Gujarat, Goa and Delhi in the near future.

The Minister reduced passenger fares across the board-for the sleeper class fares by 4%, a token reduction of Rs. 2 in the ordinary class, and Re. one per season ticket for daily commuters; for AC First Class by 6% in lean season, and 3% in peak season; for AC II Tier by

4% in lean season and 2% in peak season; and for AC III Tier by 8% in lean season and 4% in peak season. However, the share of higher class remains stagnant at 18% in the total passenger revenue. IR will introduce 800 newly designed high capacity coaches (which will have 84 seats instead of 72 now) for Sleeper Class and various AC Classes to maximise revenue. The lowering of fares will no doubt help IR in fighting competition from low cost airlines. But the low cost airlines opine that it would not blunt their competitive edge. For Internet Savvy-e-ticket charges have been brought down considerably. The wooden seats in unreserved Second Class coaches would be converted into cushioned seats. Every new train would get six unreserved Second Class coaches instead of four at present. Senior Citizens and Women above 45 years will have enhanced quota of lower berths in AC and Sleeper Classes. Students going for UPSC and Central SSC by rail would be entitled to 50% concession. Of the total receipts (Rs. 56,752 crores) during 2005-06, the passenger segment contributed 29% (Rs. 15,126 crores). In the passenger traffic – on the short haul the bus service and on the long haul the low cost airlines are other important players. The Minister said that there was no inherent conflict between Social obligations and Commercial objectives of IR. 'Most of the trains introduced lead to Uttar Pradesh and Bihar'.

The Minister, instead of increasing freight rates, announced cut in tariffs for Diesel, Petrol, Ammonia, Iron ore, Limestone and Cement; and kept them unchanged for others. During the last three years freight income has risen because of reclassification of goods for levy of freight. He also announced empty-flow rebate for open wagons, thus providing concessions for Wheat, Fertilisers and Cement in specific sectors. An analysis of commodity-wise freight traffic shows an increase in the share of revenues from non-bulk traffic in recent years. However, the IR loses business to Roads Transportation because the Truckers offer door-to-door service, provide time guarantee to move and deliver the Cargo and for many consumer durables and perishables, road transport is the best bet. IR would build triple-stack container trains for diesel powered routes and double-stack container trains on electric routes to enhance capacity. 2007-08 budget targets growth in freight traffic at 17%, similar to '06-07.

The Minster also announced that Public Private Partnership (PPP) options would be explored to modernise Metro and Minimetro Stations with world class passenger amenities, and to construct Multimodal Logistic Parks, Warehouses and Budget Hotels.

The estimates announced for 2007-08 state-the revenue growth at 12.8% (as against 16% for 2006-07); the net revenue to increase by 7.7% (45% in 2006-07), the operating ratio to be around 80% (98.3% in 2000-01 and 78.7% in 2006-07); and freight loading to increase by 8.1 % (8.9% in 2006-07).

Questions:

(i) Of which components of the external business environment the budget has taken care of?

(ii) With whom IR is facing competition in the passenger segment?

(iii) With whom IR is facing competition in the Cargo segment?

(iv) What is the basic strategy of IR to increase revenue from Cargo and passenger segments in 2007-08 and onwards?

(v) During the last 3 years IR has been achieving increasing growth rate, but estimates are lower for the year 2007-08. What is the reason?

(vi) To fulfill social responsibility towards poor sections of society –what steps have been proposed in the Budget?

ANSWER 6

(i) The rail budget has considered all major components of its external business environment:

(a) **Economic environment**: The economic environment includes the factors and forces in the industry to which the enterprise belongs. The rail budget makes an attempt to reduce inflation by reducing both passenger fares and freight rates. Having different fares for peak and lean season and reducing fares for higher classes will make railways competitive against low cost airlines. To meet increasing funds requirement option of public private partnership is proposed to be explored. To lower the cost, emphasis on 'outsourcing' is also proposed.

(b) **Technological Environment**: Technology environmental factors include dynamics of product and process technology, research and development activities in the industry and elsewhere, innovations in products and processes, technological obsolescence and so on. To affect costs, profitability, growth and development, the budget has proposed new coaches with higher capacity (84 seats as compared to existing 72); containers having triple-stack and double-stack; and world class facilities-oriented metro and mini metro stations.

