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MANAGEMENT INFORMATION SYSTEMS

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Module–I Introduction Concepts of Data and Information—Management Process and Information Needs, Systems Approach to Problem Solving—Levels, Classification and Capabilities of Information Systems. Module–II Modern Data Bases, Concept of Database, Differences from Traditional File Organization Systems, DBMS and its Advantages, Classification of Database Systems, Schema and Subschema, Data Dictionary and Data Manipulation Language etc., Modern and Advanced Databases, Data Warehousing and Data Mining. Module–III System Analysis and Implementation—Information System Building, Traditional Life Cycle Method, Other Methodologies, like Prototyping, for Systems Development, Tools Used for System Design Such as Data Flow Diagrams, Entity Relationship Diagram, Context Diagram, System Flow Charting, Input-Output Chart etc., System Development and Implementation, System Operational Phase. Module–IV Application of Information Systems in Functional Areas—HRIS, FIS, Manufacturing Information System, Marketing Information System, Application in Banking and Other Servies. Module–V Introduction in Networking, World Wide Web and Internet, Decision Support Systems, Expert Systems, Concepts of ERP, SCM, CRM and E-Business Knowledge Management, Information Security Aspects. Unit 1: Concept of Data and Information (Pages: 5–34); Unit 2: Strategic Role of Information Systems (Pages: 35–74) Unit 3: Management Information System and DBMS (Pages: 75–124) Unit 4: System Analysis and Implementation (Pages: 125–158) Unit 5: Application of Information Systems (Pages: 161–176) Unit 6: Networking (Pages: 177–211) Unit 7: Internet and WWW (Pages: 213–236) Unit 8: Decision Support Systems (Pages: 237–266) SYLLABI-BOOK MAPPING TABLE Management Information Systems Syllabi Mapping in Book

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Summary 8.7 Key Terms 8.8 Answers to 'Check Your Progress' 8.9 Questions and Exercises 8.10 Further Reading Introduction Self-Instructional Material 1 NOTES INTRODUCTION Rapid globalization coupled with the growth of the Internet and information technology (IT), has led to a complete transformation in the way businesses or organizations function today.

This has affected management cultures and

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also led to increased competition in terms of market and resources. E-business is gaining popularity because businesses have become more customer-driven.

Even the

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traditional means of correspondence have given way to online dealings, e-mails and chats. This paradigmatic shift in business approach

has resulted in the need for a specialized system that has the ability

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to handle the various departments and functions in an organization.

A

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Management Information System or MIS can be called an organized and well-structured system that is introduced in an organization to collect, store, process and disseminate data in the form of information.

Management can thus ensure that the organization is running in a smooth manner. Management Information Systems has been written keeping in mind the special requirements of the MBA students of MGU who are pursuing this course through the distance learning mode. The book explains the concept of MIS, its nature and scope, as well as its characteristics, benefits and limitations. The book has eight units, which deal with the various aspects of management systems. It is devoted to discussing information and decision-making, information systems, information systems planning and business strategy. An entire unit has been devoted to networking and management information system. Written in the self-instruction format, each unit of this book begins with an 'Introduction' to the topic of the unit followed by an outline of the 'Unit Objectives.' The content is then presented in lucid language and a simple and structured form interspersed with 'Check Your Progress' questions to facilitate a better understanding of the topics discussed. The 'Summary' and list of 'Key Terms' given at the end of each unit will help recapitulate the unit. The 'Questions and Exercises' will provide adequate practice from the examination perspective. The content of the book is expected to help in the understanding of MIS so that the readers are able to use it for analysing the information needs of a business and management of an organization in this competitive business environment.

MODULE - 1

Self-Instructional 4 Material Concept of Data and Information NOTES

Self-Instructional Material 5 Concept of Data and Information NOTES UNIT 1 CONCEPT OF DATA AND INFORMATION Structure 1.0 Introduction 1.1 Unit Objectives 1.2 Data and Information 1.2.1 Classification of Data 1.2.2 Dimensions of Information 1.3 Management Process and Information Needs 1.3.1 Need for Information Management 1.3.2 Information Needs of an Organization 1.3.3 Methods of Assessing Information Needs 1.3.4 Nature of Information 1.3.5 Information Models 1.3.6 Role of Information in Decision-Making 1.4 Systems Approach to Problem Solving 1.4.1 Concepts of System 1.4.2 Systems Approach 1.4.3 Information Systems 1.4.4 Types of Information Systems used by Organizations 1.4.5 Components of Information Systems 1.4.6 Applications of Information Systems 1.4.7 Subsystems of Information Systems 1.5

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Decision-making requires information. Managers at various levels in the hierarchy of an organization need different kinds of information since the nature of decisions they take vary. In this unit, you will analyse and understand the requirement of information for decision-making. Most management thinkers agree that decision-making is a manager's most important job and that it is not an event but a process, where information is required at each stage. Simon has contributed immensely to the literature of decision-making. He created decision-making and decision science as a field of study. Management deals with organizational functions. Managers drive an organization by planning for its future, organizing and controlling its present and directing others in the organization to work towards a common objective. Strictly speaking, management is all about taking decisions. However, decisions cannot be taken arbitrarily and have to be based on information. The requirements of decision-makers fuel an insatiable need for information within the organization. This need is met by a set of information systems working in a synchronized manner and collectively called management information systems (MIS). The competitive environment of today's business necessitates that the MIS of any modern organization works on an IT platform and that suitable information
Self-Instructional 6 Material Concept of Data and Information NOTES be delivered to the right person at the right time. To create a successful MIS, an information systems professional needs to know what managers do and how they use information to make decisions. 1.1

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UNIT OBJECTIVES After going through this unit, you will be able to: • Define

data, information and knowledge • Analyse how data is classified • Understand management information systems • Describe the systems approach to problem solving • Know the various levels and capabilities of information systems 1.2 DATA AND INFORMATION Data refers to the

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basic facts and entities such as names and numbers. Examples of data are dates, weights, prices, costs, numbers of items sold, employee names, product names, addresses, tax codes, registration marks, etc. Data is

collected, stored and processed in such such that it provides specific conclusions. In a business, data input is a collection of facts about elements, such as consumers, suppliers, competitors and government. Data refers to the raw materials consumed in production processes used in factories or industries. Information Information is data that is converted into a more useful form. Information is directly utilized by people, as it helps them in their decision-making process. For example, information can be used to make

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time tables, merit lists, report cards, headed tables, printed documents, pay slips, receipts, reports, etc. It is obtained by assembling items of data into a meaningful form.

78% **MATCHING BLOCK 17/190** W

Other forms of information are pay-slips, schedules, reports, work sheet, bar charts, invoices and account-returns. Information may further be processed and/or manipulated to form knowledge.

Knowledge Knowledge is a hierarchy of reliable data and information that is used to service work and decisions. Its consolidation creates an intangible wealth for all purposes. There exists a small difference between data, information and knowledge. Data is raw facts and numbers, information is processed data, and knowledge is an accumulation of relevant information. Knowledge is of two types: 1. Explicit: Knowledge which can be attained from reading documents. 2. Tacit: Knowledge attained from an individual's experience through dialogue, judgement, lessons, etc. Tacit knowledge is not easily transferable. In a competitive market where every organization is primarily using innovation as a tool for competitive advantage, knowledge combined with a good strategy enables promotion of innovation.

Self-Instructional Material 7 Concept of Data and Information NOTES Data in itself, especially raw data in large quantities, is of very little use or rather no use to decision-makers within an organization. It is too difficult for a single or a group of persons to look at a set of data and extract some meaning from it. Figure 1.1 shows the process of using data, information and knowledge to make organizational decisions. Figure 1.1 Process of Data, Information and Knowledge 1.2.1 Classification of Data For data management purposes, data is classified into two categories: (i) structured and (ii) unstructured data. Structured Data Structured data or structured information is the data stored in fixed fields within a file or a record. This form of data representation is also known as tabular data, where data sets are organized in the form of a table. Structured data is managed by techniques that work on query and reporting against programmed and stored data types and relationships. Databases and spreadsheets are examples of structured data.

Unstructured Data People use and create unstructured data everyday, although they may not be aware of the same. A word processed letter or e-mail, in fact documents, and images such as those captured by a digital camera are all examples of unstructured data. Unstructured data primarily consists of textual data and image data. Textual data being any string of text, this could be a whole book or simply a short note. Images are digital pictures such as photographs and maps. In business, unstructured data can take the form of letters, memorandums, reports and legal documents. In order to manage this data effectively it needs to be organized for storage and retrieval, because the information in these documents may be critical to business processes. One technique for organizing or structuring unstructured data is to utilize metadata. Metadata In its simplest definition, metadata is 'data about data.' Metadata about a document could include: • Author or source • Date written

Self-Instructional 8 Material Concept of Data and Information NOTES • Document category • Document content • Number of pages, words, data entries, etc. The use of metadata does not require one to follow any rules or protocol. Any conceivable characteristic can be attributed to a document or a set of data, though an effective use of metadata requires some planning and foresight. It allows an organization to structure and index its digital document resources based on categories or characteristics defined by the organization itself. Managing data Data is a valuable resource for any organization, large or small. Regardless of the operations and objectives of an organization, it keeps records of its finances, employees, stocks, production, and so on. Whether these records are stored and updated electronically using a computer system or on paper using a filing cabinet, an organization will benefit by managing this data effectively. Recording and storing data within an organization is only useful if this data is used to benefit the firm. Unused data, apart from the legal requirements of record keeping, is generally considered a wasted resource. Data on stock control and production output in a manufacturing firm can be analysed to identify strengths and weaknesses in the production process, employee records can help identify trends and information regarding salary and demographics can help focus development on the workforce. These and many more such benefits can be achieved by managing an organization's data. At its most basic level, managing data is about organizing an environment or system where data can be stored, updated and retrieved. An organization's data management requirements will be greater than the aforementioned and its specific requirements will be more complex. Standard requirements of data management within an organization are as follows: 1. Outline the organization's objectives: What does the organization want to achieve through data management? What systems and processes are already in place? What are the remaining requirements to fulfill these objectives? These are questions an organization needs to ask before implementing a data management strategy or changing the way it manages data. Every organization is different and, therefore, the requirements of data management are also different. One objective may be to use a decision support system that utilizes data from three different departments in order to help focus the organizational goals and improve business processes. This objective can be broken down into technical requirements and specifications. By doing the same with all identified objectives, the organization can quickly view its total requirements to achieve all its objectives related to data management. 2. Provide a data storage solution: This involves designing and implementing an appropriate system for the organization to store its data. It usually, but not always, involves a database system. The storage solution should fulfil the following basic requirements: (i) Security: The storage system should not be accessible to outsiders. Sensitive data should only be made available to appropriate persons, departments or systems within the organization.

Self-Instructional Material 9 Concept of Data and Information NOTES (ii) Easily updatable: The system should allow updation of records and addition of new data quickly and easily. (iii) Easy retrieval of data: The system should allow data to be retrieved quickly and easily. (iv) Appropriate capacity: The system should be designed such that its capacity is large enough for both current and future data requirements. It should also be upgradable and expandable for future needs. (v) Backup: There should be an appropriate backup system in place in order to recover data should there be a critical failure or event. The more often a system updates and alters data, the more often backups should take place. To summarize, a poor data management strategy can at best provide the basic functions for storing and updating organizational data and at worst become a security risk for sensitive data. A good data management strategy allows an organization to utilize data to increase its effectiveness. Developing and implementing an effective data management system can be costly. However, for most organizations the benefits far outweigh the costs. Data management in IT From the very moment a computer was used to make calculations involving data, the need to store and access this data was identified and the following solutions were developed: File System was developed in the 1950's followed by hierarchical Data Base Management Systems (DBMS) in the 1960's. Network DBMS, followed by Relational DBMS were developed in the 1970's and later on developed into Object- oriented DBMS in the 1990's.These concepts will be examined in the following sections. 1.2.2 Dimensions of Information Information can have different dimensions, broadly categorized under business and technical dimensions. Business dimensions This dimension relates to the business angle of information and its value to the organization. The sustainability of getting information from a managerial standpoint, the accuracy and reliability of information and its scope and appropriateness, are the parameters for understanding the business dimension of information. This dimension has got more to do with the 'what' of the information rather than the 'how.' The business dimension of information can have the following parameters: • Time: Information has to be timely to be of any value. • Accuracy: Information has to be accurate to satisfy the user. • Reliability: Information has to be reliable, so that users have confidence. • Appropriateness: Information must be relevant to the receiver. It must be appropriate to his needs. • Scope: Information should be within the user's scope. • Completeness of Content: Information should be complete and not in bits and pieces.

Self-Instructional 10 Material Concept of Data and Information NOTES Technical dimensions Technical dimension relates to the gathering, summarizing, storage and retrieval, analysis and cost aspects of information. It can have the following parameters: • Information gathering • Analysis methodology • Technological issues • Networking and communication o Data management and maintenance o Visualization and reporting • Costs of information • Cost of data acquisition • Cost of data maintenance • Cost of data access 1.3 MANAGEMENT PROCESS AND INFORMATION NEEDS Information systems that help management in taking decisions are called management information systems (MIS). MIS may consist of a set of information systems working towards the common goal of achieving greater efficiency in management decision- making for each level of management. Typically, management information systems deal with information that is generated internally. The in-house data is processed (summarized / aggregated) to create reports, which enable decision-making at different levels in the organization. Today's management information systems have a data repository at the core, which is in the form of a relational database management system (RDBMS). All in-house transaction-related data are saved in this database that is designed on the basis of set rules. This data repository is topped by several tiers of logic and/or business rules, which enable the creation of an interface and the various reports that managers need at different levels. The MIS is normally designed to achieve an information flow based on the need-to-know principle. Managers are only given information based on their needs and their place in the organization. A shop floor supervisor gets the personnel details of all his subordinates but not the salary related details pertaining to senior management. This hierarchical rule-based information delivery to different levels of management is put in place to avoid information overload and to enable data security. Modern systems, such as ERP, CRM and supply chain management systems(SCM), have been built to help managers perform various tasks. ERP systems are transaction processing/support systems that include industry-wide best practices and are used to generate integrated scenarios for managers at different levels. CRM systems enable customer management by creating profiles and providing complex analytical tools to process customer data to managers. SCM systems provide tools to enable managers to deal with supply chain data. All these modern systems basically help in achieving greater efficiency by allowing the process of management decision- making better and, therefore, fall under the category of management information system. Check Your Progress 1. Define data. 2. Define knowledge. 3. List the categories into which data is classified for data management purposes.

Self-Instructional Material 11 Concept of Data and Information NOTES 1.3.1 Need for Information Management All managers today have to manage a lot of information; some for the purpose of reporting and some to take actionable decisions. The competitive environment that exists today makes this task even more challenging. Decisions have to be taken very fast and after analysing a lot of data. It is precisely for these reasons 2 that Information Technology (IT) intervention is used in modern management functions. However, Information Management (IM) using IT has itself changed dramatically over the years. IM and IT go hand in hand because without IT , IM will not be able to fulfil the most important criteria of modern competitive management: speedy and accurate information supply to management for decision-making. The market condition is such that use of IT has become inevitable in the field of IM. From being a support function, it has become a key resource to gain competitive advantage. Corporations are investing in acquiring the latest Management Information System (MIS) tools, such as ERP, CRM, Knowledge Management (KM), Decision Support Systems (DSS), Business Intelligence (BI) suites and DW facilities as they are convinced of the benefits of such large investments. The main purpose of a business information system is to produce such information that will reduce uncertainty in a given situation. The difficulties in determining a correct and complete set of information are as follows: • The capability constraint of a human being as an information processor, a problem solver and a decision maker. • The nature and variety of information. • Reluctance of decision makers to spell out the information for political and behavioural reasons. • The ability of the decision makers to specify the information. 1.3.2 Information Needs of an Organization Accessing the information needs of an organization for business execution is a complex task. The complexity can be handled if the information is classified on the basis of its user and application. The classification of information is as follows: 1. Organizational Information Organizational information is the information that is required by departments and divisions in an organization. It may contain the number of employees, products, services, and locations, the type of business, turnover and variety of the details of each one of these entities. 2. Functional Information Functional information is the information required by functional heads to conduct management functions. This information is purely local to that function and by definition does not have a use elsewhere. Examples are purchases, sales, production, stocks, receivables, payables, outstanding, budget, statutory information. Functional information is normally generated at equal time intervals, such as weekly, monthly or quarterly, for understanding the trends and making compressions against the time scale. Such information is used for planning, budgeting and controlling the operations. Functional information is used for assessing particular aspects of business, such as stocks of finished goods, receivables and so on.

Self-Instructional 12 Material Concept of Data and Information NOTES Functional information can be assessed on the basis of the parameters such as work design, responsibility and functional objectives. 3. Knowledge Information Knowledge information creates an awareness of those aspects of business where the manager is forced to think, decide and act. Such information shows the trends of the activity or a result against a timescale. For example, the trends in scale production technology the deviations for budgets, targets norms, etc., a competitor's information, industry and business information, plan performance and target and its analysis. Middle and top management use this information. 4. Decision Support Information Decision support information is required by the middle and top management for decision- making. This information does not act as a direct input to the decision-making procedure or formula but supports the manager in decision-making. Information is used in a decision support system to build models and solve problems. The support may act in two ways: one for justifying the needs of a decision and the other as an aid to decision-making. For example, information on a particular aspect such as utilization, profitability standards, requirement versus availability; information for problem solving and modeling; information on the business status; non – moving inventory, overdue payments and receivables. 5. Operational Information Operational information is required by operational and lower level management. The purpose of this information is fact-finding and taking such decisions and actions that will affect the operations at a micro level. The source of operational information is largely internal through transaction processing and the information relates to a small time span and is mostly current. 6. Strategic Information This is the information needed for long range planning and directing the course the business should take. 7. Tactical Information This type of information is needed to take short-range decisions to run the business efficiently. Tactical information requires specifically designed processing of data. Most of it is obtainable from day to day collection of routine data. 1.3.3 Methods of Assessing Information Needs The four methods of assessing information needs are as follows: 1. Asking or interviewing 2. Determining from the existing system 3. Analysing critical success factors 4. Experimentation and modelling 1. Asking or interviewing In this method, a designer of an MIS converses with the user of the information to determine the information requirements.

