

Operational planning involves the conversion of strategic planning into detailed and specific action plans. It relates to lower and middle level of management.

As planning is an important part of the management process so, we should know it's methodology.

The methodology of planning consists of various steps. They are shown with help of a flow chart in Figure below.

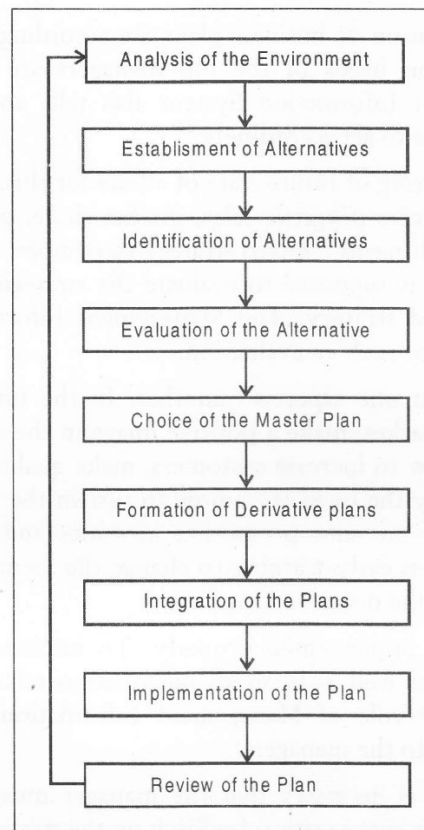


Figure 8.3: Process of Planning Methodology

Management Information System in Planning

To make planning effective and efficient the manager needs lots of external and internal environment information. The external environment information includes economic and technological changes, political scenario of the country, information of the competitors as well as cost and availability of resources. The internal environment information contains information regarding sales forecast, human and financial resources, etc. The manager also has certain knowledge of various analytical tools to analyze the information collected from both environments, i.e., external and internal.

Moreover, business environment is dynamic in nature and because of this very nature, business planning is very complex. There are number factors such as market forces, technological changes and cut throat competition have a significant impact on any business prospects. The Management Information System design should be such which can monitor these factors as well as provide insight into these factors, enabling the management to make strategy to deal with these factors. All these

factors are related to the business environment. So the Management Information System should provide information of these factors to management so that the manager can form a strategy accordingly. Business planning is based on the SWOT analysis, vision, value system and objective of the organization. As we all know, it is the responsibility of the top manager and the top manager relies on Management Information System for providing the information like, what is the vision to establish the organization and so on.

Most of the time strategy formulation or business plans are according to the current position of the business. The current information needs of the top managers are satisfied by the Management Information System. Management Information System also tells about the current status of the organization and helps the manager to act accordingly.

The planning also includes forecasting of future state of affairs for this. Again, it requires internal and external information such as business progress, sales, market share, profit and so on. In business, a single strategy can not work out. It needs a mixed strategy to compete in a dynamic environment and Management Information System is supposed to evaluate the strategies in terms of their impact on business and also suggest a mixed strategy. The Management Information System is supposed to provide a strategy-pay off matrix for such an evaluation.

In business, the focus shifts from one aspect to another. In the initial years the focus is on the introduction of products in the market, make a positive image in the eyes of customer and so on. At the time of growth focus is on how to increase customers, make quality products, capture the market and so on. At the time of maturity the focus is on how to sustain the present customer and finally at the time of decline the focus is on sales promotion activities and so on. So it is Management Information System which provides early warning to change the focus of the management and make such plans which are profitable to the organization.

Planning is a failure if it is not implemented properly. To implement the plans successfully the manager needs various resources as well as he needs information related to availability of resources, their cost and quality. Now the role of Management Information System emerged, to provide information related to each aspect to the managers.

After implementing the plans, it is necessary that the manager must get a feedback. Management Information System is supported to give a critical feedback on the strategy performance.

Management Information System also provides the knowledge base which consists of past records, standards to make the norms, implementation and taking feedback about the effectiveness of the plans.

Management Information System satisfies the information needs required for planning as well as, it provides decision support to the manager that, which course of action is suitable for the particular organization. Use of simulation, artificial intelligence techniques and neural networks etc. and with the help of computer, Management Information System have improved the predictive value of plans as well as value added on to the planning information.

Finally, Management Information System helps in planning activity by providing information support to the following.

1. Decide the goals and objectives of the organization.
2. Identify the correct focus for the attention and action of the management.
3. What is the strategy mix?
4. Knowledge base.

5. Present status of resources, their cost and quality, resource mix.
6. Evaluate the performance and give a correct feedback.

8.6 BUSINESS PROCESSES V/S INFORMATION SYSTEMS

The building blocks of information systems evolve from needs of business processes from the broad perspective of business model. A business model comprises sum total of business activities. Top management express the basic strategies and goals of the organization which act as guidelines in establishing lower level plans. These plans are worked from top down and bottom up and correlated at various stages in the planning cycle. The planning cycle comprises series of interactive feedback loops before finalization of the plan for information systems development. The database is the source of information and building block of the architecture of information systems. The general principles of business process analysis and classification and the methodology of looking at a viable and effective information and communication system to support a series of interacting subsystems are applicable across variety of industrial sectors. For instance, consider a business model from a manufacturing sector. We begin by categorizing the business processes in the manufacturing business model into three mutually related groups viz. primary, supportive and administrative.

IT with its computer-based system for information processing has influenced the process of management in all the activities of the organizations like strategic planning, production planning, inventory control, finance and accounts, marketing and personnel management.

The computer systems enable the management process of planning by identifying the problems and opportunities through analyzing the trends from the data stored; supporting analysis, evaluation of options and selection of alternatives. It also supports decision implementation by watching the progress and identifying possible problems. The techniques such as Programmed Evaluation and Review (PERT), Critical Path Method (CPM) simulations and linear programming enable the process of decision-making.