(c) **Political-legal environment**: It includes such factors as the general state of political development, the degree of politicalisation of business and economic issues, the law and order situation, stability, fiscal, monetary policy and so on. Measures to overcome inflation in the rail budget also have political dimensions. Proposals conducive to senior citizens and women above 45 years of age; reduction of ordinary class and daily commuters; and conversion of wooden seats to cushioned seats in unreserved coaches may also be reflecting more on the political ideologies of government than on the commercial reasons.

(d) **Socio-cultural environment**: It is a complex of factors such as general population dynamics, urbanisation, social traditions, values and beliefs, literacy and education, ethical standards, and so forth. The budget contains several measures to different sections of the society. There are measures for lower strata as well as higher strata of the society. Measures such as cushioned seats should address the emerging need of comfort with the passengers.

(ii) In the passenger segment the railways is facing competition from two other modes of transport as follows:

(a) For short distances bus services are competing with the railways.

(b) For long distances low cost airlines are giving tough competition to them.

(iii) In the cargo segment, IR has to face competition from the truckers, who are able to offer door-to-door services, time guarantee to move and deliver the cargo, and a better mode transportation of consumer durables and perishables.

(iv) The basic strategy being followed in both the segments is to increase the volume to maximize the revenue. Competitive pricing, increasing capacity and its better utilization will ultimately have positive bearing on the volumes that the Indian Railway is able to generate.

(v) Indian Railway is expecting that overall growth will be maintained, however, at a lower rate. It may be on account of cautious approach of the budgeters. It is also possible that the railway has used major portion of the slack in the system and generated additional revenue out of the existing capacity.

(vi) To serve the poor sections of the society the budget contains several measures such as:

- Number of ordinary class unreserved coaches are to increase in the new trains.
- Reduction of Rs 2 per ticket for ordinary class and reduction of Re 1 for season tickets.
- Conversion of wooden seats into cushioned seats.
- Introduction of many trains from metro cities to places in UP and Bihar to benefit labourers.

Case 2

DD is the India's premier public service broadcaster with more than 1,000 transmitters covering 90% of the country's population across an estimated 70 million homes. It has more than 20,000 employees managing its metro and regional channels. Recent years have seen growing competition from many private channels numbering more than 65, and the cable and satellite operators (C & S). The C & S network reaches nearly 30 million homes and is growing at a very fast rate.

DD's business model is based on selling half-hour slots of commercial time to the programme producers and charging them a minimum guarantee. For instance, the present tariff for the first 20 episodes of a programme is Rs. 30 lakhs plus the cost of production of the programme. In exchange the producers get 780 seconds of commercial time that he can sell to advertisers and can generate revenue. Break-even point for producers, at the present rates, thus is Rs. 75,000 for a 10 second advertising spot. Beyond 20 episodes, the minimum guarantee is Rs. 65 lakhs for which the producer has to charge Rs. 1,15,000 for a 10 second spot in order to break-even. It is at this point the advertisers face a problem – the competitive rates for a 10 second spot is Rs. 50,000. Producers are possessive about buying commercial time on DD. As a result the DD's projected growth of revenue is only 6-10% as against 50-60% for the private sector channels. Software suppliers, advertisers and audiences are deserting DD owing to its unrealistic pricing policy.

DD has three options before it. First, it should privatise, second, it should remain purely public service broadcaster and third, a middle path.

The challenge seems to be to exploit DD's immense potential and emerge as a formidable player in the mass media.

(i) What is the best option, in your view, for DD?

(ii) Analyse the SWOT factors the DD has.

(iii) Why to you think that the proposed alternative is the best?

Suggested Solution

(i) For several years Doordarshan was the only broadcaster of television programmes in India. After the opening of the sector to the private entrepreneur (cable and satellite channels), the market has witnessed major changes. The number of channels have increased and also the quality of programmes, backed by technology, has improved. In terms of quality of programmers, opportunity to advertise, outreach activities, the broadcasting has become a popular business. Broadcasters too have realised the great business potential in the market. But for this, policies need to be rationalised and be opened to the scope of innovativeness not only in term of quality of programmes. This would not come by simply going to more areas or by allowing bureaucratic set up to continue in the organisation.

Strategically the DD needs to undergo a policy overhaul. DD, out of three options, namely privatisation, public service broadcaster or a middle path, can choose the third one, i.e. a combination of both. The whole privatisation is not possible under the diversified political scenario. Nor it would be desirable to hand over the broadcasting emotively in the private hand as it proves to be a great means of communication of many socially oriented public programmers. The government could also think in term of creating a corporation (as it did by creating Prasar Bharti) and provide reasonable autonomy to DD. So far as its advertisement tariff is concerned that can be made fairly competitive. However, at the same time cost of advertising is to be compared with the reach enjoyed by the doordarshan. The number of viewers may be far more to justify higher tariffs.