Self-Instructional Material 13 Concept of Data and Information NOTES 2. Determining from the existing system Existing systems have evolved after a number of years of usage. They are fairly useful in determining the information requirements of an organization. Sometimes, information systems of other organizations can also come in handy in determining information requirements. 3. Analysing critical success factors Each business organization has certain critical factors which decide its performance. Analysing those factors can give a valuable insight. 4. Experimentation and modelling Where there is total uncertainty, the designer and the user of the information resort to experimentation to determine information requirement. The experimentation would decide the methodology for handling the situation. If the method is finalized, the information needs are determined as they have evolved through experimentation. Test marketing of a product is an example of this approach. 1.3.4 Nature of Information Information is nothing but refined data,

As a corporate resource, its nature can be defined by the following characteristics: 1. Information is meant to be shared by all who are associated with the attainment of the company's common goals and they, in turn, contribute to the corporate stock of information. 2. Most of the information is organization specific and its value depends upon its use by the decision maker. 3. It has a high rate of obsolescence and thus must reach the user as early as possible. Redundant part of this resource must be weeded out of the total stock of information. 4. Information is exposed to a variety of security risks. Therefore, it has to be protected by implementing appropriate security policies and procedures such that its seamless flow is not hindered. 5. Information is a value added resource; just as value is added to a product as it moves from raw material stage to final stage, the same is true for conversion of data into information. 6. Information has a specific cost associated with it just as if it were acquired from the market. Therefore it is as essential to acquire and utilize information efficiently as it would be for any other resource. 1.3.5 Information Models An information model is a formal representation of any particular entity, be it a project, an object or a system. It includes the entity's various features and characteristics, functions and interrelations. An information model represents all the concepts, rules, operations, limits and specifications to represent the data in a stable, sharable and organized structure. A mapping of an information model is called a data model.

Self-Instructional 14 Material Concept of Data and Information NOTES Facility information model A facility information model is a model of a facility with integrated data and documents. A facility is something that can be designed, fabricated, constructed and installed, operated, maintained and modified. Examples of a facility include an infrastructural network, a building, a process plant, a highway, a plane or a ship. It is different from a product model, which is typically expressed as a data structure. A facility information model on the other hand can integrate more than 1000 components and a large number of documents. It is useful to those who want information about the components of a facility and their operations. A facility information model can be a fixed data model or can be expressed in a flexible modelling language such as Gellish English. A facility information model may consist of the following: (i) A facility model with processes and activities (ii) A documents and data sets section (iii) An electronic common dictionary (iv) Requirements models The Facility Model A facility model describes a facility in a hierarchical structure. These are divided into sections, which in turn are broken into units and utilities. They are further divided into equipment systems, sub-systems and control loops, which are broken into components of equipments. A facility model comprises data in the form of relations between the components and their properties and relations to other objects. Documents and Data sets Each document and data set is related to a particular element in the facility model. Electronic Common Dictionary All the components, data and documents are classified and defined in an electronic common dictionary, which is an integral part of a facility information model. Requirements Models The requirements of a facility information model are defined in computer-interpretable ways to measure its quality. Integrating the information model with the data processing system The primary function of an information system is to manage large quantities of data, which can be both structured or unstructured. Data models depict structured data so they can be stored in data management systems. Unstructured data like E-mails, word processing files, digital audio, video and images are generally not depicted.

Self-Instructional Material 15 Concept of Data and Information NOTES Business Model Process Model Data Model Process Data Pseudocode Application Prototypes Process Process Data Data Requirements Document Logical Model Physical Model User View Panels Application Programs Database Generation I/O Data Structures Figure 1.2 Business Process Integration The integration of data processing system and information model (Figure 1.2) illustrates the functions associated with a process that is performed and the organizations that perform these functions. Role of data models Data models provide the data's definition and format and support data and computer systems. Data can be compatible if this is done consistently across all systems. Different applications can share the same data if the same data structures are used. Some of the drawbacks of data models are: • Small changes in business operations require major changes in computer systems. • Sometimes, entity types are wrongly identified, or not identified at all, leading to duplication at all levels, with attendant costs. • Data models for different systems can be different, requiring complex and costly interfaces to share data. • Not all data can be shared electronically due to their inherent structures. The main cause for these drawbacks is a lack of standards for data models. Information modelling and business orientation Information models are a major component of enterprise content management and dynamic content management. Business information modeling (BIM) provides a structure for describing the business under consideration from an information perspective. BIM breaks down a business into its basic components and identifies information-processing requirements. An understanding of the flow of information throughout an organization provides a foundation for identifying opportunities for automation that can add a significant value to companies, especially in reducing costs, improving quality, increasing revenues and enhancing customer service. A BIM (Figure 1.3) is often divided into primary functions, the functions that are required to develop and deliver the company's products or services; and support functions, which the company requires to perform to support the primary functions.

Self-Instructional 16 Material Concept of Data and Information NOTES Primary Functions: Support Functions: Design Product Manufacture Product Market and Sell Product Distribute Product Plan the Business Manage Human Resources Manage Finances Manage Facilities and Material Manage Information Figure 1.3 A Business Information Model The BIM serves as a framework to document business processes. It also depicts that data which the company requires for its business processes, and, also the data which in turn, is produced by these processes. These processes have to be documented in process models. The data used by each process should be standardized and documented in data models. 1.3.6 Role of Information in Decision-Making Decision-making is a process that includes the following stages: • Identification and structuring of problems: One needs information to identify a problem and describe it in a structured manner. • Putting the problem in a context: Without information about the context in which the problem has occurred, one cannot take any decision on it. In a way the context defines the problem. • Generation of alternatives: Information is a key ingredient in the generation of alternatives for decision-making. • Choice of the best alternative: Based on the information about the suitability of the alternatives, a choice is made to select the best alternative. Information is required to take decisions. Imagine a simple decision like the one a driver makes when he presses the brakes to stop his speeding vehicle when he sees a child crossing the road. The driver decides on braking based on the information processed by his brain. At every stage, he uses information, which he captures visually. All decisions are like this. First, we get information about a problem, which we format into a structure. Then we get information about the context in which the problem has occurred. In the example described above, if, instead of the child crossing the road, the driver had seen the child about to cross over with a few steps only, he would not have braked to stop but would have slowed down, as he would have calculated that by the time the vehicle will reach the crossing stage, the child will have passed. If the problem was described as 'how not to hit the child crossing the road,' and if the child was in the middle of the road, the driver would have braked but had the child been about to complete crossing the road, the driver would have only slowed down and not braked to stop. Therefore, we see that context has a major role in decision-making and information is required both about the problem and about the context in which the problem has occurred. The next stage for the decision-maker would be to generate alternatives. In the driver's case, such alternatives would be to: • Stop by braking • Slow down • Take a sharp turn towards the left or right to avoid the child

Self-Instructional Material 17 Concept of Data and Information NOTES • Press the horn so that the child crosses the road quickly • Drive the vehicle on to the footpath and out of the road to avoid collision So the decision-maker generates these possible solutions to the problem at hand, based on the knowledge and information he has. For instance, in the example discussed above, the driver would need to know that braking stops the vehicle. If he is unaware of this crucial information he will not be able to generate this alternative. To decide which alternative to choose, the decision-maker needs to know what will be suitable. In our example, the driver calculates the payoff for each alternative, based on his calculation of the outcome, which again is based on information. He selects the best option to solve the problem. Thus, we can see that information is the key to the decision-making process. Without information and the right kind of information, decision- making is not possible. Therefore, to enable managers to take good quality decisions, it is very important to provide them with the right kind of information. An MIS provides this service to the managers, enabling them to take informed decisions. 1.4 SYSTEMS APPROACH TO PROBLEM SOLVING A system can be defined as a set of interacting entities that includes interrelationships or interconnections amongst the entities and forms an integrated whole. In this context, an entity may be conceptualized as something that has a distinct existence. The entity may be abstract without any material or animate existence, but it has to be distinct. The entities can themselves be systems, in which case they are called subsystems as they work like components that make up the bigger system. Most systems would include at least one input and one output, through which the system would interact with the environment. However, there are systems (theoretical cases) that do not need to interact with the environment. A system can be conceived as a white box where a clear understanding of the internal workings of the system is known, i.e., the interrelationships between its constituent elements are understood, or as a black box where there is no clear understanding of the internal workings of the system. Figure 1.4 depicts this conceptual framework. Input/s White Box Black Box Sub-system Output/s Inter Relationships Boundary Entity Entity Figure 1.4 Conceptual White Box and Black Box Model of a System with Subsystems in it Check Your Progress 4. What are the four methods of assessing information needs? 5. Define a facility information model. 6. What is the primary function of an information system?

Self-Instructional 18 Material Concept of Data and Information NOTES Typically, systems are conceptualized as black boxes when the inner working of the system and its interrelations are not fully understood or are ignored it for the sake of simplicity. The boundary of a system is the imaginary line separating the domain of the system from that of the environment. It is an abstract concept rather than a physical one. However, in some cases, the boundary of a system may indeed be also its physical boundary. A manner of identifying a system boundary is to find out if the boundary encloses a self-contained entity and if there is adequate control of the system within the boundary. The environment of a system is the set of variables that interact with the system. 1.4.1 Concepts of System Systems and their management have become a major objective in business management. Business systems in general and information systems in particular have become a major area of study and development. With the increase in competition and changes in the marketplace, managers rely on their systems for decision-making. Systems have been transformed into complex entities with multiple objectives and non-linear interdependencies. Managing them and keeping them at critical performance standards are other challenges as the smooth of systems functioning has become a mission in itself. The need analysis, conceptualization, design, creation, implementation and smooth functioning of systems have become important subjects of study. A special class of systems dealing with the storage, processing and delivery of information is of special significance to business and is called information systems. When these information systems aid management in taking decisions, they are broadly classified as management information systems. These are special systems with unique characteristics. Even though this unit focuses on business systems and information systems, the concept of a system is at the core of many scientific management theories and techniques. In fact, the idea of a system originated from physical and biological sciences. After a lot of deliberation, scientists in these fields could define a system with clarity. Management has borrowed the concept from these disciplines and has used it extensively in its theory. Some modern management techniques have evolved from the concept of systems. In fact, the entire study of management decision-making using information is derived from the study of the structured systems-based approach and systems concept. Characteristics of a system Systems have very specific common characteristics that help in their identification. These characteristics are: •••• A specific structure that is defined by its components (entities/sub systems) and processes (interrelationships between its components): A system is a collection of interrelated entities and / or subsystems that can be analysed. It is possible to understand the specific structure of a system. However, in some systems, complete knowledge may not be available. At the same time in most cases the fundamental entities and their interrelations are known. •••• A model of reality: A system is an abstraction of reality. It is created to comprehend the nuances of a real-world condition and to understand the interrelationships of subsystems in such real-world conditions with a greater clarity. •••• A purpose: A system performs a function. The purpose in most cases is the output of the system and in a way the output defines the purpose of the system.

Self-Instructional Material 19 Concept of Data and Information NOTES •••• Inputs and outputs: A system (unless fully closed) interacts with the environment. It receives inputs and after processing them, produces outputs. •••• Performance that can be measured in terms of output: A system will have measures of performance. In most cases, the performance of the system is a function of its input and output. •••• Serves a client: The system will have a utility and hence a client for it. The client can also be another system. • Functional and structural interrelationships amongst the components of a system •••• An environment: A system cannot exist in isolation. It exists in an environment. The environment interacts with it. • Purpose and measure of purpose for each subsystem Systems and control Control is essential to monitor the output of systems and is exercised by means of control loops. It is necessary to monitor the desired output of a system with the actual output so that the performance of the system can be measured and corrective action taken if required. Schoderbek (1985) mentions four elements required for effective control: •••• A control variable: To determine the degree of performance of the system •••• A detector: To monitor the output of the system by measuring the control variable parameters •••• A comparator: To compare the actual and planned output of the system •••• An effector: To make suitable changes. To illustrate these in greater detail, let us visualize the cooling system of a refrigerator. The cooling coils cool the refrigerator to bring the temperature to a certain level and then the effector is relied upon to change the system inputs so that the cooling process stops once the desired temperature is reached. The detector measures the temperature and compares it with the desired temperature and the effector stops the cooling process once the desired temperature is reached. Again, if the temperature rises above the desired temperature, the effector comes into play by turning the cooling system on. This is called control and the process in which this is done is called a control loop; in this case, a closed loop. The open loop control systems have a structure in which the output of the system in not coupled with the inputs of the system. Types of control Control mechanisms can be of the following two types : 1. Feedback control When we have a control structure in which the output is used to directly alter the inputs, we call it a feedback control mechanism. Feedback control can be of two types, positive feedback and negative feedback. Positive feedback is when the output of a system is positively correlated with the input, i.e., more output prompts more input or less output prompts less input. For example, the stock market sometimes exhibits positive feedback. Positive feedback generally indicates an unstable system unless there is an outside mechanism to stop the process beyond a point. Negative feedback is the opposite of

Self-Instructional 20 Material Concept of Data and Information NOTES positive feedback and the relationship between output and input is negative. The refrigerator example given earlier is an example of negative feedback. Feedback control systems, particularly the ones with negative feedback, have a tendency to oscillate around the desired values of control variables. Take the example of a driver driving a vehicle at a speed of around 60 km per hour. He will apply brakes when he is beyond 60 km per hour and the vehicle speed will reduce to 55 km per hour. At this time, he will again press the accelerator and push the speed to 60 km per hour and this will again lead to crossing the 60 km per hour speed limit, alerting him to press the brakes and slow down. Thus, vehicle speed will oscillate around 60 km per hour. This happens as control mechanisms are not designed to work step-by-step, instead, they have a steady effect on the system. This means that system oscillations happen when control mechanisms might take some time to react to an alert or may also take a finite time to take effect or both. This can also happen if the control mechanism overcompensates for the deviation from a stable state. 2. Feed forward control It is a type of control mechanism that addresses the problem of system oscillation. In this control mechanism, the control is exercised after predicting the output. If the output crosses the stable limit or the target, the control mechanisms are applied before the target value of the control variable is attained. For instance, in the previous example, if the vehicle had an intelligent braking system controlled by computer-aided automatic brake controls, then whenever the vehicle went over 58 km per hour, automatic brakes would be applied, bringing down the speed to the desired level. This is called a feed forward system and it works on a proactive philosophy rather that the reactive philosophies of a feed back control mechanism. However, to apply feed forward control mechanisms, we need to completely understand the system. Basic systems concepts Let us now discuss some basic systems concepts which are generic in nature and are present irrespective of the type or characteristics of a system. Emergent properties: This is a fundamental systems concept. It means that the system exhibits a set of properties when working collectively and that these properties are not present in any of the entities that make up the system. The manner in which the system will behave cannot be understood by looking only at its constituent elements. An example of this concept is a living organism. The organism as a whole exhibits properties that differ from the properties of its constituent elements, i.e., cells. By examining cells alone, the behaviour of the living organism cannot be determined. Hierarchy: In most systems, the interrelated entities of which a system is composed may contain some entities that are systems in themselves. They have their own inputs and outputs, sets of interrelated entities and emergent properties. These are called subsystems. Indeed the system under study may itself be a subsystem of a larger system called supra-system. For instance, when one analyses organizations as systems, one finds that these organizations include subsystems, such as HR and production, but the organization itself is a subsystem of society and civilization at large. One finds that systems are subsystems of a larger system and contain subsystems that interact with other entities to create the system. Therefore, there is a hierarchy of systems. Each level of hierarchy presents its own set of complexities. One has to understand the level of granularity one wishes to approach in understanding a system. At one level, you may just wish to understand the interrelationships amongst a system's entities, some of which

Self-Instructional Material 21 Concept of Data and Information NOTES may be subsystems. At another level, you might analyse the interrelationships of entities of the subsystems of the system under review. This hierarchy helps in the understanding of the abstractions of systems. Communication: This is an issue that affects all systems and is a major reason for system failures. In the context of systems, means the ability of the interrelated subsystems and entities that make up the system to interact with each other. Sometimes the output of a subsystem may be the input of another subsystem and if the communication between these two subsystems does not function, the system will face problems. For example, if in an organization system, the output of the marketing subsystem based on the demand in the market is not clearly communicated to the production subsystem, the organization system will face problems. In fact, this issue leads to another important concept in system literature, i.e., the issue of coupling. The degree of closeness of subsystems is known as coupling. Control: The mechanism used to regulate the system. It is the internal mechanism to create a stable system so that the output remains within the desired limits. Types of systems Different types of systems exist, either as abstract concepts or as concrete examples. Given below are the different types and classes of systems. Closed and open systems: A system is said to be closed if it does not interact with the environment in which it exists. It is in a state of isolation and is completely self-contained. Crosed systems are only of theoretical interest as in reality systems exhibit different degrees of openness. A system is said to be open when it interacts with the environment in which it exists. It exchanges inputs and outputs with the environment. A system might be said to be open with regard to some entities and processes but might exhibit closed behaviour with respect to other entities and processes. Deterministic, probabilistic and random systems: A system is deterministic if its outputs are certain. This means that the relationships between its components are known and certain and the output can be predicted when an input is given. The common entrance examination for entry into the IIMs is an example of a deterministic system. A probabilistic system is one where the output from the system behaves probabilistically, i.e., the output is predictable according to probability values. The portfolio investment systems of asset management companies that invest in the stock market will have a probabilistic output for a given input as the system and its entities behave probabilistically. Random systems are completely unpredictable systems. One is completely unaware of the components and their relationships with each other and hence the output is random. The transport system is an example of a random system. Given an input, one is not sure about the output. Human, machine and human-machine systems: A human system consists of humans as components. It is an open system exhibiting probabilistic behaviour. An example of this kind of system is a department within an organization. A machine system is composed entirely of machines and machine subsystems. It is deterministic and relatively closed. An example of this type of system would be a fire alarm system.