The IT is mainly used for keeping track of inventory of raw material, semi-finished and finished goods. It is also used for distribution and marketing logistics, keeping information on branch plants, etc. The information is made use for planning the purchases, organizing the production schedule, and keeping track of the production process. The introduction of IT has enabled the industry to adopt management techniques like 'Just in Time Management' that can reduce cost of holding the inventory of raw material and finished goods.

IT helps management in maintaining the personnel inventory for the skill levels available, training inputs imparted to the staff planning staff career planning including retirement planning, maintaining the staff records of salary and other payments, etc.

IT has an impact on organizational structure since the processing capabilities enable the data dependent activities to be either automated or delegated. At the same time, centralization of data and communication capabilities of IT can help in centralizing the organizational structure for improved decision-making. In practice, both centralization and decentralizations of activities are done with the help of IT depending on the type of organization, nature of applications and the cost considerations involved. For example, resource and finance management can be centralized whereas production management or process management may be decentralized.

The control activities of the management are supported by IT with its ability to analyze past and present data, comparing the trends and results with pre-set standards and generating exception reports.

Marketing research agencies involved do a lot of research activities beginning from research survey on product development till distribution and judgment of customer response. Gone are the days of manual analysis of data. The MR agencies use sophisticated statistical software packages for data analysis and interpretation. Some of the statistical software packages are created by their own for customized problems. In the same fashion, advertisement agencies use lot of software for creating advertisements. Lot of animations and graphics can be done using IT tools. Therefore, in the business world too things can be done differently with the help of IT.

Group I – Primary Business Processes

Primarily, the key activities in the manufacturing business are:

1. Inventory Control and Reporting
 - (a) Stock status reporting
 - (b) Statistical replenishment
 - (c) Requirement generation.
2. Purchasing and Receiving
 - (a) Vendor management
 - (b) Quality control.
3. Production Scheduling
 - (a) Fabrication and assembly scheduling
 - (b) Shop loading
 - (c) Job orders.
4. Production Control
 - (a) Performace v/s plan analysis (monitoring)
 - (b) Variance reporting
 - (c) Quality control
 - (d) Maintenance.
5. Logistics
 - (a) Distribution network
 - (b) Areawise short/surplus analysis
 - (c) Warehouse stock status reporting.
6. Sales Order Processing
 - (a) Customer billing
 - (b) Order processing
 - (c) Transportation.

Group II – Supportive Business Processes

Supportive business processes in manufacturing business are:

1. Engineering, Research and Development
 - (a) Design automation
 - (b) Project design and control
 - (c) Numerical analysis and configuration management
 - (d) Industrial engineering
 - (e) Bill of material generation.
2. Strategic Planning
 - (a) Econometric models
 - (b) Simulation
 - (c) Market segmentation
 - (d) Investment analysis
 - (e) Facility planning
 - (f) Decision framework.
3. Marketing
 - (a) Brand positioning
 - (b) Advertising and brand consolidation
 - (c) Sales analysis
 - (d) Market survey analysis
 - (e) Sales forecasting
 - (f) Sales management.

Group III – Administrative Business Processes

Administrative business processes are:

1. Financial
 - (a) Accounts receivable
 - (b) Accounts payable
 - (c) General ledger
 - (d) Cost accounting
 - (e) Fixed asset accounting
 - (f) Budgeting
 - (g) Financial models

- (h) Ratio analysis
 - (i) Working capital management
 - (j) Profit and loss account.
2. Personnel
- (a) Payroll generation
 - (b) Leave record maintenance
 - (c) Wages and compensation analysis
 - (d) Performance appraisal
 - (f) Recruitment process
 - (g) Training.
3. Legal
- (a) Documentation of rules, regulations and policies
 - (b) Implementation of legal statutory requirements.

It is pertinent to identify the proper interrelationship amongst the business processes which is imperative to trace common data flows and exchange of data amongst the various processes; and to build effective information systems that avoid redundancy of data within subsystems taking advantage of common data flows. Therefore, information systems are designed on the basis of real time data flow amongst the business processes and subsystems following system approach.

System Approach in a Business Model

We explore the system approach by traversing the business model through a primary business process. A manufacturer produces items, purchases raw materials, assemblies, maintains inventory levels as the sales are effected and stores are replenished. The reorder levels of raw material purchases are set in accordance to sales turnover and lead time to replenish the raw materials for production of finished goods. This forms basis of accounting process for setting accounts receivable and payables and eventually cash inflows, cash outflows for basis of profit and loss accounts. The source document of information is the record of sales, movement of finished goods from stores and the relevant sales analysis as input for accounting and marketing process to initiate further strategies to expand market and optimise profitability and productivity taking in view of external factors through the external data viz. economic conditions, competitions and political factors. Engineering and research process is also a vital business process which focusses on quality control, maintenance in accordance to sales turnover and lead time to replenish the raw materials, production scheduling, product designing, bill of materials generation (which indicates quantities of raw materials, assemblies and components in production of an item) and requirement analysis. The requirement analysis utilizes information from inventory control subsystem as well as E & R process by multiplying the finished goods inventory by components that constitute these from information source of bill of materials. This is compared with the sales forecast and sales orders to derive net requirements for production. This process assists in production planning and scheduling facilitating a high quality logistics, inventory control, order processing, financial planning. Since human resource, which participate in entire business process, is a very important part of any business model, their recruitment, salary, wages and performance

appraisals are in consequence of their role in all the business processes. The flow of information can be traced through all the business processes with a business model and all types of accounting and statistical data can be derived through interrelationship of data stored within mutually dependent business processes.

Case 1: Computerization in an Indian Private Bank

In competition to foreign banks in India, the Indian private banks are now providing effective banking solutions through centralized approach of computerization. Home, Tele and Internet banking are the new ways of banking in India. HDFC Bank Ltd (Housing Development Finance Corp.) was the first private bank to receive approval from RBI, in August 1994, to set up a bank, as part of RBI's deregulation policy of the Indian banking industry. The bank's 20 per cent equity is held by NatWest Markets, the worldwide Corporate and Investment Banking arm of National Westminster Bank plc., UK. This alliance offered the HDFC bank an access to world class banking technologies, customer relationships, product expertise combined with international expertise.