(ii) The SWOT analyses involves study of strengths, weaknesses, opportunities and threats of an organisation. SWOT factors that are evidently available to the Doordarshan are as follows:

S – Strength

- More than 1000 transmitters.
- Covering 90% of population across 70 million homes against only 30 million home by C & S.
- More than 20,000 employees.

W – Weakness

- Rigid pricing strategy.
- Low credibility with certain sections of society.
- Quality of program's is not as good as compared to C & S network

O – Opportunities

- Infrastructure can be leased out to cable and satellite channel.
- Digital terrestrial transmission.
- Regional focused channels.
- Allotment of time, slots to other broadcasters.

T – Threats

- Desertion of advertisers and producers may result in loss of revenues.
- Due to quality of program the reach of C & S network is continuously expanding.
- As the C & S network need the trained staff, some employees of DD may switchover

and take new jobs.

- Best of the market-technology is being used by the private channels.

(iii) It is suggested that the DD should adopt a middle path. It should have a mix of both the options. It should economise on its operational aspects and ensure more productivity in term of revenue generation and optimisation of use of its infrastructure.

Wherever, the capacities are underutilised, these may be leased out to the private operations. At the same time quality and viewership of programmes should be improved.

Bureaucracy may reduce new strategic initiatives or make the organisation less transparent. Complete privatisation can fetch a good sum and may solve many of the managerial and operational problems. However, complete public monopoly is not advisable because that denies the government to fully exploit the avenue for social and public use. The government will also lose out as it will not be able to take advantage of rising potential of the market.

CASES FOR PRACTISE

1. Home Ease Ltd is a major manufacturer of home appliances in the country. The company manufactures water purifier, electric ovens, irons, juicers and choppers. Last two years have not been good for the company. It has lost its market share to its competitors and imports. The Chief Executive Officer, Kawaljit, is worried as the company has underperformed in its key financial indicators. Cheap Chinese products have also threatened the survival of the company. Opening of economy has also brought in manufacturers from around the world who also possess new technology and designs. The customers are attracted to these designs.

   To discuss the matters Kawaljit called Gopinath, and Premnath to his office. Gopinath is a bright Chartered Accountant and is acting as head of Finance Department in the company. Premnath an engineer and MBA with twelve years of experience in marketing of electronic goods. He has joined company around six months back and is acting as head of marketing division and managing things at national level

   Premnath felt that the company is facing problems as it has been too complacent. It has not responded to the changing environmental conditions and has not undertaken any formal strategic planning. He also felt that in the past the company has pursued objectives that have been conflicting to each other. In order to bring competitive advantage, Premnath suggested involving people from all levels in the organisation for developing business strategy. He also said that the sales people who are in touch with the customers and retailer should also be involved and greater emphasis should be placed on understanding the external environment. Then the company can assess and formulate ways to have competitive advantage using unique combination of resources, skills and capabilities within the environment.

However, Gopinath outlined the benefits of more formal top down approach to planning. Premnath argued that in the dynamic environment in which the company is operating involving too many people would be waste of time. The company has to incur huge cost and such an approach will only result in more confusion and chaos.

Read the above case and answer the following questions:

(a) Do you think that involving too many people in the planning exercise would be a waste of time? Discuss.

(b) If Kawaljit hires you as an consultant which approach will you advocate? Why?

2. Soft Breads Ltd, a bread manufacturer from south, entered into the business of bread manufacturing in the northern India in the year 1995 by acquiring brand name 'Delicious' from a local baker 'Kuldeep Sodhi' in Chandigarh known for his quality breads. The baker kept on preparing and selling breads, however, now with a different name – 'healthy' in changed package.

Soft Breads Ltd invested heavily in the machinery and equipment. In fact, it invested a sum of rupees thirty-five crores over a period of five years. It got immediate acceptance from the market as Delicious, a household name, was well known for its quality. Gradually, it captured major markets in adjoining cities of Haryana and Punjab. In the year 2005 its total turnover was 10 crores per annum with 50% market share in Chandigarh.