Self-Instructional 22 Material Concept of Data and Information NOTES A system which consists of humans and machines is called a human-machine system. Information systems are examples of human-machine systems. These systems are deterministic in delivery but probabilistic in interpretation. Abstract and concrete systems: An abstract system is an ordered arrangement of concepts. Abstract systems can be procedural or conceptual. Concrete systems are systems in which at least two components are objects. Concrete systems can be physical or social systems. Adaptive and non-adaptive systems: A system is adaptive if it modifies itself based on the changes in its environment. A non-adaptive system does not react to changes in its environment. Simple and complex systems: A simple system is one in which there are a few interrelated entities, whereas a complex system is one in which there several components with many interrelations amongst them. 1.4.2 Systems Approach The systems approach is an old concept. It assumes that the breaking down of a complex concept into simpler and easy- to-understand units enables people to understand a complex concept. The systems approach was first proposed under the name of a general systems theory by Ludwig von Bertalanffy. He noted that most systems of any practical relevance are open as they interact with the environment. Therefore, to understand the system, it has to be differentiated from the environment, i.e., the boundary of the system, and the point at which it interacts with the environment, has to be clearly defined. The systems approach concentrates on the holistic entity of the system without neglecting its components. It attempts to understand the role played by each component in the system. Simultaneously it tries to understand the activity of the whole system. Major concepts of the systems approach include the following: • Specialization: A whole system can be divided into granular (smaller easy to understand) components so that the specialized role of each component is appreciated. • Grouping: The process of specialization can create its own complexity by proliferating components with increasing specialization. To avoid this, it becomes essential to group related disciplines or sub-disciplines. • Coordination: The grouped components and sub-components need to be coordinated. • Emergent properties: This is an important concept of the systems approach. It means that a group of interrelated entities (components) have properties that are not present in any individual component. This is the holistic view of a system. For example, multi-cellular organisms exhibit characteristics as a whole that are not present in individual constituent parts like cells. Applying the systems approach to problem solving The systems approach is widely used in problem solving in different contexts. Researchers in the field of science and technology have used it for quite some time now. Business problems can also be analysed and solved using this approach. The following steps are required to analyse business problems using the systems approach. • Defining the problem: Sometimes one may confuse the symptom or the exhibition of a behaviour to be a problem, but actually it may only be a symptom

Self-Instructional Material 23 Concept of Data and Information NOTES of a larger malaise. It may just exhibit the behaviour of a larger phenomenon. It is vital to drill deep into an issue and clearly understand the problem rather than to have a superficial understanding of it. One must appreciate that this is the initial stage of problem solving and if the problem itself in not correctly diagnosed, then the solution will be incorrect. The systems approach is used to understand the problem in granular detail to establish requirements and objectives in depth. By using the systems approach, the problem will be analysed in its entirety with inherent elements and their interrelationships.Therefore this detailed analysis will bring out the actual problem and separate out the symptom from it. • Developing alternative solutions: In this stage, alternative solutions are generated. This requires creativity and innovation. The analyst uses creativity to come up with possible solutions to the problem. Typically, only outlines of solutions are generated rather than the actual solutions. • Selecting a solution: In this step, the solution which suits the requirement and objectives in the most comprehensive manner is selected as the best solution. This is done after evaluating all the possible solutions and then comparing the possible set of solutions to find the most suitable solution. A lot of mathematical, financial and technical models are used to select the most appropriate solution. • Designing the solution: Once the most appropriate solution is chosen, it is then made into a design document to give it the shape of an actionable solution. At this stage, the details of the solution are worked out to create the blueprint. Several design diagrams are used to prepare the design document. The requirement specifications are again compared with the solution design to double check the suitability of the solution for the problem. • Implementing the solution: The solution that has been designed is implemented as per the specification laid down in the design document. During implementation, care is taken to ensure that there are no deviations from the design. • Reviewing the solution: At this point, the impact of the solution is studied. This stage enquires if the desired result has been achieved. An example of systems approach Let us assume that A is the coach of the Indian cricket team. Let us also assume that the objective which A has been entrusted with is to secure a win over the touring Australian cricket team. The coach uses a systems approach to attain this objective. He starts by gathering information about his own team. In systems terms, a views the Indian team as a system whose environment would include the other team in the competition; the umpires; regulators; crowd and media. His system, i.e. the team itself may be conceptualized as having two subsystems, i.e., players and supporting staff for players. Each subsystem would have its own set of components/entities, e.g., the player subsystem will have openers, middle order batsmen, fast bowlers and a wicket keeper. The supporting staff subsystem would include the bowling coach, batting coach, physiotherapist and psychologist. All these entities would indeed have a bearing on the actual outcome of the game. The coach adopts a systems approach to determine the playing strategy that he will adopt to ensure that the Indian side wins. He analyses the issue step by step as given below: Defining the problem: In this stage, the coach tries to understand the past performance of his team and that of the other team in the competition. His objective is

Self-Instructional 24 Material Concept of Data and Information NOTES to defeat the competing team. He realizes that the problem he faces is that of losing the game. This is his main problem. Collecting data: The coach employs his supporting staff to gather data on the skills and physical condition of the players in the competing team by analysing past performance data, viewing television footage of previous games and making psychological profiles of each player. The support staff analyses the data and comes up with the following observations: • Both teams use aggressive strategies during the period of power play. The competing Australian team uses the opening players to spearhead this attack. However, recently the openers have had a personal fight and are facing interpersonal problems. • The game is being played in Mumbai and the local crowd support is estimated to be of some value amounting to around forty thousand. The crowd has come to watch the Indian team win. A loss here would cost the team in terms of morale. • The umpires are neutral and are not intimidated by a large crowd support but are lenient towards sledging. Identifying alternatives: Based on the collected data, the coach generates the following alternate strategies: • Play upon the minds of the opening players of the competitors by highlighting their personal differences using sledging alone. • Employ defensive tactics during power play when the openers are most aggressive and not using sledging. • Keep closing fielders who would sledge and employ the best attacking bowlers of the Indian team during the power play. Evaluating alternatives: After having generated different alternatives, the coach has to select only one. The first alternative may lead to a loss of concentration on the part of the openers and result in breakthroughs. However, there is a chance that the interpersonal differences between the two openers may have already been resolved before they come to the field and in such a case this strategy will fail. The second strategy provides a safer option in the sense that it will neutralize the aggressive game of the openers but there is limited chance of getting breakthroughs. The third option of employing aggressive closing fielders to play upon the internal personal differences of the openers and at the same time employing the best bowlers may lead to breakthroughs and may also restrict the aggressive openers. Selecting the best alternative: The coach selects the third alternative as it provides him with the opportunity of neutralizing the aggressive playing strategy of the openers while increasing the chances of getting breakthroughs. Implementing and monitoring: The coach communicates his strategy to his players and support staff and instructs the support staff to organize mock sessions and tactics to be employed to make the strategy a success. The performance of players and support staff is monitored by the coach on a regular basis to ensure that the strategy is employed as planned. 1.4.3 Information Systems According to Orlikowski (1992), 'Nothing is more central to an organization's effectiveness than its ability to transmit accurate, relevant, understandable information amongst its employees. All the advantages of an organization's economy of scale,

Self-Instructional Material 25 Concept of Data and Information NOTES financial and technical resources, diverse talents, and contacts are of no practical value if the organization's employees are unaware of what other employees require of them.' Definition MIS is a set of systems that enables management at different levels to take better decisions by providing the necessary information. The role of IT in developing good MIS is to enhance the timeliness and quality of information. However, the subject of MIS does not include a study of IT even though MIS has an overwhelming IT component. MIS is not a monolithic entity but a collection of systems that seem monolithic to the user. The various subsystems in the background have different objectives but work in concert with each other to satisfy the manager's requirement for information. An MIS can be installed by either procuring off-the-shelf systems or by commissioning a customized solution. Sometimes, MIS can be a mix of both, i.e., an off-the-shelf system customized to suit the needs of the organization. Characteristics Since management information is a specialized information system category, it conforms to certain characteristics that are generic in nature. These characteristics remain more or less the same even when the technology around such management information system changes: • Management oriented: MIS is designed top-down. This means that the system is designed around the felt needs of management at different levels for information. • Management directed: Since MIS is for the management, it is imperative that it also should have a very strong management initiative. Management is involved in the design process of MIS and also in its continuous review and upgradation to develop a good quality system. The system is structured based on the directions provided by the management. This minimizes the gap between the management's expectations and the actual system. • Integrated: MIS is integrated with the operational and functional activities of management. An integrated system enables managers to receive information from different departments and locations within the organization. A lack of integration does not help managers, since it fails to meet their need for information. • Common data flows: Since MIS is required to be an integrated system, data, during its storage, retrieval, dissemination and processing has to be handled in an integrated manner. The integrated approach to data management avoids data redundancy and simplifies operations. • Strategic planning: An MIS undergoes much planning before being designed or built because it must satisfy the information needs of managers today and should be usable for the next five to ten years, with some modifications. Sometimes, when planning is ignored, systems perform well in the present but they become obsolete with time. • Bias towards centralization: Since MIS is required to give the correct version of the latest information, the data repository should be centralized, because it facilitates version control and an integrated, common view of data across the organization. In a decentralized system, data is entered, updated and deleted

Self-Instructional 26 Material Concept of Data and Information NOTES from different locations and it is impossible to provide correct information to managers. In a decentralized system, news of an employee's retirement is noted by the HR department, but not by the finance, which continues to pay his salary. Suffice it to say that this would not happen in a centralized system. In a centralized system, the superannuating employee's details are deleted from the master file, data from which is shared by all departments, thereby eliminating the risk of generating his salary for the next month. • ICT enabled: Competition requires information to be timely and accurate for effective decision-making, both of which are ensured if information is managed using IT. Hence, MIS has a very high degree of technology intervention in it. In fact, all MIS run on an ICT platform to enable smooth functioning of the system and to ensure timely and accurate results. What is an information system? Information systems (IS) are a special class of systems that are used for data storage, retrieval, processing, communication and security. Information systems that help management at different levels to take suitable decisions are called management information systems (MIS). Information systems are housed in a computerized environment / platform to enable users to get accurate information immediately. Information systems over the years Information systems have been remarkably transformed in the last forty years of their existence. Initially, information systems were designed to perform a specific task quickly with the fewest errors possible. The concept of using information systems to take decisions had not been thought of. Organizations used information systems only for data processing, be it salaries or bills. Those who worked on these systems were familiar with the commands and the interface, which were character based. The output was in the form of salary slips, bills and invoices. These were data processing systems. These systems used file-based data storage systems on which a programme would work, i.e., the programme would be able to access the data and organize it, but it would store the data in a file. The problem with this type of system is that it leads to replication of data and loss of consistency. Over the years, information systems have changed. The focus is now on helping the management by providing information useful for decision-making. Data processing systems have become obsolete. The focus is now on delivering

Now, information systems have become faster, more accurate and user friendly. Those who work on information systems nowadays know little about systems. They are normal users. New concepts, such as client server architecture, networking, distributed computing, centralized database, graphical user interface and the Internet, have emerged in the information systems space to help organizations get better value for their money. The bulky and expensive mainframe systems have been replaced by expensive software. 1.4.4 Types of Information Systems used by Organizations Organizations use several types of information systems to suit their needs. The various types of information systems that an organization uses may be classified into the following categories: • Office automation systems (OAS) • Transaction processing systems (TPS) • Decision support systems (DSS)
Self-Instructional Material 27 Concept of Data and Information NOTES Apart from these broad classes of information systems, organizations also use information systems for special tasks, such as Executive Information Systems (EIS), Enterprise (wide) Resource Planning Systems (ERPS), Customer Relationship Management Systems (CRMS) and Supply Chain Management Systems (SCMS). These systems also fall under the above mentioned broad classifications. (i) Office Automation Systems This type of information system is used in automating office tasks and plays a limited role in decision-making. The information coming out of this kind of system can be used for rule-based decision-making for managers at the operational level. These systems play an important role in automating several office functions and thus help in creating paper-less offices. These systems help in increasing the productivity and efficiency of the office workforce by automating simple tasks. These systems deal with operational data. Modern businesses are opting for this paper-less office environment as this brings in unique advantages for the business, such as: • Speeding up office work and making it process-driven • Digitizing and storing all basic level data for future action An example of an office automation system is the Microsoft Office suite of software that automates simple office tasks like presentations and documentation. (ii) Transaction Processing Systems This type of system is critical to the smooth functioning of an organization. This system is used to capture all transaction-related data between the organization and its external and internal customers. The transaction-level data is stored in a pre-formatted manner in a relational database for further action in the future. TPS are the most widely used forms of information systems as they provide the management with the flexibility of storing data in a structured manner and retrieving it at a later date using queries. The system is also used to aggregate and summarize data to create management reports. Visualization tools, such as graphs and tables, are used to clarify situations and scenarios for managers. These systems handle tactical data from within the organization. An example of TPS would be a sales management system with a relational database management system at the server side back end and a customized front end to interact with the users. (iii) Decision Support Systems Decision Support Systems (DSS) enable senior management to take strategic decisions. Unlike the systems discussed so far, DSS are developed with the objective of providing the users (top management personnel) with unstructured information. These systems enable management to work on a 'what-if' analysis so that different scenarios can be developed for decision-making. DSS deal with both internal and external data. Such systems are custom-built with features, such as a business dashboard and scenario panel. Such systems are complex with internal models working on the data to provide senior managers with decision support. Unlike transaction processing systems, these systems are not just query dependent. Their main role is to access data from a data repository and then pass that data through a model, either mathematical, heuristic, statistical, econometric, operations research, or combinatorial, so that the senior management can take better decisions by carrying out either a 'what-if' analysis and scenario building or a predictive analysis to get some insight into a business issue. Such systems are very costly to build and require advanced analytical tools.

Self-Instructional 28 Material Concept of Data and Information NOTES A decision support system, as Gory Scott Morton has observed, has the following characteristics: 'Couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. [They comprise] a computer-based support system for management decisions makers who deal with semi-structured problems.' 1 The characteristics of a DSS may be summarized as follows: • It is used in semi and unstructured environments, not in a structured environment. • It plays a decision support role and does not replace the decision maker. • It supports all phases of the decision-making process. • It focusses on the effectiveness of the decision made. • It remains under the control of the DSS user. • It uses underlying data and models. • It can provide support for multiple independent or interdependent decisions. The Client User The Mathematical Logic of the Model The User Interface The Server The Data Repository Figure 1.5 Decision Support System within a Client-Server Framework Work on using computers to solve analytical models started in the early days of computing in the 1960s 2 and became an established tool in management decision-making (Michael S. Scott Morton, 1971). This class of systems, loosely clubbed as decision support systems, changed the way in which MIS was conceived (Gordon Davis, 1974). Little (1970) observed that the biggest obstacle with management science/operations research-based models was that people at the decision-making stage rarely used them and thus incorporated models inherently in such systems. These writers and researchers laid the foundation of today's DSS. The framework for decision support was, however, laid much earlier by Gorry and Scott Morton (1971), and also in the seminal works of both Simon (1977) and Anthony (1965). Framework for decision support Simon laid out the most popular framework for decision support which consists of three linear phases: intelligence, design and choice. Van Grundy, Mintzberg and others modified this framework to suggest that decision-making as an activity was more complex and 1. Gorry, G.A. and M.S. Scott Morton, 1989, 'A Framework for Management Information Systems.' Sloan Management Review 13(1): 49–62. 2. Scott Morton (1967). Self-Instructional Material 29 Concept of Data and Information NOTES could not be described in a linear model, and went on to give more comprehensive frameworks. These works led to models on the framework of problem solving. Sprague(1980) gives us a framework for DSS in which DSS is conceptualized as having three components: a database, a model base and a dialogue management system. There have been several extensions on this, specially in the realm of spatial decision support systems by Densham (1991) to address the issue. Most DSS, however, stand on Sprague's platform of conceptualization. Model management Models

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and model management have several connotations in DSS literature and there have been wide-ranging definitions of these terms. The common feature that emerges from these definitions is that a model consists of a solver, a model for solving a problem and data (Ramirez,

Chiang and St. Louis, 1993), where the

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model represents relationships between variables, data represents the values of the variables under consideration and the solver is the tool that enables the computation of the variable values and their relationships. It has also been conceptualized in some literature as a procedure that works on data to provide an output after analysis. Model base A model base or a model base management system (MBMS) is a software that has the capabilities to manage a model for it to be useful to the decision-maker. It is the core of a DSS.

Though there are several definitions, there is no standard definition of MBMS and it is conceived as a component of the DSS. 1.4.5 Components of Information Systems Information systems are

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a type of data processing systems, which collect the data from different sources, process that data and generate information from the data to be used for different applications within the organization. For example, in a business context, an information system collects data from various systems such as finance and sales systems

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supplier side. The information system processes the data and generates information for the customer. Customers provide feedback to the supplier depending on the information processed by the information system. Figure 1.6 shows the information system in a business context. Figure 1.6 Information System in a Business Context Information

systems are basically systems that help in maintaining and managing the information. An

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information system helps to manage and store information to perform various functions such as decision-making, documentation of business activities and generation of reports for analysis of organizational operations.

You need to understand the concept of information and system for acquiring basic knowledge of information systems. Various terms used in information systems are as follows:
Self-Instructional 30 Material Concept of Data and Information NOTES • Data is a

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raw material that can be a number, a fact, a sound, a picture or a statement gathered from different sources. In the real world

data can represent anything related to

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business processes and employee details. • Information is a meaningful data or a processed data. It defines the relation between different data. • System is a collection of components that helps in achieving a common objective. For example, in a human–machine system, the machine element consists of hardware and software to perform computation, and people make decisions based on this computation.