The initial emphasis of the bank was only on corporate banking and custodial services, but the fluctuations in money markets and the restriction that a bank can only deal on behalf of a customer, pushed HDFC into retail banking. The systems implemented are on a centralized host with clients from the branches getting attached via leased lines using a standard TCP/IP protocol. For the wholesale banking practices, HDFC Bank uses Microbanker from CITIL, essentially used for processing deposits, loans, letters of credit, bills discounting and foreign exchange. These activities operate centrally on a Sun Enterprise 3000 system. To support retail banking business, Fin ware, from CITIL, is used, which caters exclusively to retail banking functions affords a high degree of parameterization and multiple product support.

The Custodial software supported by Price Water House Associates is meant for large institutional investors and mutual funds. It is implemented using Oracle on a Sun Solaris platform. It offers the bank the ability to secure the share certificates given by customers for safe custody and electronically monitor their passage through various operations. The customers are, in turn, informed about their assets under the bank's custody, which benefits them while dealing with a volatile share market. The bank's premises uses AT&T's Systemax PDS Level 5 cabling and security system. For networking, HDFC Bank uses RAD modems for 64 kbps transmissions and Motorola 3266, 4x for analog transmissions and Cisco routers. For smaller applications like ATMs, the RAD short range modems were introduced with Bay Network's hubs with CAD5 cabling.

HDFC Bank has 27 branches in nine cities, with 24 ATMs in eight cities. HDFC Bank uses the NCR and Diebold ATMs (Automated Teller Machines). The bank recently introduced ATMs which converse in regional languages. All the ATMs in the north (Delhi) and the west (Ahmedabad, Mumbai and Pune) and Bangalore have the options of transacting in both English and Hindi. HDFC bank is part of the SWIFT (Society for Worldwide Interbank Funds Transfer) network. SWIFT is a network of banks, through which member banks settle remittances with each other. HDFC Bank is also offering Internet banking, which is the latest way of banking in India.

Questions

1. Describe the computerized facilities provided by your bank. Are you satisfied with those services? Compare the services of a private and a nationalised bank of India.
2. Describe the software used by HDFC for wholesale and retail banking practices.
3. What are ATMs? Discuss their benefits.

Source: Adapted from Computers Today, Nov. 1997

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Case 2: Computerizations of Stock Exchanges in India

Bombay Stock Exchange (BSE), located at Mumbai (India), is one of the oldest stock exchanges in Asia. During 1993-94, the number of deals per day at BSE were much more than the London and the New York exchanges and the BSE's turnover was also nearly twice than the previous financial year. The manual system was slow and inefficient with a lot of problems. As the exchange needed cost-effective immediate solutions, the BSE decided to computerize the system in multiple phases. BSE was the first in India to computerize trading operations. During the first phase of computerization, two Tandem Himalaya servers with K10000 x 6 CPUs (256 MB memory) and a 36 GB Hard Disk were installed at BSE. Trader Workstations (TWS), installed at the members' locations were connected to the server. These systems were capable of handling about 4 lakh trades per day in five and half hours of their operations. The Display Information Driver System provided transaction prices and BSE Sensitive Indices in respect of 750 actively-traded scripts. During the second phase, the procedures for uploading and downloading of data files required for linking computers in respective members' offices were undertaken. During the last phase, all the scripts were transferred to the BOLT (Bombay On-line Trading) system. The BSE system provides a quote-driven automated trading facility along with an order-book facility. The order-book allows retention and matching of orders against one another where no quotes exist for a particular script. The new system improves the price competitive character of the market.

National Stock Exchange

National Stock Exchange, set up by the Government of India, was another exchange to computerise trading operations. It was set up with a mandate to enable automated trading of debt/capital market instruments throughout the country, which, in the long run, would result in the emergence of a single unified market. NSE's other objective was to enable shorter settlement cycles and book-entry settlement systems. For this, the exchange operations were decided to begin with the debt rather than the equity segment. In the latter segment too, the nationwide trading facility represented a paradigm shift as members were now location-independent. The NSE trading software, NEAT (National Exchange for Automated Trading), is a fully-automated screen-based trading system, originally developed by TCAM Systems Inc., New York, for the Vancouver Stock Exchange. It was customised for Indian use by Tata Consultancy Services. NEAT adopts the principle of an order-driven market and allows trading members to operate from their offices through a communication network of 750 VSATS set up by Comnet at an initial cost of Rs 20 crore. Each member on the wholesale debt market segment trades with others at the trading members' office, using a terminal at NSE, connected through dedicated 64 Kbps lines. Members on the capital market segment are connected by satellite links, using NSE's VSAT system. NSE use RISC-based servers for back office processing. The software runs on a STRATUS mainframe while the client software runs under Windows on PCs. The mainframe and PCs are incorporated in a packet switching network, for which Motorola has been contracted to supply the equipment. A BBS delivers daily reports regarding trade, obligations etc. to all members, allowing them a direct interface to the backoffice systems. The exchange organises hands-on training programmes for members on regular basis. A computer-based training multimedia package is also available for members. The exchange also runs a help-desk, installed, with an Interactive Response System, for 12 hours every day. Apart from catering to members' problems, the help-desk provides facilities like voice-mail, audiotext and fax-on-demand.

Questions

1. Why did the BSE decide to computerise the system in multiple phases? Discuss the advantages of phase wise implementation of a system.
2. Describe the features of the NSE trading software, NEAT.