Meantime, 'Healthy' also got some recognition and was able to grow. Some of the loyal customers of 'Delicious' shifted to 'Healthy' realising that the baker has changed the name of the product. Its market share, in 2005 stood at 15% in the Chandigarh city. Inspired by the success of 'Delicious' the baker joined with his two rich friends to form a partnership by the name of 'Healthy Foods' in the year 2006. They acquired automatic modern plant to manufacture breads. The plant was better than that of Soft Breads Ltd. They were able to reduce their costs and started selling breads at one rupee cheaper than the competitors. They also introduced new products such as whole wheat bread, breads enriched with vitamins, bread for kids in chocolate flavour. In short span of their market share grew to 35% in Chandigarh. In the year 2007 their turnover was 12 crores against 18 crores of Soft Breads Ltd. Now they plan to enter into business of cakes and biscuits on a large scale.

Read the above case and answer the following questions:

(a) Discuss the strategy of Soft Breads Ltd.

(b) Discuss the strategy of Healthy Foods.

(c) Perform a SWOT analysis for Soft Breads Ltd.

(d) Do you think that Soft Breads Ltd has missed something while acquiring the brand name?

(e) What are the alternatives before the Soft Breads Ltd?

3. AO Swift (Pvt) Ltd. was promoted nineteen years back as company manufacturing automobile parts with an investment of Rupees 5 crores by Abhishek Oberai. He took over as its chief executive and is occupying the same position till date. Abhishek an automobile engineer himself possessed rich experience of working abroad and in Hindustan Motors Ltd in India. He is dynamic and ready to take risk. He always emphasized on maintaining high quality standards.

Initially the products were supplied to automobile service centers all across the country. The market was small and the company suffered some losses. Eight years after its inception the company entered into an agreement with Maruti Udyog Ltd to manufacture and supply specific components for their small car. These were earlier being imported by Maruti Udyog Ltd from Japan.

This agreement was a turning point for the company. Later the company was able to enter agreements with other companies entering India. The company is able to manage a growth rate of over 20% in last five years. Its turnover in the last financial year exceeded 800 crores. The overall market is also witnessing a very high growth rate.

Abhishek also possessed strong behavioural skills and allowed some autonomy and discretion to the senior managers of the company. A year back in an internal meeting Abhishek felt that the company can grow still faster if it enters other markets outside India. Various options were analysed and efforts were made to discuss and negotiate with major manufacturers of the world. Getting some response from two manufacturers in European Union the company opened an office in London.

Abhishek closely monitored the day-to-day working of this office. Having strategic implications all major decisions were taken by himself. He will also visit London every month to have first hand information about its working. However, as the company is growing it is becoming increasing difficult for him to manage this office. He also wants to expand further. He called a meeting with head of various department. In the meeting following alternatives were considered for foreign market:

- Continue to manufacture products in India and export them to other countries.
- Initiate manufacturing activities in other countries.

- Take over existing manufacturers of the products.

Answer the following questions:

(a) Write a note on reasons for AO Swift Ltd to open office in London?

(b) What should be the strategy of the company in a high growth market? Why?

(c) Make an analysis of various alternatives that are being considered for expanding in foreign markets?

4. Sweet Drinks Ltd is a drinks company whose core business is manufacturing and selling soft drinks to 80,000 outlets throughout India. The business of the company is good with annual turnover exceeding three billon of rupees. Profits are good and shareholders are often rewarded with lucrative dividends and bonuses.

Four years back the company has diversified into the alcoholic drinks industry and has taken-over two small breweries located in western India. The company has also diversified into hotels with purchase of twenty-five hotels of three/four star category across the country. To its advantage the company has been able to obtain a monopoly for the sale of its soft drinks in its hotels and is beginning to establish itself as a brand name in the brewery industry.

Part of the strategy of the company is to continue to purchase hotels, particular by targeting National Capital Region of Delhi where tourism is likely to pick up with the forthcoming Commonwealth Games . The company also intends to construct a five star hotel in Gurgoan to take tax advantage.

Everything was going on well until recently, when a Public Interest Litigation from NGO accused the company of indulging in surrogate advertising of its brewery products. In fact the company has similar brand names for its soft drinks and brewery products. This triggered a lot of protests and demonstrations against the company. Newspapers were flooded with the articles against the company. There were also some demonstrations and some small incidents of stone pelting in a few of its hotels.

(a) Discuss the factors related to SWOT analyses for the company?

(b) Explain how Sweet Drinks Ltd is achieving synergy?

(c) Explain the nature of diversification adopted by the company.