A

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system consists of two types of components, abstract system components and physical system components. Abstract system components perform such operations as collecting input data, processing the data and generating information from that data. Physical system components consist of various elements such as hardware, software and human resources. There are a few more components of an information system, such as: • Data: Input that the system takes to produce information. • Hardware: A computer and its peripheral equipment such as input, output and storage devices. •

Software: Application programs or a

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set of instructions that process the input data using computers, generate information and store information for future use. • Network: A collection of computer systems connected to each other for communication to share the information. • Manpower: Information system professionals and users who perform various organizational operations such as analysis of information, designing and construction of the information system, and maintenance of the information system. The workforce could comprise IT experts, managers and workers. • Graphical User Interface (GUI): This is an interface for the users of

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information system to work with information on the computer system. A user can operate, process and retrieve information from the computer storage using GUI. The components of an information system describe the functioning of the system. An information system takes input data from the users of the system to perform business operations. The users interact with the computer to process data using GUI. After the data has been processed, information is retrieved at the users' end. Figure 1.7 shows the basic information system to perform business operations. Figure 1.7 Basic Information System Self-Instructional Material 31

Concept of Data and Information NOTES 1.4.6 Applications of Information Systems There are many application areas that implement information systems in a business environment to solve business problems and to pursue business opportunities. Figure 1.8 shows the various application areas of information systems in an organization. Figure 1.8 Application Areas of Information Systems 1.4.7 Subsystems of Information Systems An information system allows the storage, retrieval and processing of data in a secure environment. Logically, the subsystems of an information system are: • Data repository: This subsystem is at the core of any information system. This is a relational database management system (RDBMS) that includes preformatted and structured tables for storage of data. These structures are arranged in a way that helps in speedy storage and retrieval of the data and with adequate security. • User interface: This subsystem handles the interaction of the system with the user and hence has to take care of issues related to the display of data on an output medium. This can be either graphical or character-based depending on the level of ease offered to the user. • Network: This subsystem ensures communication between the different entities of an information system. It is crucial for the functioning of an information system. • Computer hardware: IT infrastructure is necessary to use information systems in an effective manner. Almost all the components of an information system are housed in some kind of computer hardware to enable it to perform tasks faster. An algorithm to find the lowest of three numbers can be calculated manually, but in a computerized system it will be much faster and more efficient. • System software: Some basic software is required for an information system to function efficiently. System software enables information systems. Examples would include operating systems.
Self-Instructional 32 Material Concept of Data and Information NOTES • Input/output: Sometimes, this is clubbed with the user interface (UI) to suggest that I/O functions are handled by UI alone. However, in some systems, I/O may be user-independent, such as when an alert is activated, the input for the alert comes from some other system input, rather than from a user. • Business rule (process): This is a set of rules that governs how a system should function to mimic real-world business processes. • Algorithm/application software: This is the component that integrates all the other components. The logic (business rule) is defined in the program (embedded in it), which enables the functioning of the information system for some specific purpose. All the above components work in concert to make a functional information system. 1.5 SUMMARY This unit focussed on information systems and decision-making. You have learned the definition and characteristics of MIS: it is a set of systems that enables management at different levels to take better decisions by providing the necessary information. MIS is usually management oriented, management directed, integrated and biased towards centralization, and it also ensures common data flows and strategic planning. In this unit, you have understood the requirement of information for the process of decision-making. You have learned that information is required to identify a particular problem or opportunity and to understand the context of a problem, when the decision- maker has to choose between numerous alternative solutions. The unit analysed the importance of information. Factors such as timeliness, presentation, accuracy, context and expectation play a significant role in contributing to the value of the information. In addition, you have studied why managers need MIS. Managers take decisions for an organization and therefore need information to make these decisions. 1.6 KEY TERMS • Organizational information: This is the information required by departments and divisions in an organization. • Tactical information: The type of information that is needed to take short- range decisions to run the business efficiently. • Data model: It is a mapping of an information model. • Positive feedback: This term refers to the feedback received when the output of a system is positively correlated with the input. • Coupling: It is the degree of closeness of subsystems. • Probabilistic system: It is a type of system in which the output of a system is positively correlated with the input • Information systems: These systems are a special class of systems that are used for data storage, retrieval, processing, communication and security. • Primary data: It is that data collected for the first time by a researcher. Check Your Progress 7. List the four elements mentioned by Schoderbek for an effective control of systems. 8. List the major concepts of the systems approach. 9. List the various types of information systems an organization uses.
Self-Instructional Material 33 Concept of Data and Information NOTES 1.7 ANSWERS TO 'CHECK YOUR PROGRESS' 1. Data refers to the basic facts and entities, such as names and numbers. 2. Knowledge is a hierarchy of reliable data and information that is used to service work and decisions. 3. For data management purposes, data is classified into two categories: (i) structured and (ii) unstructured data. 4. The four methods of assessing information needs are: (i) Asking or interviewing (ii) Determining from the existing system (iii) Analysing critical success factors (iv) Experimenting and modelling 5. A facility information model is a model of a facility with integrated data and documents. 6. The primary function of an information system is to manage large quantities of data, which can be both structured or unstructured. 7. Schoderbek mentions the following four elements for effective control of systems: (i) A control variable (ii) A detector (iii) A comparator (iv) An effector 8. Major concepts of the systems approach include the following: • Specialization • Grouping • Coordination • Emergent properties 9. The various types of information systems that an organization uses may be classified into the following categories: • Office automation systems (OAS) • Transaction processing systems (TPS) • Decision support systems (DSS) 1.8 QUESTIONS AND EXERCISES Short-Answer Questions 1. What is the difference between data, information and knowledge? 2. Write a short note on management information system. 3. How does timeliness affect the value that is placed on information? 4. Write a short note on publicity as a marketing function.
Self-Instructional 34 Material Concept of Data and Information NOTES Long-Answer Questions 1. Explain the need for managing information. 2. How would you assess the information requirements of an organization? 3. What are the subsystems of an information system? Describe each of them. 4. What are the major concepts of the systems approach? How is systems approach applied to solve problems? 1.9 FURTHER READING McLeod, R. Management Information Systems. Chicago: Science Research Associates, 1983. Curry, A., P. Flett and F. Hollingsworth. Managing Information and Systems: The Business Perspective. Oxford: Routledge, 2006. Orna, E. Information Strategy in Practice. Burlington: Gower Publishing Ltd., 2004. Madnick, S.E. (ed.). The Strategic Use of Information Technology. New York: Oxford University Press, 1987.

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Self-Instructional Material 35 Strategic Role of Information Systems NOTES UNIT 2 STRATEGIC ROLE OF INFORMATION SYSTEMS Structure 2.0 Introduction 2.1 Unit Objectives 2.2 Information Systems and Strategies 2.2.1 Information Systems and Business Strategy 2.2.2 Business Information Systems 2.2.3 Organizational Information Strategy 2.2.4 Firm-Level Strategy and Information Systems 2.2.5 Industry-Level Strategy and Information Systems 2.2.6 Network Economics 2.3 Information Management for Competitive Advantage 2.3.1 Trends in Modern Business 2.4 Levels and Capabilities of Information Systems 2.4.1 What is Information? 2.4.2 Why a Manager Needs an MIS 2.4.3 Information and Decision-Making 2.4.4 Management and Decision-Making 2.4.5 Decision-Making Models 2.4.6 Need for Information Systems in a Digital Firm 2.4.7 Contemporary Approaches to Information Systems 2.4.8 Toward the Digital Firm: The Role of Information Systems in Organizations 2.4.9 Classification of Information Systems 2.5 Business Processing Re-engineering 2.6

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Summary 2.7 Key Terms 2.8 Answers to 'Check Your Progress' 2.9 Questions and Exercises 2.10 Further Reading 2.0 INTRODUCTION

This unit will discuss how IT at the business level, helps a firm reduce costs, differentiate products and serve new markets. The ATM was first introduced by the Citi group but they soon lost the competitive advantage because it became part of every bank. Credit cards, online reservation (air/train) systems and single window banking are some of the examples that gave advantage to organizations that introduced them, but competition caught up fast and made these systems an essential part of organizations. Online reservation systems made it possible to check all possible trains/flights, bypass the agents and make reservations, all in real time. Manufacturers and retailers have started using

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information systems to create products and services that are custom-tailored to fit the precise specifications of individual customers. Dell Computer Corporation sells directly to customers using assemble-to- order manufacturing.

Individuals, businesses and government agencies can buy computers directly from Dell, customized with the exact features and components they need. They can place their order

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directly using a toll-free telephone number or Dell's

website.
Self-Instructional 36 Material Strategic Role of Information Systems NOTES Once Dell's production control receives an order, it directs an assembly plant to assemble

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the computer based on the configuration specified by the customer

using components from an onsite warehouse. These assemble-to-order strategies require careful coordination of customer requirements with production and flexible processes throughout the firm's value chain. In the following sections, you will read about some of the functional areas where information systems are being used for competitive advantage.

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An information system can have a strategic impact if it helps the firm provide products or services at a lower cost than its competitors, or if it provides products and services at the same cost as competitors but offers greater value.

In this unit, you will learn about information systems and strategy. You will look into the relationships between information systems and business strategy, information systems and firm-level strategy, and information systems and industry-level strategy. 2.1

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UNIT OBJECTIVES After going through this unit, you will be able to: •

Understand relationship between information systems and strategy • Analyse information for competitive advantage • Describe the various levels and capabilities of information systems. • Explain business processing re-engineering 2.2 INFORMATION SYSTEMS AND STRATEGIES There are various strategies for running a business. One strategy is to compete in the existing market by providing better price and quality. The other strategy is to create a new market by introducing new products and services. Yet another strategy is to expand the market by becoming global. Strategic information systems can facilitate an organization in changing the goals, operations, products, services or environmental relationships. Strategic information systems can be used for understanding customer requirements and to market trends faster and more deeply than the competitors. Porter's Value Chain model lists all the activities of an organization and categorizes them as primary activities and support activities. It highlights specific activities in the business where competitive strategies can be best applied and where information systems are most likely to have a strategic impact. The value chain model identifies specific, critical leverage points, where a firm can use information technology most effectively to enhance its competitive position. This model views the firm as a series or chain of basic activities that add a margin of value to a firm's products or services. These activities can be categorized as either primary activities or

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support activities. Primary activities are most directly related to the production and distribution of a firm's products

and services that create value for the customer. The primary activities include: • Inbound logistics — managing inventory after it has arrived in the organization • Operations — adding value to the raw material • Outbound logistics — getting the products to the customers • Sales and marketing — identifying customers • Service — providing support to customers
Self-Instructional Material 37 Strategic Role of Information Systems NOTES Inbound logistics include receiving and storing materials for distribution to production. Operation transforms inputs into finished products. Outbound logistics entail storing and distributing finished products. Sales and marketing includes promoting and selling the firm's products. The service activity includes maintenance and repair of the firm's goods and services. Support activities make the delivery of the primary activities possible, and consist of: • Organization infrastructure — administration and management • Human resources — employee recruitment, hiring and training • Technology — improving products and the production process • Procurement — purchasing input

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Administration and Management: Electronic scheduling and messaging systems Human Resources: Workforce planning

systems Technology: Computer-aided design systems Procurement: Computerized ordering systems Inbound Logistics Automated Warehousing Systems Operations Computer- Controlled Machining Systems Outbound Logistics Automated Shipment Scheduling Systems Service Equipment Maintenance Systems Sales and Marketing Computerized Ordering Systems Firm Value Chain Primary Activities Support Activities Customer relationship management systems Sourcing and procurement systems Supplier's Suppliers Suppliers Firm Distributors Customers The firm value chain and the industry value chain. Illustrated are various examples of strategic information systems for the primary and support activities of a firm and of its value partners that would add a

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margin of value to the firm's products or services.

Industry Value Chain 2.2.1 Information Systems and Business Strategy

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An information system can have a strategic impact if it helps the firm provide products or services at a lower cost than its competitors or if it provides products and services at the same cost as its competitors but offers greater value. The activities that add most value to products and services depend on the features of each individual firm.

A firm can link its suppliers and customers to its own value chain. The suppliers can access their orders online, coordinate their deliveries with the production schedule of the company and receive payments online. All these activities help both partners in cutting down on cycle time and cost. Digitally-enabled networks can be used for procurement and for closely coordinating the production of many independent firms. The Internet technology has made it possible to extend the value chain so that it ties together, the firm's suppliers, business partners and customers.

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Businesses should try to develop strategic information systems for both internal and external value activities that add the most value. A strategic analysis

studies the organization, its structure, processes and data flow. To conduct such a study, a software model of the organization is created that captures its processes and functions, the people who perform these functions and the data required by the functions. An analysis is
Self-Instructional 38 Material Strategic Role of Information Systems NOTES thereafter conducted to identify the activities where an information system can help improve the process and its impact. The analyst may identify those sales and marketing activities where information systems can provide the greatest boost. The

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analysis might recommend a system to reduce marketing costs by targeting marketing campaigns more efficiently or by providing information for developing products more finely attuned to

the firm's target market. An information system, after some time, becomes a part of an organization and no longer gives competitive advantage. The organization has to study its own systems, the markets and what its competitors are doing, and respond accordingly. It may need to reorganize and reshape its structural, financial and human assets and recast systems to tap new sources of value. 2.2.2 Business Information Systems A business information system is a set of interrelated procedures using IT infrastructure in a business enterprise to generate and disseminate desired information. Such systems are designed to support decision-making by the people associated with the enterprise. It helps attain the organization's objectives. A business information system gets data as input from the environment and processes it using the resources of IT infrastructure to satisfy the information needs of different entities associated with the business enterprise. There are systems of control over the use of IT resources and a feedback system offers useful clues for increasing the benefits of an information system to business. Business information system is a subsystem of a business system and serves the function of feedback and control in the business system. Characteristics of a business information system The basic characteristics of BIS are as follows: • It is subject to the dynamics of the business environment and needs to be flexible enough to absorb the inevitable changes in the pattern of information requirement of the business. It has to be efficient to satisfy the changing needs of an organization and its management. • It needs to be proactive. It should anticipate changes in the information needs of users and accordingly adapt themselves to suit their needs. This has become important so that the managers involved in decision-making make an informed choice instead of reacting to competitors' moves. • The purpose of a business information system is to cater to the information needs of decision-making in business. • It has to be designed keeping in view the availability of financial and human resources to the business enterprise. • Cost-effectiveness is a matter of prime concern in the development and maintenance of a BIS. Investment in IT infrastructure for maintaining such a system should have economic justification, as it is a precondition for its existence and sustenance. 2.2.3 Organizational Information Strategy Organizational information strategy is being implemented in many firms across the world. These organizations realize that information is an organizational asset and should be regarded as such. They also realize that absence of a chief information strategy has resulted in numerous problems in many firms.

Self-Instructional Material 39 Strategic Role of Information Systems NOTES One such problem is the failure of the employees in a firm to obtain specific and qualified information. According to a recent research, 15-30 per cent of a knowledge worker's time is spent looking for accurate information. Such drastic losses can be corrected by ensuring that information is available as and when required. What is information strategy? Information strategy can be defined as an organization's unified blueprint for capturing, integrating, processing, delivering and presenting information in a clean, consistent and timely manner. All information in a firm should satisfy a certain standard of quality. It should be delivered consistently across the firm, i.e., requests for the same information in various departments should get the same yield immediately and users and applications should not have to wait long to receive their required information. Information in a firm can be compared to the availability of water in a metropolitan city. In the earlier days, the source of drinking water was a well which was dug in the backyard of each house. This water was used for the purpose of drinking, cooking and cleaning. This water was not necessarily hygenic nor was it shared. As city plans became more sophisticated, people began to consider water as a common utility. Therefore, they began to integrate, clean and distribute it from a central organization in the metropolis. Thus, the residents of a metropolis have the right to obtain clean, potable water on time. The same can be applied to information in a firm. By implementing the principles applied by the city planners, one can capture, integrate and cleanse the information in a central repository, and provide it to the internal and external users in a clean, consistent and timely manner. There are many reasons for implementing an information strategy in a firm. Primarily, information should be treated as an organizational asset. It has value just like all other assets do. The value of information is in its accessibility and accuracy. Information that is not accessible on demand and/or is not accurate cannot be considered as an asset. Again, similar to most assets, information loses value as time goes by. Hence, it needs to be governed and managed properly. An information strategy permits a firm to manage, govern and provide access to this asset. An organization has a lot of information which cannot be managed in an unorganized manner. This is another reason for a firm to have an information strategy. One needs a plan, a blueprint and a strategy, for capturing, storing, governing and delivering information to its internal and external users. Another important reason for having such a strategy is the business mandate for it. Business groups have become very perceptive in accessing, manipulating and using information and they expect that complete and accurate information be made available to them. In fact, with the new Web 2.0 technologies, they not only request internal information, but also external information provided by many websites such as myspace.com. Information available in such community sites can be used to analyse and interpret customer views and their likes and dislikes which further help improve a firm's products, services, image and marketing campaigns.
Self-Instructional 40 Material Strategic Role of Information Systems NOTES 2.2.4 Firm-Level Strategy and Information Systems A business firm is typically a collection of businesses. Often, each business unit manages its own finance, market and suppliers. Information systems can improve the overall performance of these business units by promoting collaboration. Two business units may

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pool markets and expertise. Such relationships can lower costs and generate profits.

One use of IT is

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to tie together the operations of disparate business units so that they can act as a whole.

It is possible for a business unit to have a core competence developed by it over a period of time. This core competence may be useful to other business units as well. Any information system that encourages the sharing of knowledge across business units enhances competency. 2.2.5 Industry-Level Strategy and Information Systems

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Firms together comprise an industry, such as the automotive industry, telephone, television broadcasting and forest products industries. The key strategic question at this level of analysis

is, 'How and when should one compete with, as opposed to cooperate with, others in the industry?'

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The three principal concepts of analysing strategy at the industry level are (i) information partnership, (ii) the Competitive Forces Model and (

iii) network economics. Information partnerships Firms can form information partnerships and

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even link their information systems to achieve unique synergies. In

an information partnership, both companies can join forces by sharing information without actually merging; for example, Big Bazaar has a tie-up with ICICI Bank to give additional discount to its customers for using ICICI's credit card.

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Such partnerships help firms gain access to new customers, creating new opportunities for cross-selling and targeting products. Companies that have been traditional competitors may find such alliances to be mutually advantageous.

The Competitive forces model In Porter's Competitive Forces Model,

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a firm faces a number of external threats and opportunities: the threat of new entrants into its market, the pressure from substitute products or services, the bargaining power of customers

and suppliers and the positioning of traditional industry competitors. How can information systems be used to achieve strategic advantage at the industry level? By working with other firms, industry participants can force all market participants to subscribe to similar standards.

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Such efforts increase efficiency at the industry level as well as the business level. It makes product substitution less likely and raises entry costs. Thus new entrants

are discouraged. The Internet has dramatically increased the availability of information to customers. They can now compare prices and this has increased their bargaining power. This has dampened profits.

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Although the Internet can provide benefits such as new channels to customers and new operating efficiencies, firms cannot achieve competitive advantage unless they

carefully integrate the Internet initiatives into their overall strategy and operations.
Self-Instructional Material 41 Strategic Role of Information Systems NOTES 2.2.6

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Network Economics A third strategic concept useful at the industry level is network economics.

The law of diminishing returns states that

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the more any given resource is applied to production the lower

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the marginal gain in output, until a point is reached where the additional inputs produce no additional outputs.