Source: Adapted from Computers Today, Sept. 1996

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Case 3: Healthcare Industry Solutions – Blue Cross Blue Shield (BCBS)

Today, most of the Industries are looking for the appropriate information systems because of the two most important reasons. First, an efficient computer based information system can lead to improve management processes of an organization in a big way. Second, an efficient information system can also essentially provide much desired competitive edge for the business enterprise. Nowadays, most companies in the corporate world as well as the individual professionals are preferring the specialized information systems, both in terms of hardware and software which should appropriately fulfill their information needs. The companies engaged in the software solution providing enterprise are also focused to create customized and specialized packages for the huge market comprising the various differentiated industrial segments. Major hardware companies are also collaborating with the software solution provider companies to provide their customers with appropriately optimized and specialized packaged system. We study how the health care industry is being benefited by implementation of a specialized information system packaged solution. In this case study, the users of the packaged system, Blue Cross Blue Blue Shield of Montana, elaborate how the use of Data Scan a specialized information system has transformed their management and business processes.

Blue Cross Blue Shield of Montana serves 236,000 beneficiaries statewide with traditional coverage, HMO Montana and Montana HealthLink, a preferred provider organization. The Helena-based plan is the Medicare intermediary administering Medicare Part A and B for Montana's nearly 1,35,000 beneficiaries. It also acts as a third party administrator for another 40,000 covered lives through a subsidiary.

Features of Data Scan System

Data Scan is a typical provider profiling and decision support system developed by IBM business partner, the MEDSTAT Group, Blue Cross Blue Shield (BCBS) of Montana. MEDSTAT's DataScan system addresses the needs of managed care and health insurance organizations in using information strategically to improve upon management processes and sustain competitive advantage. Data Scan uses IBM's DB2 database system to create new decision support capabilities which capture and organize vast stores of healthcare, financial, clinical and other data. DataScan system provides pertinent solutions to reconstruct how patients choose and use healthcare as well as how providers deliver and price their services. The salient features of the Data Scan system include (i) Provider profiling, (ii) Group reporting, (iii) HEDIS reporting, (iv) Management reporting, (v) Actuarial and underwriting, (vi) Marketing and sales and (vi) Network development.

In today's managed care environment, the role of information is extremely important. IBM's System/390® enterprise server and Data Scan® provide a good source of information with features of provider profiling and decision support. Following report is on the implementation of Data Scan system in the health insurers and managed care organizations.

Application — A Decision Support System for Health Insurers and Managed Care Organisations

Software :

DataScan from The MEDSTAT Group, MVS/ESA(TM), DB2/MVS,
CICS(TM), OS/2(R)

Hardware :

ES/9000(R), IBM PCs

Implementation of the Packaged Solution

BCBS officials created a team of analytical staff members and a core IS group dedicated to implementation for installation of the packaged system. MEDSTAT added its own implementation team. Since, the implementation included creation of a massive data warehouse, a user group was also formed to assist

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with mapping. This group evaluated data elements and defined what needed to be included in the data fields. IBM professionals supplied necessary consulting assistance. IBM's System/390, provided fast, efficient, cost effective access to data from a variety of clients. As BCBS went online with the DataScan system, the launch culminated a two-year planning process to develop a better system for managing the plans which needed appropriate information sources.

Working and Advantages of the Packaged Solution

Garth Trusler, Vice President of Finance and Actuarial, comments on the working of DataScan system as follows:

"The system is allowing us to work in a cooperative way with providers statewide to analyse more cost-effective ways to practice quality medicine." For example, we're sitting down with physician groups. We have access to more data than they do. They want to know as a group how their practice patterns stack up with practice patterns in the state."

"I can now sit down with them and say: 'Here's what's happening to you; here's what's happening in similar industries.' I can show them where the deviations are and why they have occurred. As a result, clients may be more wellness oriented. They may decide to pay for physicals or communicate better with their employees about health issues. Because they now have this data, they're getting involved."

Garth Trusler explains the benefits of DataScan system to the clients as follows :

The system assists in planning health care cost effective solutions for the clients. The clients are able to analyse factors contributing to higher healthcare bills. "With healthcare costs dramatically impacting their balance sheets, believe me, clients are extremely interested in this type of information."

Garth Trusler explains the benefits of DataScan system to the doctors as follows :

Once information is available to the doctors on outcomes, on best demonstrated practices, they can make clinical decisions that lead to better, more cost-effective outcomes."

On choice of DataScan system and IBM as vendor, he says:

"IBM was involved with us in looking at MEDSTAT to be sure there was communication between the hardware and software," he adds. "We wanted their knowledge in the more technical system requirements. We wanted to know how it was going to run and how it would impact our machine. IBM has been our vendor of choice for years."

The Ann Arbor, Michigan-based MEDSTAT Group was ultimately selected because of "their commitment to the healthcare industry, their ommitment to R&D, their ability to deliver analysis and how their system was running from a technical standpoint. We felt the product was compatible with what we're doing. Other factors we looked at included the fact that they have M.D.'s helping them."

Garth Trusler tells:

"When the system was in place, MEDSTAT got us going and held our hands for the first series of updates."

Today, Blue Cross Blue Shield of Montana uses the DataScan System for provider profiling, group reporting, actuarial and financial analyses, underwriting, managed care and marketing needs. The data warehouse provides a myriad of data elements and information such as demographic and geographic information; medical data relating to physicians, dentists, hospitals, drugs and other provider information. The system also provides financial information such as charges, paid claims.

Though the objective of DataScan System is to attain power of information, the plan officials have realised that the system can reduce operational costs and save time. The plan officials using this system don't have to write new program codes because the system provides easy approached to analysis. "With

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DataScan," Trusler says, "the user can sit at a terminal, create his own inquiry and his own report. I save time in the user having to write, document and meet with IS on a request and then having IS write a program. But if we work this right, the information we have available will ultimately help lower costs." The system, he adds, "helps you make wiser business decisions."

Trusler advises:

"We will be able to link directly with providers through the network. We already do electronic claims processing. We'll be able to link patient records directly to our data bases, update our files and create information directly from those records. Once that data is keyed in a real-time mode, we can have interchange from the doctors and hospitals in real-time. In the future, by having clinical and analytical data available, a doctor, for example, could create an inquiry, such as: 'I have a patient with 103 temperature, with these symptoms, on these meds.' What's the most effective treatment? Where is the most cost-effective hospital? It all comes out to him on real-time mode."