In some situations, the law of diminishing returns does not work; for instance, it is no more expensive to operate a television station with 1000 subscribers than with 10 million subscribers. From this perspective of

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network economics, IT can be strategically useful. Internet sites can be used by firms to build communities of like-minded customers who want to share their experiences. This can promote loyalty, enjoyment and unique ties among customers. 2.3 INFORMATION

MANAGEMENT FOR COMPETITIVE ADVANTAGE Information and its use has become the competitive advantage of today's world. The efficiency with which a firm manages its information determines its success in the marketplace. This enormous power of information unleashed in today's world has reduced the managers' reaction time for decision-making, made customers aware, competitors efficient and regulators alert. Today, one can no longer hide behind excuses of 'plausible deniability.' These changes have changed the mindset of managers and have transformed the way business is conducted. Management of information itself has become a key success factor for firms. However, information is not to be seen in isolation. Information in the current competitive business environment is available to business firms in a computerized form. Computerization is required to supply timely and accurate information, since these are critical factors for success in these competitive times. Hence, the study of information management also entails an understanding of information and communication technology. However, information management is a distinct subject not related to information and communication technology. As is clear, the advantage that a modern corporate house enjoys can be traced to its management of information. If the business house cannot manage its information, then it is likely that it will not have any competitive advantage. Typically, an organization can develop competitive advantage if it can do or have what another organization cannot do or have. In modern times, the advantage on account of raw materials or technological edge is neutralized by the forces of modern business. The last frontier is information management. Companies that have managed to successfully manage information, such as Dell and Google, have generated unparalleled competitive advantage as their reaction time to changes in the market and / or competition is much less. Hence, they can shift business gears faster than their competitors. Competitive advantage through managing information can accrue to an organization if it manages information: • To reduce reaction time for change • To increase the organization's efficiency • To gain insights into the business that competitors do not have • For predictive analysis to stay ahead of competition Check Your Progress 1. List the primary activities as enumerated in Porter's value chain model. 2. Mention one problem that has resulted from the absence of a chief information strategy. 3. What are the three principal concepts of analysing strategy at the industry level?

 The competitive advantage gained by managing information also requires changes in organization cultures. Companies need to create a culture of information-based management and decision-making to take advantage of the opportunities of information management. This is a challenge, as installing an organization culture is not as straightforward as installing an information management system. It is a process that takes a lot of time.

2.3.1 Trends in Modern Business Today, economic and financial changes have become a norm rather than an exception. Business is facing new challenges in its environment. Competition is intense and companies have become aware of the perils of ignoring competition. Managers who run businesses are now always tuned in to market realities so that they can react quickly should a problem or opportunity present itself. The changes sweeping through the business and economic environment have forced business people to look at new ideas to bank on and thrive. An idea reinvented in the modern business era is the management of information, not just for reactive decision-making but for proactive decision-making so as to embrace the changes in the marketplace and turn threats into opportunities. However, one must look at the major trends in the modern business environment, which have forced management thinkers to reconsider the management of information. 1. Increasing Competition The increase in competition is the most important trend in modern business environment. Competition has forced businesses to become more efficient and effective. Corporate entities are obsessed with the efficient use of their resources to beat competition. Capital flows freely to low-cost (but not necessarily low-quality) manufacturing and servicing hubs, the world over. Economies of scale have become important along with the productivity of capital and labour. In fact, many measures that a business entity takes today are with a focus on competition. The following are the reasons why competition has increased: • Globalization and liberalization: Businesses want to derive value worldwide by leveraging a wage arbitrage opportunity, creative labour force, business-friendly government policies or low-cost manufacture/service. This will also create value for the shareholders. The world has indeed become flatter in the last few years. • Market dynamics that favour the efficient: The markets have become demand-driven. Customers today have greater choice and demand better quality at a lower price, which in turn favours those companies that are efficient in their use of resources because they can deliver better quality goods at lower prices. • The fast pace of recent technological change and innovation: The recent technological changes in information technology, space, VLSI design, nanotechnology and biotechnology have altered many market equations. Disruptive technologies have levelled the playing field, making competition difficult for the established companies and easier for startup firms. • Increased information exchange: This has resulted in the free flow of information about markets, competitors, strategies and alternatives making competition all the more difficult. 2. Increasing Uncertainty in the Marketplace The fast pace of technological change and innovation has led to uncertainty. Businesses are alert to changes in the marketplace. Disruptive technologies are developed quickly

Self-Instructional Material 43 Strategic Role of Information Systems NOTES and the life cycle of a product or service is reduced every year. Gone are the days when a company had a blockbuster product/service that it could sell for years together. Today, alternatives are created in little time, by unexpected competitors from any place in the world. This competition from unknown competitors using new technologies to create products leads to a sense of uncertainty among businesses. The manner in which business is conducted also adds to the uncertainty. Market meltdowns, such as the recent global financial market meltdown, and slowdowns strike markets without warning, creating a general feeling of uncertainty. Increasing the capacity to absorb external shocks in the organization and reducing the time taken to react to changes in the marketplace is one way to counter uncertainty. Information management becomes a crucial weapon in such situations where uncertainty is a certainty. The value that an organization gets from an investment in information management in such situations is immense, as the difference between success and failure could be just a small piece of crucial information provided by an efficient information management system. 3. Globalization Globalization is another important trend in today's business. Geopolitical boundaries have lost their relevance in business due to globalization. Today, a North American business house can source its raw materials/components from a country in sub-Saharan Africa, manufacture/assemble in China and sell in Europe or Japan. The barriers have fallen. Capital flows freely in different forms from one country to another and the primary considerations are lower costs and increased efficiency. Corporations have a pragmatic view of business and focus on increasing its value. Globalization is a powerful force in modern business. Organizations are on the lookout for global markets, global manufacturing hubs, global logistic hubs, a global labour force and global presence. Today, a business entity tries to scale up its business to a global scale as soon as possible. The idea is to find lucrative markets in different corners of the planet, create products or services where the cost of doing so is the lowest and then connect the market with the manufacturing/service hub using a global supply chain. Globalization has been transformed from a business philosophy into a unifier. Several books have been written on the effects of globalization, which has brought opportunities as well as threats for businesses. Those businesses that can link themselves to the global marketplace in any manner (in any part of the value chain) stand to gain from globalization, but those that choose to remain outside the ambit of globalization may face difficulties. The opening up of the global marketplace for commerce has also brought in threats. Businesses can no longer remain in their comfort zones with no awareness of global competition. Local businesses face increasing competition from global players and have a choice: to go global themselves or remain local. Whatever the strategy, one can no longer ignore globalization. It has forced businesses to become more efficient. It has changed the perception of customers and made them more demanding. It has made shareholders hungrier for profits and changed the fundamentals of doing business in many ways. It is here to stay and businesses have to be acclimatized to this modern trend. 4. Outsourcing Businesses try to beat competition by focusing on their core functions and competencies and by outsourcing non-key functions to specialized firms. Specialized firms have sprung up (especially in low-cost countries like India) that have made managing the non-core businesses of other companies their core competence. Special firms that are called Business Process Outsourcing (BPO) firms have created competencies in non-voice and voice Customer Relationship Management (CRM) and legal process management,
Self-Instructional 44 Material Strategic Role of Information Systems NOTES so that they can handle these processes for other companies at a fraction of the cost. Outsourcing companies can then lower costs and improve the quality of their services. They can now focus on their key functions and its non-key functions are now key functions for someone else (the outsourced entity). The tremendous wage arbitrage opportunity provided by transferring these non-core jobs to developing countries makes it a lucrative proposition for companies in developed countries. This has been made possible by the great advances in information and communication technology, which has made physical distance meaningless. It has made service delivery independent of boundaries. Anyone located anywhere in the planet can deliver a service anywhere. Outsourcing is a controversial issue. In developed countries, there is opposition to the movement of jobs to low-cost countries due to outsourcing. In countries, such as the US, outsourcing is a major political issue. Even though there has been a hue and cry over outsourcing, several studies have shown that outsourcing leads to cost savings and improved service delivery. Outsourcing is a natural corollary of the process of globalization; as more and more businesses try to become globally competitive, they will search for ways to reduce costs and improve services. Outsourcing provides them a wonderful opportunity to do just that. 5. Reducing Hierarchy and Improving Transparency Businesses have transformed themselves over time. The structures of business organizations have become flatter, reducing unnecessary hierarchy. The popular corporate culture within organizations, both in the West and in developing countries like India and China, has changed dramatically to an informal first name, efficiency-focussed and work-driven culture. The focus is on the work and how to get it done and less on massaging the egos of superiors and adhering to strict hierarchy as in the past. This free and open culture is visible and reflected in several areas of business from the modern open office design to the style of writing memos. This open culture has resulted in greater efficiency and a culture of open communication and fast action and decisions based mostly on data-driven reports. This increased openness in the office environment is a process that can be traced to the late 1980s when companies grappled with cultural issues in organizations. Transparency has improved because of this. Increased transparency has resulted in faster and more efficient reactions from employees. The trust levels in companies have gone up with an increase in transparency. 6. Increasing Clout of Civil Society and Media Civil society and media worldwide have become more aware and enjoy great clout and power. From the environment to consumer protection, they assert their power to make consumers aware of issues thereby creating a challenge for business in some cases. Environmental pollution, global warming, consumer protection and safety are now subjects that business people have to analyse attentively. No business house can afford to ignore these interest groups in this changed order. Civil society bodies and media have made it impossible for companies to hide behind a curtain of opacity. Plausible deniability excuses that companies resorted to in extreme cases have become impossible excuses. Public awareness, coupled with an active media, has forced companies to increase compliance on regulatory and ethical fronts. Companies now know that the cost of non-compliance is much higher in terms of loss of goodwill and public image. Companies have started to comply with public welfare issues and the civil society and media have even started to rate companies on their performance on this front.

Self-Instructional Material 45 Strategic Role of Information Systems NOTES 7. Increasing Customer Focus Businesses have become aware of the need for customer focus to improve market share. They have realized that the customer today has a choice as never before. Those companies that ensure customer loyalty through delivery of goods and services will win in the marketplace. These modern business trends indicate that the way business was conducted earlier has changed and will evolve further in the coming years. The existing business environment is more competitive. Liberalization and globalization have made international and geographic boundaries meaningless. Cultural changes and social empowerment have brought in positive changes in organizations. Corporate governance initiatives and media focus have made businesses more accountable and open. The World Trade Organization (WTO) has reduced trade barriers. Businesses cannot survive in this environment in isolation. They have to embrace these changes. The increasing uncertainty of market forces has to be neutralized by visionary decision-making. Businesses have to be proactive. Decisions will have to be based on a proactive approach using predictive analysis rather than a reactive approach. Efficiency will ultimately decide who wins and who loses. The need therefore is for faster access to the right type of information and insight to improve the quality of management decision-making. This is the reason why large corporate houses are investing millions of dollars to ensure a proper information technology infrastructure for better information management. Investments in Enterprise Resource Planning (ERP), CRM, Decision Management (DM) and Data Warehousing (DW) systems have now become the norm rather than the exception in corporate houses. The changes in the business environment have necessitated a new view of organizations and the role of information management in relation to it. The challenge is to integrate and enable organization structure, culture and form with information management so that management decision-making is faster, accurate, timely and reliable. 2.4 LEVELS AND CAPABILITIES OF INFORMATION SYSTEMS Initially, while opening our discussions about MIS, we have said that an MIS is a system, which provides information to the management. We have also said that we are living in an information age. Information is of critical importance for setting up, running, survival and prosperity of a business organization as it enables an organization to gain and retain competitive edge and emerge a winner. 2.4.1 What is Information? We will now discuss the concepts of information in more detail as MIS is centred around information. Information is derived from data. Data is nothing but a random, unorganized collection of indications or measurements of certain qualities or attributes relating to an entity, recorded either in alphabetical, numerical, alphanumerical, voice, image, text or any other form. Data can also be described as unstructured raw facts, observations or unevaluated messages in isolation. Data, per se, does not convey much or is not of much use. It is like a material, which is simply available in an unfinished form. Data involves facts and

Self-Instructional 46 Material Strategic Role of Information Systems NOTES figures, which are not used in the decision process and are usually kept as office/ historical records without any immediate intent to retrieve them for decision-making. Information, on the other hand, is like a finished product. Information, therefore, is defined as data that is collected, collated, processed, logically organized and analysed so that it can be used by the decision-maker. Information,

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according to Davis and Olson, is 'data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or prospective actions or decisions.'

Thus, data in order to be converted into information has to undergo processing as illustrated hereunder: Stored Data Processing (Processor) Input (Data) Output (Information) 1. Value of Information The normal mathematical and economic explanation for the value of information suggests that if an unexpected event occurs and information on its occurrence is known, then this information is valuable. For example, if someone learns that an earthquake of 10.5 on the Richter scale will hit his city, and its epicentre will be located close to where he lives, this information will be of more value to him than the information that he has to pass an exam to get a degree. In the first case, the information is valuable because he was not expecting an earthquake to take place in quite this manner, but in the second case, he knows that he has to pass exams to get a degree. All market mechanisms work on this model of information. From a managerial context, the value of information is judged on the basis of the following parameters: • Timeliness: Information of an event is valuable to management if it results in timely intervention or decision-making. Information of an event is valuable if managers have the time to react to it. It loses its value if they have no time. • Presentation: Managerial information is valuable when presented to facilitate decision-making. • Accuracy: Information provided to management is valueless unless accurate. • Context: Information provided to managers is valuable if it approximates their context and enables them to take a decision. Information on a competitor's product is of no use to a finance manager, but might interest a marketing manager. • Expectation: Information is more valuable when it is unexpected. If a manager has based his marketing strategy on his competitor launching a particular product and then learns that the competitor will launch an entirely different product, this information about the second product is extremely valuable since it is unexpected. 2. Information Processing As stated, data has to be processed before information is made available. Hence, various operations have to be carried out for converting data into meaningful information. These operations are as follows:

Self-Instructional Material 47 Strategic Role of Information Systems NOTES • Capturing Data from an event/transaction has to be recorded. • Verifying Data has to be checked/validated for correctness. • Classifying Data has to be placed in specific categories. • Arranging/sorting Data has to be placed in a particular order/sequence. • Summarizing Data elements have to be combined/aggregated. • Calculating Arithmetical/logical calculations/computations have to be carried out. • Storing Data has to be placed in some storage media. • Retrieving Specific data elements have to be searched for and accessed. • Reproducing Data has to be duplicated from one medium to another. • Dissemination/ Data has to be transmitted from one place communication (device) to another (user). 3. Information and the Decision-Maker Information is not only relevant, but also critical for the decision-maker as the quality of decision depends on the quality of information. More specifically, information is useful for the decision-maker as: • It helps in minimizing, if not eliminating altogether, the elements of risk and uncertainty in decision-making. • It minimizes the element of 'surprise' and uncertainty in decision-making. • It improves the quality of decision-making. • It helps achieve the most optimum results within given constraints. • It affects the decision-making behaviour. 4. Sources of Information Data is the foundation of all information. A few aspects of data, sources of data and methods of collecting data for the purposes of converting them into information are described as follows: Primary and secondary data: Data is the raw material used for obtaining information. Data is derived from a number of sources, both internal as well as external. If the data is collected for the first time by a researcher, it is known as primary data. If, however, data is borrowed by a researcher from other sources, it is referred to as secondary data. Primary data could be gathered directly from the respondent. Different techniques such as observations, questionnaires and interviews can be used for obtaining primary data, which can then be converted into information. Secondary sources of data/information include internal records as well as external records. Sources such as newspapers, magazines, trade journals, government publications, government policy documents, research reports and websites are considered secondary source of data. 5. Types of Information Information is used for decision-making. There are three types of information, which are required for the decision-making process:
Self-Instructional 48 Material Strategic Role of Information Systems NOTES • Strategic-level information • Tactical-level information • Operational-level information For strategic decision-making, one needs strategic information, which is holistic, unstructured and draws heavily from the external environment. It also requires futuristic inputs like the emerging technologies, competition, consumer preferences and social- economic-political changes as these inputs will be used for long-term planning. Tactical information will be used for medium/short-term planning by the middle management. Budgets, forecasts, analysis, cash/funds flow projections, etc., are a part of tactical information. Such information is mostly from the internal environment and partly from the external environment such as customer perceptions, competitors strategy and pricing. It has a medium-term impact. Operational information is mainly about current happenings within the organization and is mainly drawn from a internal sources. It also covers a specific product, a specific activity and a smaller group/number of people. Apart from the three types as stated here, you can also divide information into planning information and control information. Planning and control information can be differentiated as follows: Planning Information Control Information • It covers the whole organization. • It is concerned with a small, specific part of an organization. • It has a longer time span. • It has a shorter time span. • It looks for and analyses trends/patterns. • It looks for specific details for functional activity. • It is used for working futuristic trends/forecast. • It is used for assessing actual performance vis-à-vis budgeted performance. 6. Attributes of Information Information, in order to be used by the decision-maker has to possess certain attributes such as the following: • Timely availability • Currency • Periodicity/frequency • Pertinace/relevance • Completeness • Consistency • Accuracy • Reliability • Verifiability • Clarity • Comprehensibility • Brevity • Cost-effectiveness
Self-Instructional Material 49 Strategic Role of Information Systems NOTES Needless to add, the more attributes the 'information' possesses, the better the quality, leading to higher value of such information for the organization and the decision- maker. Types of reports Reports provide the following information to the data-driven manager: 1. Whether activities are being performed as planned. For example, a production manager would check the production schedule against a production report, to see if the production process is under control. If there is a difference between the schedule and the report, the manager knows he will have to take corrective action. 2. Provides a glimpse of the bigger picture. If an HR manager notices a high attrition rate among the employees of his firm, he might want to check if competition in the industry has gone up or if the benefits package offerred by his organization are inadequate. One can see that a modern manager relies heavily on data to take decisions and he accesses the data using reports. Reports are of many types. • Scheduled reports: These reports are generated regularly. They could be generated on a daily, weekly or monthly basis. They contain recent information. The manager uses such reports to analyse information from the context of the recent past. These reports contain the first inklings of problems or opportunities. • On-demand reports: These reports are unscheduled in nature and are created based on need. They enable the analysis of a particular issue in greater detail. These reports are the result of a reaction to an event. • Exception reports: These reports are generated in response to an occurrence that is out of the ordinary and are used to study situations that require control. For example, if the average absenteeism is 2 per cent and rises sharply to 20 per cent, an exception report is generated to get the manager concerned to dig deeper. • Predictive reports: These reports give the manager a preview of the future and are used for planning. • Summary reports: These are general reports that provide aggregated data and summarized information to the manager so that he gets an overview of an issue. • Regulatory and statutory reports: These reports are created in order to follow rules and statutes, and are submitted to regulatory bodies. Reports enable the manager to unearth the issues that underlie problems and provide him with the information he needs to take decisions. However, information can be of various degrees of value to a manager. Information that he already has is of little value to him, and incorrect information is useless. So we must understand the meaning of valuable information. Benefits An MIS, when properly developed and used in an organization, benefits the organization. The benefits of MIS for an organization include:

Self-Instructional 50 Material Strategic Role of Information Systems NOTES a. Increased productivity: i. MIS reduces the time, errors and costs associated with processing information. ii. To increase productivity, MIS follows online transaction processing (OLTP), wherein data is gathered as input, processed and updated to be output as information. iii. MIS enables customers to process their own transactions through a customer integrated system (CIS). b. Enhanced quality of decision-making: i. Top managers use MIS to get relevant information to make the right decisions. ii. MIS support for decision-making falls into two categories: 1. MIS enables managers to analyse a situation by providing the relevant information. 2. MIS might also include recommendations on what action to take. c. Improves communication and develops team spirit: i. MIS enables information management and facilitates communication between diverse teams. ii. A collaborative management information system (CMIS) is used to improve team work. iii. One aspect of electronic data interchange (EDI) is electronic funds transfer (EFT), which enables payment without physically sending money. d. Facilitates organizational transformation: i. The use of MIS enables organizations to remain competitive, enter new markets and change the way they work. Limitations Even though MIS has many benefits, it has its limitations. The limitations of MIS are stated as: • An MIS is as good as its design: A badly designed MIS does not serve the management and is of little use. • An MIS is as good as its users: If users cannot leverage the information from an MIS, then it is of little use. • The MIS is no good if the basic data which goes into it is not good (MIS will only facilitate the garbage-in garbage-out process) These are the broad limitations of MIS. Information Management Information management (IM) is distinct from information technology (IT) even though IT is used to manage information. When management thinkers realized that information can be a key resource, they wondered how to manage it, because information can be a resource if it lends itself to processing, which includes one or more of the following operations: • Recording: Saving transaction-level data in a format for retrieval at a later date.

Self-Instructional Material 51 Strategic Role of Information Systems NOTES • Sorting, merging and sequencing: Ordering and sequencing the data in records. • Analysing: Using data analysis methods, such as summarization and clustering, to analyse the data. • Retrieving: Culling information from data repositories, based on various criteria. • Reproducing: Generating information more than once. • Visualizing: Providing information in a visually stimulating manner. Data processing is a complex exercise. Gathering information is another complex task that involves the capture and storage of transactions in databases, which have to be designed suitably, and then enable access to this data repository using networks. The visualization aspect or data output is another complex operation that includes query optimization, graphics, analysis and information modelling. IT is a term that refers to technologies, such as networking, communication, database management, application software, computer hardware and system software, graphical display and Internet-enabled technologies. The scope of IT use in organizations is in terms of the following: • The IT platform, which is the hardware and software infrastructure of the organization. • Information reach, which is the ability of the organization's IT platform to reach out and capture information both within and outside the organization. • Information range, which is the diverse types of information and related services that the IT platform enables the managers to access in the organization. 2.4.2 Why a Manager Needs an MIS A modern manager takes decisions for an organization. However, if managerial tasks are categorized as staffing, planning, controlling, organizing and leading, managers who work at different levels in an organization's hierarchy spend varying amounts of time on each activity. But most managers are expected to perform all these activities in their own spheres of influence. The manager needs information to perform all these activities. For example, when making a plan, a manager would need to know many things, which include the following: • What is the objective of the plan? • What are the parameters that need special attention while planning? • What are the independent variables and what are the dependencies? • How can this plan be made more realistic? • What is the context under which planning is done? • What are the key issues related to the plan? • Who are the key people involved and affected by the plan? Managers need answers to these questions to come up with a suitable plan. However, each question leads to a series of questions, and a vast amount of information is required to set the planning process in motion. A manager may not be fully aware of all the issues and might not be personally aware of the information against each issue. This is why he needs to rely on a system to provide him with this information. An MIS

Self-Instructional 52 Material Strategic Role of Information Systems NOTES bridges this gap by providing him with the information from different angles, thereby making his task easier. It is the same when the manager is organizing or controlling activities that he has planned—he needs information. Managers rely on reports for information. Reports are formatted documents wherein the information is arranged so well that the manager can understand it without analysis. Data visualization is a common tool used in reports, and can be done using graphs. The report structure, which is preformatted, also helps the manager locate information quickly—he knows where to look for information. 2.4.3 Information and Decision-Making If one agrees that decision-making is a process, then one has to understand how it works and how information is used in the process. Decision-making enables one to identify a problem or opportunity, understand the context in which the problem or opportunity has occurred, generate alternative solutions to tackle the problem or take advantage of the opportunity, and choose amongst the many alternatives. At each stage of this process, information is required. Information is required to identify the problem or opportunity, for without information, the decision-maker does not come to know of the existence of either the problem or the opportunity. For instance, if you continue to stay in a dangerous neighbourhood after spending the night at a party, you are in for trouble, and that trouble increases because of lack of information. So information plays a key role in the identification of the problem. Information is also required to understand the context of a problem. For example, in a dangerous area continuing to remain after a party becomes even riskier if you realize that this area has recently seen a string of murders by serial killers. If the information about the problem is qualified with the information about its context, your understanding of the problem improves. Thus, information plays a vital role in the contextualization phase as well. When generating alternatives, the decision-maker needs to know what will work in that particular situation. For example, when you find yourself stranded in an unsafe neighbourhood after a party, you should know what your alternatives are: to call a taxi, call a friend to ask for help or walk out of the neighbourhood. However, if you are unaware of the alternatives or the solutions to your problem, you cannot function. Thus, information plays a role here too. Information plays its most vital role when the decision-maker has to choose between numerous alternative solutions, which are evaluated based on the information available. Alternative solutions are evaluated on the basis of their outcomes and then the alternative that maximizes the benefit or minimizes the hardship is chosen. Information about the outcome (likely) of each alternative is vital for this choice. For instance, if you decide to call a friend to come pick you up from a dangerous neighbourhood, rather than call a cab or walk, you have made a choice to trust someone you know rather than take a risk. Thus, information plays a vital role in the decision-making process. Simon has created a model for human decision-making, which is linked to information requirement. Role of information systems in decision-making Since an MIS is concerned largely with managerial applications, an appreciation of the theory of organization is a prerequisite for a successful application of MIS. Some Self-Instructional Material 53 Strategic Role of Information Systems NOTES professionals in MIS area bring forth this point in the cryptic definition of MIS as 'the supply of right information, at the right time, at the right level.' Before discussing the use of MIS in decision-making, you will first learn the basic structure of an organization, i.e., the hierarchy of an organization. The levels of management in the context of MIS refer to the classification of management originally developed by Anthony. The different levels of management are generally referred to as a pyramid in a pictorial form to emphasize the fact that in any organization there are a few top positions, a large number of supervisory staff and a much larger number of operational staff. Placing these three staff positions in order, from top to bottom would lead to a structure loosely resembling the structure of pyramids. You will now learn how this pyramid represents the three categories of employees working in an organization. Anthony classified the three levels as strategic, tactical and operational. As strategic management is concerned with long-term policy decisions such as new plant location, new products and diversification they typically need a summary of plant/organizational-level information as well as unstructured and even vague information pertaining to the environment, such as the competitors, changes in government fiscal policy, emerging technologies, and so on. The tactical management comprising functional managers needs some external information but a lot of organization- wide information to exercise control over budgeting, quality, service, inventory, etc. The operational management is only concerned with plant/organizational-level information but in a far detailed manner such as individual operator-specific, machine-specific and shift-specific performance measures. To be successful, the MIS as an organization must explicitly take into account this classification of management. Since the summary information to be provided to the tactical and strategic management must be culled out of operational information, the accuracy and timeliness of information collection and dissemination is important at the operational level. However, at the tactical and operational levels, relevance is the watchword. A relevant but slightly inaccurate data is better than irrelevant but accurate data. The context decides the trade-offs, particularly when the cost of data processing is involved. Some professionals call this process information filtering, meaning that only filtered information culled out of operational data must be presented to the middle and top management. Some others put it more effectively by emphasizing efficiency at the operational level and effectiveness at the tactical and strategic levels. Successful development of information systems insists a thorough knowledge of the organizational structure and dynamics of the enterprise. Because firms are goal- oriented, the analyst must be clear as to what data exactly needs to be collected, stored and analysed. Since the context of information is necessary, only operational information that has some relevance in decision-making process must be collected. Moreover, the information collected and processed must be suitable for the level of the firm in which it is to be applied. According to Anthony's classification, there are three levels of management, independent of the size of the organization: operational level, middle level and top-level management. Operational decisions seek large volumes of internal data while the middle management is concerned with medium-range (tactical) decisions that call for much less information. The top management which is more bothered with the long-term (strategic) decisions calls for vital internal information as well as a lot of external information. Any successful information system should take into account all these diverse information needs of the firm.

Self-Instructional 54 Material Strategic Role of Information Systems NOTES Strategic Decisions Tactical Decisions Operational Decisions Operational Middle Top Tactical Data Strategic Data Operational Data Figure 2.1 Pictorial Representation of Management vs Information Pyramid This is generally displayed pictorially in the form of management versus information pyramid. The importance of information to management is further stressed by the fact that the aim of management is primarily decision-making. While there are several views regarding what constitutes management, it is generally accepted that all such activities pertaining to planning, organizing, coordinating, directing and controlling come within the ambit of management. Information systems should clearly differentiate between programmed and non-programmed decisions by properly structuring the appropriate information. Failure to identify basic anomalies may result in the breakdown of an information system. Many functional areas of management, such as personnel, marketing, production, finance and services are considerably affected by the information systems that are to be implemented in the firm. Care should be taken to identify the fact that in every functional area, the mapping of the informational pyramid must be carefully worked out. Table 2.1 is a typical example showing the three levels of information among the functional areas of management: Table 2.1 Example of a Typical MIS Strategic Tactical Operational Production Finance Personnel Marketing Welfare Policy Advertising Leave Records Sales Analysis Payroll New Plant Location Alternative Financing Variance Analysis Daily Scheduling Performance Appraisal Production Bottleneck Competitor Survey 2.4.4 Management and Decision-Making Management is defined as 'The process of planning, leading, organizing and controlling the resources of an organization in the effective and efficient pursuit of specified organizational goals.' It is responsible for the survival, success and prosperity of an organization. However, in discharging its functions, it faces lots of problems in today's dynamic and fiercely competitive world. The management has to utilize the resources—human, financial and physical— effectively by doing the right thing, and efficiently by doing things right, so that it is able to get things 'done' and 'deliver' goods/results. This involves managing work, people and operations optimally. Optimal utilization of resources, in turn, involves exercising choices and hence, the basic job of the management is 'decision-making' in the process of discharging the various functions assigned to it. A decision is a choice made from among available alternatives, and as such, all decisions have some impact/influence on the performance of organizations. It is the

Self-Instructional Material 55 Strategic Role of Information Systems NOTES quality of decisions, which helps organizations prosper, expand and make forays into diversified fields. Managers, therefore, have to develop decision-making skills, as managers are evaluated/rewarded on the basis of the results of their decisions. Quality of decisions is the yardstick for measuring their effectiveness and value to the organizations. Decision-making environment Decisions can be made under different types of environments such as ambiguity, certainty, uncertainty and risk. An environment is ambiguous when the problem is not clear, the goal is not clear and, hence, the outcome is also not clear. An environment is said to be certain where the relationship between inputs and outputs is known and hence, the result is also known. An uncertain environment is one where there is a lack of awareness about resources and input/output relations and, hence, the outcome is uncertain or unpredictable. A risky environment is one where the result is unknown; an organization may make a profit or incur a loss as a consequence of a particular decision. Types of decisions Decisions can be divided into two categories—programmed and non-programmed decisions. Programmed decisions The major characteristics of programmed decisions are as follows: • Routine/structured • Repetitive/short term • Definite procedure is to be followed • There are laid down norms • The situations are known • Taken at the lower/operating levels in an organization The techniques used for taking programmed decisions are as follows: • Habit • Standard Operating Procedure(SOP) • Organizational hierarchy/structure • Operational research • Computers Non-programmed decisions The major characteristics of non-programmed decisions are as follows: • Novel, not cut and dried • Innovative • New/complex situations • Important and critical • Strategic • Long-term

Self-Instructional 56 Material Strategic Role of Information Systems NOTES The techniques used for taking non-programmed decisions are as follows: • Judgement • Intuition • Business acumen • Creativity • Complex/specially-designed computer programs • Training executives We must remember that while at the lower level, the decisions are programmed, at the higher level, they are unstructured as illustrated as follows: This can also be illustrated by looking at the decision-making process from the organizational pyramidal point of view. Decision-making process The decision-making process involves the following steps: • Determining the existence of problems and/or opportunities • Generating the alternative course of action • Analysing/choosing/selecting a course of action • Implementing the course of action • Monitoring, following-up and initiating course-corrective action The various steps in the decision-making process have been illustrated by Griffin and are shown in Table 2.2. Table 2.2 Various Steps in the Decision-making Process Step Detail 1. Recognizing and defining the situation Some stimulus indicates that a decision must be made. The stimulus may be positive or negative. 2. Identifying alternatives Both obvious and creative alternatives are desired. In general, the more significant the decision, the more alternatives generated. 3. Evaluating alternatives Each alternative is evaluated to determine its feasibility, its satisfactoriness and its consequences. 4. Selecting the best alternative All situational factors are considered and the alternative that best fits the manager's situation is chosen. 5. Implementing the chosen alternative The chosen alternative is implemented into the organizational system. 6. Follow-up and evaluation At some time in the future, the manager should ascertain the extent to which the alternative chosen in Step 4 and implemented in Step 5 has worked.

Self-Instructional Material 57 Strategic Role of Information Systems NOTES The decision-making process can be represented by the following flow chart: Identify and define the problem Develop alternative solutions Evaluate alternative solutions Certainty conditions Risk conditions Uncertainty conditions Select alternative Implement decision Evaluate and control Decision-making styles Decisions may be taken by various functional executives. The decisions can be made in the following manner: • Taken by an individual manager • Consultative decisions through formal or informal consultations • Group decisions by o Colleagues o Task groups o Interacting groups o Brainstorming o Delphi techniques o Nominal grouping technique o Consensus mapping o Synectics Decision-making tools There are various decision-making tools such as follows: • Pay-off matrix • Decision tree/decision tables • Queuing models • Distribution models • Inventory models • Game theory • Devil's advocacy • Dialectic inquiry

Self-Instructional 58 Material Strategic Role of Information Systems NOTES (i) Pay-off matrix A pay-off matrix is one of the more commonly used and essential quantitative techniques of decision-making. It helps in summarizing the interactions of various alternative actions and events. The pay-off matrix takes into account 'probability' (i.e., the degree of likelihood that a particular event would occur). Probabilities range in value from 0 (no chance of occurring) to 1 (certain chance of occurring). Probabilities are usually expressed in terms of percentage or as the number of times the event is likely to occur in a hundred trials. By using probabilities a pay-off matrix is prepared, which provides the decision- maker with quantitative measures of the pay-off for each possible consequence and for each alternative under consideration. This is known as Expected Value (EV). Positive pay-off implies profit and negative pay-off implies loss. Let the following example illustrate the use of pay-off: A businessman wants to invest Rs 1, 00, 000 in a new business. He has identified three alternatives—A, B and C. The businessman has worked out the probabilities of his return on investment. He has estimated that there is a probability of 0.40 that sales will be high and a probability of 0.60 that the sales will be low. The pay-off matrix based on the data available with the businessman will be as follows: Alternative High Sales (Probability:0.40) (Rs) Low Sales (Probability:0.60) (Rs) Activity A + 45, 000 – 10, 000 Activity B + 80, 000 – 25, 000 Activity C + 30, 000 – 5, 000 From the pay-off matrix, the expected value of the investment in Activity 'A' will be as follows: EV = 0.40 (45,000) + 0.60(–10,000) = 18,000 – 6,000 = 12,000 The expected value for Activity 'B' will be as follows: EV = 0.40 (80,000) + 0.60(–25,000) = 32,000 – 15,000 = 17,000 The expected value for Activity 'C' will be EV = 0.40 (30,000) + 0.60(–5,000) = 12,000 – 3,000 = 9,000 The pay-off matrix shows that Activity 'B' can give him the best possible return among the three alternatives.