Healthcare is going through an evolution. You need to work with your providers, your community and your state to develop an economical, quality-oriented delivery system. The system (DataScan and IBM System/390) is allowing us to work together."

This report and the information in the case study was adapted from the information available from the IBM and the related websites through the Internet.

Questions

1. Why most of the companies in the corporate world are keen on establishing appropriate computer-based information systems? Illustrate with examples.
2. Discuss the salient features of Data scan Systems. How do you think this system is useful for the decision support?

Check Your Progress

1. Choose the appropriate answer:
 - (a) One of the following not the part of communication system.

(i) Data source	(ii) Receiver
(iii) Data destination	(iv) Application software
 - (b) Which one is not the future of wireless technology?

(i) E-mail	(ii) VOIP
(iii) RFID	(iv) Telegram
2. Fill in the blanks:
 - (a) services provide data, voice, and video connectivity to employees, customers, and suppliers.
 - (b) management services develop and manage the physical installations required for computing, telecommunications, and data management services.
 - (c) allows reception at a much faster rate than transmission that is it is faster downstream than upstream.

8.7 LET US SUM UP

Data communication, in general, refers to the transmission of data from one location to another and now-a-days it is referred to as transmission of computerized data. Communication is essentially a perceptual process. The sender must encode, intended meaning to create messages. The receiver then decodes message to obtain perceived meaning. Effective communication depends on the sender and receiver sharing an understanding of the rules used to encode meaning into messages.

A data communication channel is a path through a medium that data can take to accomplish communication task channels and they are called 'data highways', carrying signals, from the sending stations to receiving stations along predefined routes. It is broadly categorized into three types, (a) Digital Data Transmission and (b) Analog Digital and (c) Analog Data Transmission. Most computers transfer data signals internally using digital data transmission. Analog Digital Transmission uses continuous form of representations such as sound waves or micro-waves. Digital data is hampered by three problems, if data is transmitted over long distances and they are attenuation, higher power requirement and the introduction of spurious signals.

8.8 KEYWORDS

Teleconferencing: The use of video communications to allow business conferences to be held with participants who are scattered across a country, continent, or the world.

Telecommunications: Pertaining to the transmission of signals over long distances, including not only data communications but also the transmission of images and voices using radio, television, and other communications technologies.

Transaction File: A data file containing relatively transient data to be processed in combination with a master file.

8.9 QUESTIONS FOR DISCUSSIONS

1. What is telecommunication?
2. Discuss telecommunication technologies in business.
3. Discuss information systems planning.
4. Discuss the alignment of Business and IT.

Check Your Progress: Modal Answers

1. (a) Application software
(b) Telegram
2. (a) Telecommunication
(b) Physical facilities
(c) Asymmetric DSL

8.10 SUGGESTED READINGS

Bhatnagar, S.C. and K.V. Ramani, *Computers and Information Management*, Prentice Hall of India Private Ltd., New Delhi, 1991.

Goyal D.P., *Management Information Systems (MIS)*, Deep & Deep Publications, New Delhi, 1994.

LESSON

9

NETWORKS

CONTENTS

- 9.0 Aims and Objectives
- 9.1 Introduction
- 9.2 Networks and their Types
 - 9.2.1 Metropolitan Area Network (MAN)
 - 9.2.2 Wide Area Network (WAN)
- 9.3 Classification of Networks
 - 9.3.1 Broadcast Networks
 - 9.3.2 Point-to-point or Switched Networks
- 9.4 Advantages of Networks
- 9.5 Let us Sum up
- 9.6 Keywords
- 9.7 Questions for Discussion
- 9.8 Suggested Readings

9.0 AIMS AND OBJECTIVES

After studying this lesson, you will be able to:

- Understand network and their types
- Discuss classification of networks
- Discuss network topologies
- Discuss goals and advantages of networks

9.1 INTRODUCTION

A Computer network includes, the network operating system in the client and server machines, the cables, which connect different computers and all supporting hardware in between such as bridges, routers and switches. In wireless systems, antennas and towers are also part of the network.

Computer Networks are mostly classified on the basis of the geographical area that the network covers, the topology used, the transmission media used and the computing model used.

9.2 NETWORKS AND THEIR TYPES

A Computer network consists of two or more autonomous computers that are linked (connected) together in order to:

1. Share resources (files, printers, modems, fax machines).
2. Share Application software like MS Office.
3. Allow Electronic communication.
4. Increase productivity (makes it easier to share data amongst users).

The Computers on a network may be linked through Cables, telephones lines, radio waves, satellites etc.

Based on the geographical area covered the networks may be LAN, MAN, WAN.

Computer networks are generally classified according to their structure and the area they are localised in as:

1. **Local Area Network (LAN):** The network that spans a relatively small area that is, in the single building or campus is known as LAN.
2. **Metropolitan Area Network (MAN):** The type of computer network that is, designed for a city or town is known as MAN.
3. **Wide Area Network (WAN):** A network that covers a large geographical area and covers different cities, states and sometimes even countries, is known as WAN.

9.2.1 Metropolitan Area Network (MAN)

Metropolitan Area Network is a Computer network designed for a town or city as shown in Figure above. In terms of geographic area MAN's are larger than Local Area Networks (LANs), but smaller than Wide Area Networks (WANs). MAN's are usually characterised by very high-speed connections using fiber optical cable or other digital media.

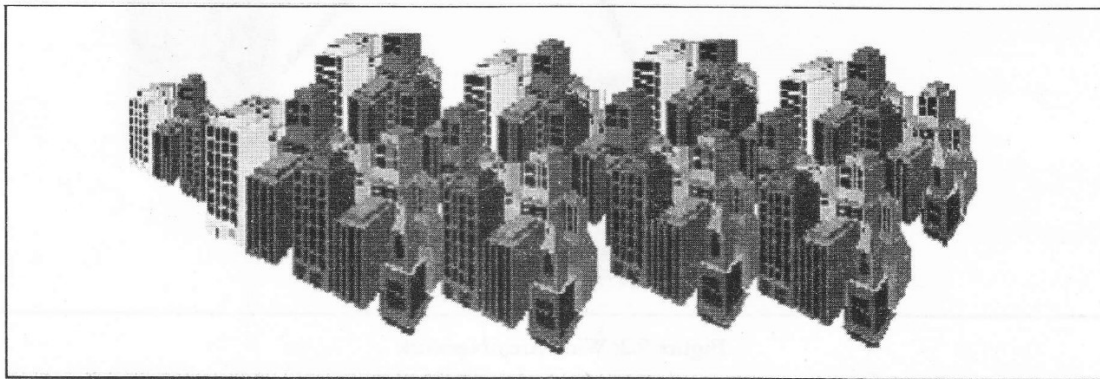


Figure 9.1: Metropolitan Area Network

Typical Characteristics of a MAN

1. Confined to a larger area than a LAN and can range from 10km to a few 100km in length.
2. Slower than a LAN but faster than a WAN.

3. Operates at a speed of 1.5 to 150 Mbps.
4. Expensive equipment.
5. Moderate error rates.

9.2.2 Wide Area Network (WAN)

Wide Area Network is a computer network that spans a relatively large geographical area. Typically, a WAN consists of two or more local-area networks (LANs), which are depicted, in Figure above. They can connect networks across cities, states or even countries.

Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites.

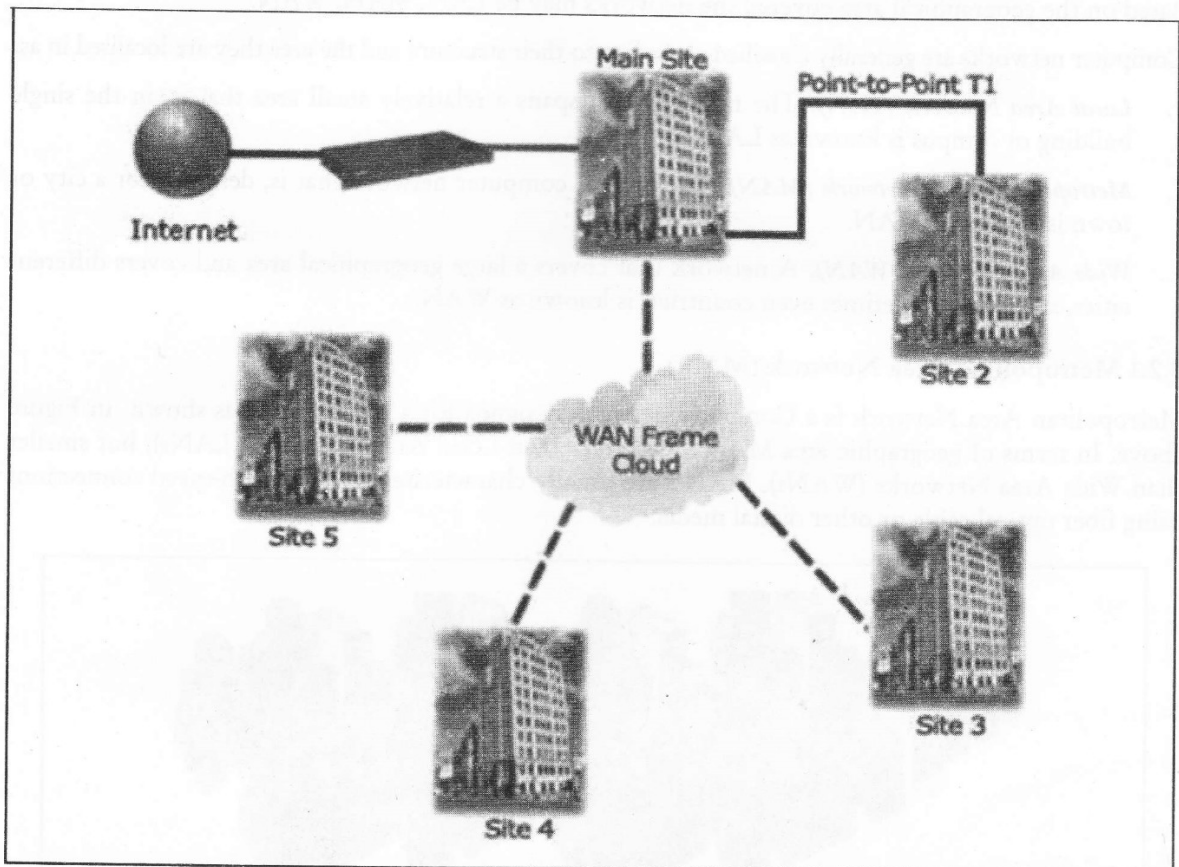


Figure 9.2: Wide Area Network

Typical characteristics of a WAN

1. A WAN can range from 100km to 1000km and the speed between cities can vary from 1.5 Mbps to 2.4 Gbps.
2. WAN supports large number of computers and multiple host machines.

3. Various segments of network are interconnected using sophisticated support devices like routers and gateways.
4. Usually the speed is much slower than LAN speed.
5. Highest possible error rate compared to LAN & MAN

Table 9.2: Comparison between LAN, MAN, WAN and GANN

Network	Size	Transmission Media	Maximum Distance
Local Area Network	Confined to building or campus	Cable used	Covers up to 10 km
Metropolitan Area Network	Network confined to city or town	Different hardware & transmission media are used	Covers the area of a city or town
Wide Area Network	Larger than MAN	Telephone lines, radio waves, leased lines or satellites	Covers a number of cities or countries

The additional characteristics that are also used to categories different types of networks are:

- **Topology:** Topology is the graphical arrangement of computer systems in a network. Common topologies include a bus, star, ring, and mesh.
- **Protocol:** The protocol defines a common set of rules which are used by computers on the network that communicate between hardware and software entities. One of the most popular protocols for LANs is the Ethernet. Another popular LAN protocol for PCs is the token-ring network.
- **Architecture:** Networks can be broadly classified as using either a peer-to-peer or client/server architecture.