Self-Instructional Material 59 Strategic Role of Information Systems NOTES It must, however, be remembered that the pay-off matrix has an obvious weakness. It is dependent on the decision-maker's judgement of the possible outcomes for each alternative and also the values the decision-maker assigns to each. At the same time, it must also be remembered that the pay-off matrix forces the decision-maker to make a firm judgement about what he thinks may happen and the worth of those outcomes to him. The pay-off matrix does not make a decision but it does force the decision- maker to be more realistic about possible outcomes. (ii) Decision tree / decision tables A decision tree technique is an extension of the probability theory of decision-making. It is a simple technique, which mathematically factors the degree of risk into a business decision. It allows the decision-maker to work out the options after taking into account the 'odds', and then make a reasonably precise comparison among alternative courses of action. It is a useful technique for presenting analysis when the decision-maker has to make a sequence of decisions. It is referred to as a decision tree as different alternatives form branches from an initial decision point (known as decision node) and then moves on to various options emanating from different points (called chance nodes). The steps involved are as follows: • Build a tree starting with decision points • Add branches for the external states of events, which are likely to occur • Include probability of each state • Assign a value to each unique branch • Work backwards to analyse the consequences at each 'node' of the tree Thus, a decision tree is a means of representing the sequential multi-stage logic of a decision problem. The decision tree technique is oriented to show decision paths that may be taken rather than the criteria for selecting a given path. It is convenient for showing the probabilities for outcomes. Decision trees may be represented in the following different ways: (a) Bottom to Top (b) Left to Right (c) Top to Bottom

Self-Instructional 60 Material Strategic Role of Information Systems NOTES Standard Presentation The standard presentation of a decision tree is as follows: Decision rules Decision rules and decision tables are used together. Decision rules enable decisions to be made better and more economically. Decisions could also be faster and more accurate. Decision rules/tables are to be used for programmable or routine/operating decisions. It is, therefore, imperative that decision rules are documented. Decision table A decision table contains documents or rules that select one or more actions based on one or more conditions from a set of possible conditions. It is precise and compact. A decision table may include both qualitative and quantitative bases for decision-making. Decision tables are in the forms of 'IF' and 'THEN' listings. The 'IF' listings stipulate the required conditions and the 'THEN' listings provide the actions to be taken if the conditions exist. The 'IF' listing forms the 'CONDITION STUB' and the 'THEN' listing forms the 'ACTION STUB.' A decision table helps the analyst consider all options, conditions, variables and alternatives. It must, however, be remembered that this technique has to be used in conjunction with other techniques. Principles of decision-making Apart from the various tools and techniques used for decision-making as illustrated earlier, the following principles are also used for decision-making. • The principle of bounded rationality • The principle of logic and intuition Principle of bounded rationality While decisions should normally be based on rationality, what is observed is that our rationality, in reality, is conditioned by various factors/constraints which can be financial, technical or administrative. In view of this reality of situation, the principle of bounded rationality comes into existence. It implies that it is practically difficult, almost impossible, to take a completely

Self-Instructional Material 61 Strategic Role of Information Systems NOTES rational decision. The principle of bounded rationality, therefore, highlights the fact that as it is not possible to arrive at a scientific solution, it is worthwhile to carry on and arrive at workable decisions. If a scientific decision cannot be taken or implemented, it would remain only an ideal, hypothetical yet impracticable decision. Under these circumstances, a workable solution should be worked out while continuing to work on developing a scientific solution. In other words, a workable decision is the starting point of a scientific solution, which is the ultimate goal that one must strive to achieve. Principle of logic and intuition The principle of logic and intuition refers to taking a number of decisions based on their own logic and intuition, though professional managers are keen to take decisions based on data, facts and figures. Decisions based on intuitions are those where logical explanation is not possible though the decision-makers themselves believe, and like others to believe, that their decision is the right one. It must be remembered that in today's environment, where so much information is available, it would not at all be desirable to ignore logic while arriving at a decision. The focus should be on arriving at a decision mainly on the basis of data/information though due weightage should be given to logic and intuition as well. 2.4.5 Decision-Making Models Every manager has to take decisions on the basis of an appropriate model, and in a way, every manager is a model of decision-making himself. Though there are a number of models that facilitate the decision-making process, as per the requirements of the sylabi, the following decision-making models will be discussed: • The Classical Model • The Administrative Model • The Herbert Simon Model 1. The Classical Model According to the classical model of decision-making, a manager, when confronted with a decision-making situation, would collect all the information that is required for that activity and take a decision which would be in the best interests of the organization. 2. The Administrative Model In the administrative model, a manager is more concerned about himself. As such, when confronted with a decision-making situation, the manager would collect whatever information is available and take a decision, which may not be in the best interests of the organization but would certainly be in the best interests of the manager. Expediency and opportunism are the hallmarks of the administrative model. 3. The Herbert Simon Model The Herbert Simon model is related to the decision-making process. It describes the core of decision-making process. According to the Herbert Simon model, the decision- making process consists of the following three interrelated phases:

Self-Instructional 62 Material Strategic Role of Information Systems NOTES • Intelligence phase • Design phase • Choice phase The three phases are interrelated, as there is a flow of activities from the intelligence phase through the design phase to the choice phase. However, there may be a return to the previous phase as illustrated hereafter. The Herbert Simon Model Intelligence Design Choice The intelligence phase It consists of problem-finding activities related to searching of the operating/business environment for identifying conditions calling for decisions. This is imperative, as there cannot be any analysis/design/choice unless the problem is identified or clearly formulated/ stated. The intelligence phase requires extensive and comprehensive database. It, therefore, involves searching or scanning of the environment—both internal as well as external—for conditions, which indicate or suggest a problem or opportunity. The activity of search for problem/opportunity can be illustrated as follows: Societal Environment Competitive Environment Organizational Environment Intelligence Problem • Risk • Performance • Demand for Product, etc. Opportunity • Risk Reduction • Profit • Societal Service, etc. The environment for the purpose of discussions in the Herbert Simon model is divided into three broad categories: • Societal environment • Competitive environment • Organizational environment

Self-Instructional Material 63 Strategic Role of Information Systems NOTES •••• Societal environment: It includes economic, legal and social environment in which the organization operates. •••• Competitive environment: It includes understanding and analysing the characteristics, trends and behaviour of the market and the market players in which the organization operates. •••• Organizational environment: It includes capabilities, strengths, weaknesses, constraints and other factors affecting the ability of the organization to perform its functions. The scanning of the environment leads to identification of the problem/opportunity, which then leads to the next phase, i.e., the design phase of the decision-making process. The design phase The design phase involves inventing, developing and analysing possible alternatives to the problem/opportunity situation. Generally, the following iterative steps are used: • Support in understanding the problem. A correct model of the situation needs to be created/applied and the assumptions of the model tested. • Support for generating solutions by: o Manipulating the model to develop insights o Creating/using database retrieval system, which may help in generating a solution • Support for testing the feasibility of a solution by analysing it in terms of the environment it affects. The environment includes, as stated earlier, problem area, organization itself, competitors and society. The design phase then leads to the third and final phase of the Simon model, i.e., the choice phase. The choice phase The choice phase leads to the selection of a specific alternative or course of action from the ones generated and considered during the design phase. It requires the application of a choice procedure and the implementation of the chosen alternative. Limitations of the Herbert Simon model While, undoubtedly, the Simon model provides the core of decision-making process, it must be noted that it does not go beyond the choice phase. The Simon model, therefore, excludes or does not take cognizance of the implementation and the feedback aspects, which are an inseparable part of any decision-making process. In this context, it would be both relevant and pertinent to keep in mind the following steps of a decision-making process as suggested by Rubenstein and Herbertson: • Recognition of problem or need for decision • Analysis and statement of alternatives • Choice among the alternatives • Communication and implementation of decision • Follow-up and feedback of the results of decision

Self-Instructional 64 Material Strategic Role of Information Systems NOTES 2.4.6 Need for Information Systems in a Digital Firm This section discusses the various aspects of information systems and the factors that decide the organizational need for one. Competitive business environment In the last four decades, the following four powerful worldwide changes have altered the business environment: 1. Information technology has been instrumental in making local economies into a global one. An organization may have virtual teams working on a project and the team, suppliers and customers may be located across political and geographical boundaries. A manufacturing organization imports raw material or semi-finished products from vendors who give the best price and the required quality. IT helps in locating resources and their price, checking quality and tracking imports. US companies provide 24×7 support to their customers through their customer support offices located in India. Manufacturing organizations set up their manufacturing plant where market and trained manpower is available and the political environment is conducive. They manage their remote setups through IT. Organizations that are able to think globally are the only ones likely to survive in this era of a global economy. Business Strategy Rules Procedures Interdependence Software Hardware Database Tele- communi- cation Organization Information System Figure 2.2 Interdependence between Organizations and Information Systems 2. Manufacturing is not the dominating component of an economy any more. Knowledge- and information-based services constitute a major part of an economy. Companies are introducing new services and products to meet the requirements of the information economy. The lead time to introduce a new product or service has shortened and competition has increased. One of the reasons for increased competition is that the service industry requires less time and capital to be set up. India has been able to do better in the IT sector for this very reason. The product life has also become shorter. Earlier, the main activity of manufacturing organizations was mass production. Today, vendor management, sales and marketing and customer management
Self-Instructional Material 65 Strategic Role of Information Systems NOTES have become important activities. Many services have become popular and IT has played an important and crucial role in this. One can look around and find that a large number of people are employed by the service industry such as insurance, banking and education. IT plays a very critical role in providing services. Earlier, one had to remember when one's car insurance expired or when the car needed to be serviced. But now insurance and car service companies keep track of their customers and issue them reminders using IT tools. 3. IT has transformed organizations in multiple ways. Organizations now have fewer hierarchical levels than before. Earlier, an organization relied on fixed procedures that were often people-centric. The top management communicated the targets to the next level of management who then translated them into operational plans. Their operational plans reached the operational staff in terms of production schedules. The operational staff did not understand the importance of their work in the organization's overall objectives. A close supervision at each level was required because the operational staff played no role in decision-making and had very narrow job profiles. Figure 2.3 Comparison of a Traditional Hierarchical Organization with a Modern Day Digitalized Organization The scenario has subsequently changed. The job profiles at each level have become broader. Everyone is expected to make use of IT to access the information related to his job and understand his role, monitor his own progress and ensure quality in his work. Each employee knows his targets and makes a plan to achieve his goals. This is in contrast to earlier times when a plan was communicated to workers only for the prupose of execution. Any deviation in the plan required intervention of the management. Now the goals are known and employees are expected to adjust their plans to achieve their goals with minimum supervision. IT facilitates dissemination of information in a controlled manner. 4. IT has become an integral part of companies; it was introduced to the non- academic world in the 1960s in the US where it was accepted immediately to keep track of business transactions. Later, management information systems, followed by decision support systems, came into existence. Now, firms use IT to change their core business processes, manage their customers and suppliers and manage themselves and their employees. These firms are known as digital firms.

Self-Instructional 66 Material Strategic Role of Information Systems NOTES They rely on IT to a great extent. Look at the Indian Railways system that relies on IT for making reservations, scheduling, freight management, introducing new policies and trains and many more functions. It manages its human resources through IT as well. The salaries of the Indian Railways personnel, other benefits, their skill sets and the various training programmes they have undergone are all maintained in an easily accessible database. A firm uses a Supply Chain Management (SCM) system to manage and interact with its vendors. An SCM system helps an organization to plan its supplies and vendor-related activities. Another system called Customer Relation Management (CRM) system helps an organization to perform its customer-related activities. To manage the business processes within the organization, an Enterprise Resource Planning (ERP) system is used. These systems integrate with each other. A customer order entered into the ERP system is instantly visible to the production unit and a production plan is automatically generated or the existing one is revised. If the raw material is required to be ordered, a purchase order is created, which becomes available to the supplier through the SCM system interface. The customer can track his order through the CRM system interface. Many service-providing companies in India have become digital firms. Many government services—such as the passport offices—have become almost totally digital. 2.4.7 Contemporary Approaches to Information Systems The previous section discussed that an information system's main objective is to make information available to its users. The people involved in designing, implementing and using it have different perspectives. Technical approach Computer scientists look at an information system as a technical system and are concerned about putting hardware, software and networking together to make it work. Management science and operations research professionals provide application software and algorithms for decision-making and analysis. These approaches towards information systems comprise the technical approach. Behavioural approach Psychologists and sociologists are interested in learning about the impact of IT on management and their decision-making, and on individuals within the organization. The underlying assumption is that an information system affects processes as well as employees. One of the jobs of management is to ensure that employees work towards achieving organization goals. The central mechanism in the organization is one of the most expensive components. Economists study an information system to know if it helps in reducing the control cost. This approach towards information systems is termed as the behavioural approach. Socio-technical systems The latest trend is to treat an information system as a socio-technical system. This view integrates the behavioural approach to aid management in decision-making and may have an impact on the processes and people of an organization and is known as a Management Information System (MIS). People may take time to adjust to the impact of a new MIS because it may impact the manner in which employees have been doing their work. Management needs to understand this to work out a change strategy.
Self-Instructional Material 67 Strategic Role of Information Systems NOTES 2.4.8 Toward the Digital Firm: The Role of Information Systems in Organizations Nowadays, every organization uses IT. A medicine shop that one finds round every street corner in India may dispense around 25,000 medicines. The new regulations hold the seller accountable for selling any outdated or expired medicines. Therefore, most medicine shops now use a simple database system to keep track of their stocks and serve their customers better. One can clearly see that such a small system also requires domain business process knowledge. Widening scope of information systems An MIS integrates business strategy, processes and the governing rules with hardware, software, database and communication systems. If the technology or business strategies change, the MIS will also have to change. It is also important to design the system in such a way that it can adapt to changes. The life span of an MIS is approximately 5-10 years. When designing an information system, organization requirements for the next 5–10 years should be taken into account. An organization usually defines its strategic goals for about five years, so it is possible to assess the direction of change that will be required. The strategy may be to introduce a new product, increase market reach in terms of a new customer segment or new geographical area, or improve business processes to improve the quality of its products and services. The role of the MIS may also change in the organization. At first, an organization uses IT to keep track of basic transactions such as sales, purchases, salaries, etc. As they gain confidence and feel comfortable, they start using this consolidated data to make their decisions and check for any deviation from what was planned. As the usage of the information system increases, its spread and penetration in the organization also increases. The higher-level management starts using it for strategic decision-making and managing suppliers, customers and internal business processes. Real-time communication via the intranet and Internet has increased the scope of information systems' functions. A number of services and products have emerged due to the Internet technology. Businesses such as online shopping, online auction, comparative price checking, etc., are built on the Internet technology. Building, using, managing and obtaining productivity enhancement using IT are challenging tasks that require the involvement of management as well as employees. Flattening organizations and the changing management processes Information systems make information available to all employees – but with different levels of access. They are groomed and trusted to make decisions at their level using the required information. They can monitor their progress against targets using information in real time and take corrective measures or seek help if required. IT has been instrumental in empowering employees. Management can also access information and get a consolidated picture using information systems for which they had to earlier depend on the middle management. Organizations today have fewer layers of management and have therefore become flatter. The span of control and management is now across locations. Algorithms from mathematics, statistics, operations research and computer science have been integrated with information systems. These algorithms help management analyse data scheduling and strategic planning.

Self-Instructional 68 Material Strategic Role of Information Systems NOTES Separating work from location Employees, especially knowledge workers, can work from anywhere. Nowadays, organizations work with virtual teams. They have a very small team of just a couple of persons at the client's site to interact with the client, and the remaining team is located where it is most economical. Paperless offices are fast becoming a reality. A bank in Japan scans every paper that enters its programmes and files it away for legal purpose only. The digital images of papers and documents are electronically filed in a database. There is absolutely no paper anywhere in the bank, so no papers can be lost or misplaced! Reorganizing work flows Since all documents are available in an electronic form, parallel processing is possible. A loan application in a bank requires about ten different people to examine it and give their feedback. A paper-based sequential process takes about twenty-one days whereas an electronic document with parallel processing takes one day to approve a loan. IT has had a tremendous impact on work flow in organizations. It has led to extremely efficient processes. An organization starts out small with simple people-centric and ad-hoc processes. As the organization grows, the processes also grow—but in an ad hoc manner. These processes are often inefficient and do not integrate well with other functional units in the organization. IT provides an opportunity to organizations to critically evaluate their processes and improve them. Increasing flexibility of organizations Flexible manufacturing and mass customization have been possible due to information technology. IT helps organizations collect data on changing market trends and requirements, analyse data and often customize products on a mass scale. Information systems have added flexibility to manufacturing and production processes. Inventory purchase and production schedules can today be fine-tuned to customer requirements. Customized products and solutions can target specific market segments. This kind of marketing is known as micro marketing. If you visit Big Bazaar in three different states in India, you will notice that the products they carry are different and take local requirements into account. Redefining organizational boundaries: New avenues for collaboration Networks and IT have made organizational boundaries less rigid. E-commerce has integrated financial institutions seamlessly with buyers and sellers. Lead times and transaction costs have come down and cash flows have improved. The time cycle to procure requirements and to develop, manufacture and market a new product has become significantly shorter. 2.4.9 Classification of Information Systems Functionally, management can be segregated into several compartments; each having specific specializations. Normally, management is a term loosely used to identify people within an organization who have the authority and capability to take decisions (mostly functional for the middle and junior level, but strategic for the top level). The following is a brief description of the various functions of management.

Self-Instructional Material 69 Strategic Role of Information Systems NOTES 1. Marketing Functions Marketing is the activity of reaching out to customers, communicating the offerings of the organization to them, selling the product or service and ensuring their satisfaction. It is the activity through which an organization can keep its ears close to the pulse of the market. It generally encompasses the following subactivities: • Sales: It is the activity of selling the products or services of a firm. It is one of the most important activities of marketing and employs a large number of employees within the marketing department. Normally, sales function deals with the management of the channels of sales, i.e., managing wholesalers, retailers, stockists, etc., to ensure that the product or service reaches the consumer. Some authors argue that selling is a push activity for marketing in the sense that selling normally involves a top-down approach. Sales department is the department, which is the interface between the customer and the organization. One can conceptualize a sales department as lying at the boundary between the organization system and the environment of the customers. • Advertising: It is the activity of highlighting the positive aspects of a product, service, brand or company in electronic or print medium to create need among consumers. Advertising is essentially a pull activity. It creates a need among consumers and thereby increases the revenue of the organization. Sometimes, advertising can also be associated with creating an image for the organization or sending a message to the consumers. It is a tool at the hands of marketers to promote their products or services. However, advertising is not an exclusively targeted activity in the sense that the communication from the company to its consumers is not targeted at the specific segments of consumers but sent to all consumers in general. This 'carpet bombing' kind of strategy is a drawback of advertising. • Publicity: It is that activity, which also results in greater revenue for the company. It ensures that positive articles get published or broadcast so that consumers are convinced of the efficacy of a product or service. Normally, it is done in a way to show that the article or broadcast does not have any direct association with the company or the brand. For example, when a prominent nutrition specialist writes a positive article about a health drink saying that it reduces (say) cholesterol, then people reading the article may rightly infer that this is the honest opinion of the nutritionist; however, the fact may be that the health drink company may have persuaded or induced the nutritionist to promote the company's health drink. Publicity is used to create awareness and build customer base. • Product Management: It is the activity of managing the entire life cycle of a product. It involves managing all activities associated with the product. • Customer Relationship Management: It is the activity of fostering loyalty of the customer towards a brand or a product or a company. It encompasses activities, which result in greater understanding and knowledge of the customer. It is the activity, which enables a company to have a long-term view of customers rather than having a short-term view. The activity of CRM is based on the understanding of the customer as a person who has a long-term relationship with the organization rather than at the time of sale only. • Market Research: It is the activity of conducting research on the market for planning strategies or finding out whether the strategies of the company are