9.3 CLASSIFICATION OF NETWORKS

Depending on the transmission technology i.e., whether the network contains switching elements or not, we have two types of networks:

1. Broadcast networks.
2. Point-to-point or Switched networks.

9.3.1 Broadcast Networks

Broadcast networks have a single communication channel that is shared by all the machines on the network. In this type of network, short messages sent by any machine are received by all the machines on the network. The packet contains an address field, which specifies for whom the packet is intended. All the machines, upon receiving a packet check for the address field, if the packet is intended for itself, it processes it and if not the packet is just ignored.

Using Broadcast networks, we can generally address a packet to all destinations (machines) by using a special code in the address field. Such packets are received and processed by all machines on the network. This mode of operation is known as "Broadcasting". Some Broadcast networks also support transmission to a subset of machines and this is known as "Multicasting". One possible way to achieve Multicasting is to reserve one bit to indicate multicasting and the remaining (n-1) address bits contain group number. Each machine can subscribe to any or all of the groups.

Broadcast networks are easily configured for geographically localised networks. Broadcast networks may be Static or dynamic, depending on how the channel is allocated.

In Static allocation, time is divided into discrete intervals and using round robin method, each machine is allowed to broadcast only when its time slot comes up. This method is inefficient because the channel capacity is wasted when a machine has nothing to broadcast during its allocated slot.

Dynamic allocation may be centralised or decentralised. In centralised allocation method, there is a single entity.

Example: A bus arbitration unit which determine who goes next and this is achieved by using some internal algorithm. In Decentralised channel allocation method, there is no central entity, here, each machine decides for itself whether or not to transmit.

The different types of Broadcast networks are:

1. Packet Radio Networks.
2. Satellite Networks.
3. Local Area Networks.

Packet Radio broadcasting differs from satellite network broadcasting in several ways. In particular stations have limited range introducing the need for radio repeaters, which in turn affects the routing, and acknowledges schemes. Also the propagation delay is much less than for satellite broadcasting.

LAN (Local Area Network)

Local Area Network is a computer network that spans over a relatively small area. Most LANs are confined to a single building or group of buildings within a campus. However, one LAN can be connected to other LANs over any distance via telephone lines and radio waves. A system of LANs connected in this way is called a Wide Area Network (WAN).

Most LANs connect workstations and personal computers. Each node (individual computer) in a LAN has its own CPU with which it executes programs, but it is also able to access data and devices anywhere on the LAN. This means that many users can share data as well as expensive devices, such as laser printers, fax machines etc. Users can also use the LAN to communicate with each other, by sending e-mail or engaging in chat sessions. There are many different types of LANs, Ethernets being the most common for PCs.

The following characteristics differentiate one LAN from another:

1. **Topology:** The geometric arrangement of devices on the network.
Example: Devices can be arranged in a ring or in a straight line.
2. **Protocols:** The rules and encoding specifications for sending data. The protocols also determine whether the network uses peer-to-peer or client/server architecture.
3. **Media:** Devices can be connected by twisted-pair wire, coaxial cables, or fiber optic cables. Some networks communicate via radio waves hence, do not use any connecting media.

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.

The typical characteristics of a LAN are:

1. Confined to small areas i.e., it connects several devices over a distance of 5 to 10 km.
2. High speed.
3. Most inexpensive equipment.
4. Low error rates.
5. Data and hardware sharing between users owned by the user.
6. Operates at speeds ranging from 10Mbps to 100Mbps. Now a days 1000 Mbps are available.

9.3.2 Point-to-point or Switched Networks

Point-to-point or switched, networks are those in which there are many connections between individual pairs of machines. In these networks, when a packet travels from source to destination it may have to first visit one or more intermediate machines. Routing algorithms play an important role in Point-to-point or Switched networks because often multiple routes of different lengths are available.

An example of switched network is the international dial-up telephone system.

The different types of Point-to-point or Switched networks are:

1. Circuit Switched Networks.
2. Packet Switched Networks.

In Switched network, the temporary connection is established from one point to another for either the duration of the session (circuit switching) or for the transmission of one or more packets of data (packet switching).

Circuit Switched Networks

Circuit Switched networks use a networking technology that provides a temporary, but dedicated connection between two stations no matter how many switching devices are used in the data transfer route. Circuit switching was originally developed for the analog based telephone system in order to guarantee steady and consistent service for two people engaged in a phone conversation. Analog circuit switching has given way to digital circuit switching, and the digital counterpart still maintains the connection until broken (one side hangs up). This means bandwidth is continuously reserved and "silence is transmitted" just the same as digital audio in voice conversation.

Packet Switched Networks

Packet switched Networks use a networking technology that breaks up a message into smaller packets for transmission and switches them to their required destination. Unlike circuit switching, which requires a constant point-to-point circuit to be established, each packet in a packet-switched network contains a destination address. Thus, all packets in a single message do not have to travel the same path. They can be dynamically routed over the network as lines become available or unavailable. The destination computer reassembles the packets back into their proper sequence.

Packet switching efficiently handles messages of different lengths and priorities. By accounting for packets sent, a public network can charge customers for only the data they transmit. Packet switching has been widely used for data, but not for real-time voice and video. However, this is beginning to

change. IP and ATM technologies are expected to enable packet switching to be used for everything. The first international standard for wide area packet switching networks was X.25, which was defined when all circuits were digitized and susceptible to noise. Subsequent technologies, such as frame relay and SMDS were designed for today's almost-error-free digital lines.

ATM uses a cell-switching technology that provides the bandwidth sharing efficiency of packet switching with the guaranteed bandwidth of circuit switching.

Higher-level protocols, such as TCP/IP, IPX/SPX and NetBIOS, are also packet based and are designed to ride over packet-switched topologies.

Public packet switching networks may provide value added services, such as protocol conversion and electronic mail.

9.4 ADVANTAGES OF NETWORKS

Computers in a networked environment provide numerous advantages when compared to computers in a stand alone environment. The immense benefits that the computer networks provide are in the form of excellent sharing of computational resources, computational load, increased level of reliability, economy and efficient person-to-person communication.

Following are some of the major advantages of using computer networks.

- **Resource Sharing:** The main aim of a computer network is to make all programs, equipment, and data available to anyone on the network without regard to the physical location of the resource and the user. Users need to share resources other than files, as well. A common example being printers. Printers are utilised only a small percentage of the time; therefore, companies don't want to invest in a printer for each computer. Networks can be used in this situation to allow all the users to have access to any of the available printers.
- **High Reliability:** Computer networks provide high reliability by having alternative sources of supply.

Example: All files could be replicated on two or three machines, so, if one of them is unavailable (due to hardware failure), the other copies could be used. In addition, the presence of multiple CPUs means that if one goes down, the others may be able to take over its work, although at reduced performance. For military, banking, air traffic control, nuclear reactor safety, and many other applications, the ability to continue operating in the face of hardware problems is of utmost importance.

- **Saving Money:** Small computers have a much better price/performance ratio than larger ones. Mainframes are roughly a factor of ten faster than personal computers but they cost much more. This imbalance has caused many systems designers to build systems consisting of personal computers, one per user, with data kept on one or more shared file server machines. In this model, the users are called clients, and the whole arrangement is called the client-server model.
- **Scalability:** The ability to increase the system performance gradually as the workload grows just by adding more processors. With centralised mainframes, when a system is full, it must be replaced by a larger one, usually at great expense and even greater disruption to the users. With client-server model, new clients and new servers can be added when needed.

- **Communication Medium:** A computer network can provide a powerful communication medium among widely separated users. Using a computer network it is easy for two or more people who are working on the same project and who live far apart to write a report together. When one worker, makes a change to an on-line document, the others can see the change immediately, instead of waiting several days for a letter. Such a speedup makes cooperation among far-flung groups of people easy whereas previously it was impossible.
- **Increased Productivity:** Networks increase productivity as several people can enter data at the same time, but they can also evaluate and process the shared data. So, one person can handle accounts receivable, and someone else processes the profit-and-loss statements.

You know networking concept in detail but you should know benefits of networking as well

Implementation of EDI in international trade and settlement requires standardization of trade documents to be computerized and open EDI networks. This set of guidelines consists of components below:

The Benefits of Networking are:

1. **File sharing:** Network file sharing between computers gives you more flexibility than using floppy drives or Zip drives. Not only can you share photos, music files, and documents, you can also use a home network to save copies of all of your important data on a different computer. Backups are one of the most critical yet overlooked tasks in home networking.
2. **Printer/peripheral sharing:** Once a home network is in place, it's easy to then set up all of the computers to share a single printer. No longer will you need to bounce from one system or another just to print out an email message. Other computer peripherals can be shared similarly such as network scanners, Web cams, and CD burners.
3. **Internet connection sharing:** Using a home network, multiple family members can access the Internet simultaneously without having to pay an ISP for multiple accounts. You will notice the Internet connection slows down when several people share it, but broadband Internet can handle the extra load with little trouble. Sharing dial-up Internet connections works, too. Painfully slow sometimes, you will still appreciate having shared dial-up on those occasions you really need it.

Check Your Progress

1. Choose the appropriate answer:
 - (a) MAN stands for:
 - (i) Mutual Area Network
 - (ii) Metropolitan Area Network
 - (iii) Mahanagar Area Network
2. Fill in the blanks:
 - (a) services provide data, voice, and video connectivity to employees, customers, and suppliers.
 - (b) connect multiple storage devices on a separate high-speed network dedicated to storage.
 - (c) defines a client/server protocol.

9.5 LET US SUM UP

No organization is too small to reap the benefits of networking.

Through the shared use of peripheral devices, centralized storage and backup and the shared use of Internet connectivity, networks can help raise the productivity of any sized organization.

Proper planning and design of an organization's network will ensure it has a system that will evolve with the organization's needs.

You will not become a competent network manager or system administrator by following this lesson; neither will you become a serious network programmer. You will, however, understand a lot more about how networks work in general and in particular how the TCP/IP protocols (the ones used in Internet) work.

LANs and WANs in general are similar in the sense that they are collections of computers.

However, there are huge differences between the simplest P2P LAN and a WAN. Whereas it is fairly easy to connect two computers to each other and to a shared printer to form a simple P2P LAN, trying to build a safe and secure LAN takes considerable time and resources.

Understanding your organization's needs, the size of the network to be built, the complexity, and the fundamental differences between the different types of LANs and WANs will help you to build the most effective network for your organization.

9.6 KEYWORDS

IT Architecture: A conceptual design for the implementation of information technology in an organization, including its hardware, software, and network technology platforms, data resources, application portfolio, and IS organization.

Local Area Network (LAN): A communications network that typically connects computers, terminals, and other computerized devices within a limited physical area such as an office, building, manufacturing plant, or other worksite.

Network: An interconnected system of computers, terminals, and communications channels and devices.

Network Architecture: A master plan designed to promote an open, simple, flexible, and efficient telecommunications environment through the use of standard protocols, standard communications hardware and software interfaces, and the design of a standard multilevel telecommunications interface between end users and computer systems.

Network Computer: A low-cost networked microcomputer with no or minimal disk storage, that depends on Internet or intranet servers for its operating system and Web browser, Java-enabled application software, and data access and storage.

9.7 QUESTIONS FOR DISCUSSION

1. Find out applications where data is stored and maintained through Networks. Demonstrate the benefits associated with it.
2. Discuss the various issues related with the implementation and development of Networks.

3. Explain the concepts and networks and its benefits to business organizations.
4. What are the differences between the client-server network and peer-peer networks? Which one will give better solution to a e-commerce based company?
5. What are all the different types of networks? Explain their advantages also.

Check Your Progress: Modal Answers

1. (a) Metropolitan area network
2. (a) Telecommunication
(b) Storage area network
(c) Simple Mail Transfer Protocol

9.8 SUGGESTED READINGS

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