Self-Instructional 70 Material Strategic Role of Information Systems NOTES bearing results. It involves a lot of sampling survey and is applied to all aspects of marketing activity like finding out if an advertisement campaign has been successful or whether a class of product will have a market, etc. This activity is more prone to mathematical and statistical treatment and involves a lot of customer interaction. • Pricing: It is the activity of setting the price of a product or a service. It is normally a strategic decision as it is done with a view to beat competition. • Packaging: It is the activity of creating suitable packages for consumers so that the consumer is able to buy the product or service in order to maximize/optimize the profit of the organization. 2. Finance Functions No organization can survive without managing its finances. It is responsible for the management of receivables and payables, capital expenditure, costing and budgeting, taxes, etc. In short, finance is the function which helps us measure the value of the organization in monetary terms using several accounting, costing and mathematical tools. Financial management includes: • Working Capital Management: It is the activity of managing the working capital of an organization. Working capital is the capital required to run an organization on a regular basis. It is used to pay for salaries and materials. It is normally in the form of a short-term debt. • Receivables and Payables Management: The receivables and payables of a company are managed in this activity. It results in the management of creditors and debtors and helps management to take suitable decisions. This is a very important activity of finance and is done with diligence. • Budgeting: It is a strategic function of finance. It is the activity by which the quantum of money spent on each activity of the organization is set. This is a complex exercise and one which requires a strategic view of the organization for the future. • Capital Expenditure Management: This is an important activity which takes care of the capital expenditure of the company and makes a plan for such investments. These investments are inevitably linked with the cost of capital. • Auditing: It is the process of controlling finance systems. It gives us the variations between the planned and unplanned financial decisions. It also serves as a tool for taking care of malpractices in the firm by exposing frauds within the system. It also reveals any deviation from the general rules of finance as laid down by the company. These deviations, if analysed further and found serious enough, warrant attention by the top management which fixes responsibilities on people for such deviations and takes corrective actions. • Managing External Borrowings: It is also an important function these days as more and more companies are borrowing from outside the country. This is a specialized task involving managing foreign exchange, etc. 3. Operational Functions Every organization has an objective for existence, an offering in the form of a product or a service. Without an offering, management of other activities is meaningless. Operations management is that function, which helps an organization to manage the various activities related to the creation of a product or service. The various activities associated with the operations management are as follows:

Self-Instructional Material 71 Strategic Role of Information Systems NOTES • Production Management: It is the activity of managing the production process of a firm. It involves planning of production and capacities, monitoring of the production process, etc., so that control can be exercised over the production process. • Maintenance Management: It is the activity of managing the maintenance of machines in a firm. Different companies have different maintenance policies. • Quality Management: This activity is considered very important in most manufacturing and services organizations. It is the activity that measures the final output of the finished product or service against the standard. Any deviation from the standard is considered an aberration and corrective measures are applied to rectify the same. Quality management itself has several dimensions. Statistical quality control is a form of quality management that takes a view of quality that is measurable. Total Quality Management is the all-encompassing improved view of quality management that considers quality as a comprehensive package of managerial initiatives aimed at improving the quality culture of the organization. • Project Management: It is that activity that helps management to manage projects efficiently. It focuses on managing projects with respect to time and resource management. Precise mathematical techniques are used in this activity to manage projects. • Inventory Management: It is the activity to manage the raw materials and finished goods inventory of the company. This is an important activity as a lot of monetary resources are tied up in these areas. In addition, any shortfall in the raw materials may trigger a cascading effect on production and hence this activity is closely monitored. Vendors who supply the raw materials are carefully chosen and nurtured so that they perform their tasks with a high degree of reliability. Also, the lead time of vendors is closely monitored and updated regularly to reflect the current status. A lot of mathematical models are used for managing this function. 4. Human Resource Functions The most precious asset of any organization is its people. Managing them well leads to growth and prosperity and mismanagement results in losses. In fact, most of management literature is about managing this precious resource. HRM consists of the following: • Recruitment: It is the activity of selecting the right people for the right job. A selection process is used to select the right kind of people from a pool of interested people who have applied for the job in an organization. The recruitment activity is a regular activity in an organization as the organization being a growing entity requires more and more people to run its business and also because people leave an organization for various reasons. This process of people leaving an organization is called attrition. Recruitment is the process to neutralize the attrition effect and ensure that there are enough people to take care of the growth activities of the organization. It is an important activity and employs different techniques for attracting the right people for the job in the organization. The techniques employed are advertisement of jobs with enticing job description, salary details, searching for the right people with the help of online search engines, targeting potential employees through contacts and networks, employing consultants and agencies who have a database of the right kind of people for the job, etc. • Training and development: It is the activity, which involves the development of employees in terms of skills, personality, behaviour, etc. This activity is an

Self-Instructional 72 Material Strategic Role of Information Systems NOTES ongoing activity within an organization as most organizations believe in continuous improvement and in order to improve constantly, one must be trained. Some organizations consider this activity as not very important. However, most good companies take this activity very seriously as it holds the key to developing the human capital of an organization, which in turn results in improved performance of the organization. • Compensation and benefits management: This activity is required to fix the compensation and benefits of employees so that the employee is satisfied in terms of salary and benefits. This is a very crucial activity, as many things have to be taken into consideration in order to do justice to this kind of work. Issues like seniority, fairness, performance, etc., are very important in conducting this activity properly. • Performance management: It is a controlling activity. It is required to understand the level of performance of the employees in an organization. Those employees whose performance is not optimum are normally put through a training process. On the other hand, the high performance employees are rewarded so that they feel good and continue to serve the organization in future, with the same level of performance. 2.5 BUSINESS PROCESSING RE-ENGINEERING Business Process Re-engineering Sometimes, in order to develop a good information system which will serve the purpose of management even in the future, it becomes very important to have a re- look at the way business processes are conducted in a firm. The rationale for this is that the manner in which business is conducted changes with time and the information system that is designed over such outdated business processes will not provide any worthwhile value to managers. The components of management information system are as follows: • Physical ICT Infrastructure: This is the most basic component of MIS as without it MIS cannot function. It is the primary component of MIS. • System Software: Basic hardware alone will not make the system work. Systems software is also required. • MIS Application: Besides system software, the MIS application software is also loaded, which holds all the business logic and business requirements. The MIS application software will deliver information to managers. It has normally two or three distinct parts depending on the architecture of the system. If the client–server architecture is used, then the application is divided in two parts. However, if three-tier architecture is used, then the application has three parts. In the client–server architecture, the client and the server have separate functions. The client part is where the client business logic is loaded so that it can be analysed at the local client level. The server part is where the data resides. The server takes care of the data management only, while the client takes care of the business logic in the client–server architecture. However, in three-tier architecture another layer called the middle tier is used, which lies between the client and the
Self-Instructional Material 73 Strategic Role of Information Systems NOTES server. The client in this case only serves the purpose of providing the interface through which the user interacts with the system; the middle tier takes care of the business logic validation and the server manages the data. • Data Repository: In almost all MIS applications, a centralized data repository is required. This is an important component of MIS as it holds the most important resource of the system, data. • MIS Service Staff: MIS is incomplete without this vital component. MIS is heavily dependent on this component for trouble shooting and management of the system as a whole. • Information-Oriented Managerial Staff: The users are another component of MIS. They are the reason for MIS's existence. • Progressive Leadership: This is the invisible component of MIS. Without a progressive leadership at the top, which believes in the value of MIS, the system cannot succeed. This is another vital component of MIS. 2.6 SUMMARY In this unit, you have learned all about information systems and strategy. There are various strategies for running a system. Strategic information systems can facilitate an organization in changing the goals, operations, products, services or environmental relationships. They can be used to understand customer requirements and market trends faster and more deeply than the competitors. In this context, you have studied information systems and business strategy, information systems and firm-level strategy and information systems and industry-level strategy. 2.7 KEY TERMS • Primary activities: These activities are those that are

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most directly related to the production and distribution of the firm's products

and services that create value for the customer. • Business information system: It is a set of interrelated procedures using IT infrastructure in a business enterprise to generate and disseminate desired information. • Information strategy: It is an organization's unified blueprint for capturing, integrating, processing, delivering and presenting information in a clean, consistent and timely manner. • Support activities: These are those activities which make the delivery of the primary activities possible. 2.8 ANSWERS TO 'CHECK YOUR PROGRESS' 1. Primary activities as per Porter's value chain model include: • Inbound logistics — managing inventory after it has arrived in the organization • Operations — to add value to the raw material • Outbound logistics — get the products to the customers • Sales and marketing — identify customers • Service — provide support to the customers Check Your Progress 4. What are the reasons for increasing in competition? 5. What do you understand by the physical ICT infrastructure? 6. What is progressive leadership?
Self-Instructional 74 Material Strategic Role of Information Systems NOTES 2. One problem that has resulted from the absence of a chief information stragegy is the failure of the employees in a firm to obtain specific and qualified information. 3.

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The three principal concepts of analysing strategy at the industry level are (i) information partnership, (ii) the Competitive Forces Model and (

iii) network economics. 4. The following are the reasons why competition has increased: • Globalization and liberalization • Market dynamics that favour the efficient • The fast pace of recent technological change and innovation • Increased information exchange 5. Physical ICT Infrastructure is the most basic component of MIS as without it MIS cannot function. It is the primary component of MIS. 6. Progressive Leadership is the invisible component of MIS. Without a progressive leadership at the top, which believes in the value of MIS, the system cannot succeed. This is another vital component of MIS. 2.9 QUESTIONS AND EXERCISES Short-Answer Questions 1. What advantages do information partnerships offer? 2. Briefly explain the Porter's Competitive Forces Model. 3. What is outsourcing? 4. What is globalization? Long-Answer Questions 1. Discuss how IT helps a firm in reducing costs. 2. Discuss some of the functional areas where information systems can be used to gain competitive advantage. 3. Explain the need for managing information. 4. Explain how information can be considered as a resource. 2.10 FURTHER READING McLeod, R. Management Information Systems. Chicago: Science Research Associates, 1983. Curry, A., P. Flett and F. Hollingsworth. Managing Information and Systems: The Business Perspective. Oxford: Routledge, 2006. Orna, E. Information Strategy in Practice. Burlington: Gower Publishing Ltd., 2004. Madnick, S.E. (ed). The Strategic use of Information Technology. New York: Oxford University Press, 1987.
Self-Instructional Material 75 Management Information System and DBMS NOTES UNIT 3 MANAGEMENT INFORMATION SYSTEM AND DBMS Structure 3.0 Introduction 3.1 Unit Objectives 3.2 Modern Databases 3.3 Concepts of Database 3.3.1 Differences with Traditional File Organization 3.3.2 Approaches to Data Management 3.3.3 Database Management System: A Better Alternative 3.3.4 DBMS Services 3.3.5 DBMS Users 3.4 DBMS and its Advantages 3.4.1 DBMS Architecture 3.4.2 Advantages of DBMS 3.5 Classification of Database Systems 3.5.1 Types of Database Models 3.5.2 Schema and Subschema 3.5.3 Data Dictionary 3.5.4 Database Languages 3.5.5 Data Abstraction 3.5.6 Logical and Physical Views of Data 3.6 Modern and Advanced Databases 3.6.1 Distributed Database System 3.7 Data Warehousing 3.7.1 Overview of a Database Warehouse 3.7.2 Evaluation of a Data Warehouse 3.7.3 Rules for a Data Warehouse 3.7.4 Building a Database for a Data Warehouse 3.7.5 Developing a Data Warehouse for a Credit Card Bank: A Case Study 3.8 Data Mining 3.9

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Summary 3.10 Key Terms 3.11 Answers to 'Check Your Progress' 3.12 Questions and Exercises 3.13 Further Reading 3.0 INTRODUCTION

In this unit, you will learn about data management, its approaches and many other aspects related to data. Data is an indispensable resource for any organization and is generated for its operations. Data provides correct information for better utilization of other organizational resources, thereby helping an organization to make proper decisions at proper occasions or moments. Organizations cannot make good and effective decisions if the required data is not available in time, in the correct and desired format. The data that an organization necessarily maintains for ensuring its smooth operation is termed as
Self-Instructional Material 76 Management Information System and DBMS NOTES operational data. Sometimes, data and information are interchangeably used. However, it is necessary to mention here that data means known facts that can be recorded, whereas information refers to processed, organized or summarized data. You will also learn about data warehousing and data mining. A data

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warehouse is a subject-oriented, integrated and non-volatile collection of data.

It supports the management by enabling them to make better decisions. Data mining helps search information in a database and is indispensable to business related decisions. 3.1

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UNIT OBJECTIVES After going through this unit, you will be able to: • Understand the features of

a modern database • Explain the concepts of database • Appreciate DBMS and its advantages • Classify database systems • Discuss data warehousing and data mining 3.2 MODERN DATABASES A Modern database system is a type of DBMS that allows high-performance queries along with numerical data analysis over various relational databases. The main objective of modern database is to provide an interoperability technique that can run on multiple platforms such as Windows, Linux, etc. It can also handle complex object-oriented data, mediators, data warehousing, Internet, XML, numerical data, spatial data and semi-structured data, such as XML and RDF. You will now get a detailed description of a modern database. Data warehousing Data warehousing refers to a modern database maintained in an organization with various additional features such as integration and non-volatility of data. This modern database assists the management of an organization in the decision making process. You can design data warehouse using Online Analytical Processing (OLAP) and data mining. OLAP stores data in a multidimensional data model which makes a data warehouse compatible for the analysis of data. Data mining helps in searching data contained in huge databases. A database warehouse is subject-oriented, integrated, time-variant and a non-volatile collection of data. Object-oriented database A primary strength of object-oriented databases lie in their ability to model complex objects and inter-relationships among them. To make them available to the CORBA clients, a wrapper should wrap the interface of every database class by an equivalent CORBA compatible class. This class implements all methods of original database classes by the equivalents and is responsible for correct mapping of data between CORBA C++ and ObjectStore C++ data models. The instances of these classes act as usual CORBA objects as well as database clients. In other words they mediate between CORBA client and database objects converting data parameters and delegating all
Self-Instructional Material 77 Management Information System and DBMS NOTES function calls in both the directions. This separation allows working with the database not only through the new CORBA interface, but also through the original C++ interface. Moreover, when employing this method, any already existing data store with a compatible schema can always be used through the CORBA-interface. Referential integrity of the data shared by local and CORBA-conformant applications is guaranteed by the use of the native ObjectStore transaction control mechanism. XML The Extensible Markup Language (XML) does not require a complete replacement of an existing Web site environment, such as .NET, PHP (Hypertext Preprocessor), JSP (Java Server Pages), Java, ColdFusion, Dreamweaver, etc. It is more important to determine where to incorporate XML within the Web site so that it makes a noticeable impact. It is called semi structured modern database because it can be associated with MySQL (a database structured query language) that integrates the complete application with the back-end SQL database server. It makes more sense to focus on those areas of a Web site that are not managed efficiently and seem to be appropriate for an XML approach. The following are the aforementioned areas: • Publications or large amounts of text organized into pages and with links • Repetitive content or similar formatting • Identical information in different formats, such as HTML, PDF, printer friendly or for different devices, for example, computers, PDAs, cellphones Source XML File (Contents content that would be displayed in multiple web pages, such as the “About Us” section of the Web site) Transforming XSL File (Selects and formats portions of the Source XML file to create the individual HTML pages for the Web site) Producing HTML Web Pages via XML/XSL files HTML Output (Displayed as Web Page) HTML Output (Displayed as Web Page) HTML Output (Displayed as Web Page) HTML Output (Displayed as Web Page) Figure 3.1 Creating HTML Web Pages via XML Mediators As information systems become larger, their complexity becomes a crucial concern. While client-server systems with many components can be rapidly assembled with current middleware technology, their maintenance costs are high. By assigning sharable functionalities to services at the middleware layer, the high cost of adapting servers to increasing demands by client application can be mitigated. For instance, a new information function for a customer may not affect a client application greatly, but is likely to require additional server capabilities to provide the data. When a server is changed, all other
Self-Instructional Material 78 Management Information System and DBMS NOTES client applications must be checked, and perhaps adapted to the changes in the server. Switching to the new version must be scheduled weeks or months in advance. In two- layer client-server architecture all functions must be assigned either to the server or to the client. The current debates on thin versus fat clients and servers illustrate that the alternatives are not clear, even though some function assignments are obvious. Selection of data is a function which is best performed by the server since one does not want to ship large amounts of irrelevant data to the client. The effectiveness of the SELECT statement of SQL is an evidence of that assignment; not many languages can make do with one verb for most of their functionality. Customers at Client Workstations Value-added Services External and Internal Data Resources Application Layer Mediation Layer Foundation Layer Figure 3.2 Mediators for External and Internal Data Resources RDF Resource Description Framework is primarily intended to represent metadata that can be parsed and processed by machines rather than just displayed. These resources can be either in the form of content services that exist on the Web or they can be real-world objects. Anything with an identity can be described in RDF and, in this sense, RDF is a good candidate for recording and sharing knowledge on the Web. Graphically, you can begin to see how a collection of RDF statements creates an RDF graph. Figure 3.3 gives us a sense of what RDF represents. This representation could be written in RDF/ XML as a single document or in several documents that are linked together. Article1 Article 2 Article3 ArticleX ArticleY ArticleA ArticleB JohnDoe CodyBurteson MarySmith has Author has friend author of author of author of author of author of has friend Figure 3.3 RDF Graph

Self-Instructional Material 79 Management Information System and DBMS NOTES Finally, when you link several resources together in RDF, you achieve a web of data or metadata. RDF graphs create a web of data. Domain database In a client/server architecture, the Domain Name System (DNS) is used to identify clients and servers. You can use a URL of a website and a browser in a client/server architecture to access the Web sites available on the Internet. This system of naming reveals the name of the computers connected to the Internet. DNS translates the domain and host names to IP addresses. A domain name enables you to easily remember the address of a website. On the Internet, thousands of computers are connected and the host names can conflict. DNS was created to manage a number of hosts in a network. DNS is a hierarchical, domain-based and distributed database for implementing the naming scheme of the hosts on the Internet. Earlier, DNS was used to send and receive e-mails between the host computers, but now it is being used for other purposes also. DNS maps a name with the corresponding IP address by passing the host name to the resolver that sends the packet to a local DNS and returns the IP address related with that data packet. DNS namespace resembles the concept of a postal system in which it is necessary to specify the country, state, city and street address of the receiver, although in a different way. Similarly, the Internet can also be divided conceptually into more than 200 domains and each domain contains multiple hosts. Each domain is partitioned into subdomains that can be partitioned further. The domain namespace can be represented in a tree structure. DNS is implemented in the form of a binary tree which contains left, root and right nodes. The right-most node of the tree corresponds to the level of the tree closest to the root and the left-most node shows the level farthest from the root. The domains can be classified into two categories: • Generic • Country Generic domains are used to provide domain names to the hosts depending upon their generic behaviour. They contain all the general information and are also called organisation domains. Following are examples of the naming conventions of generic domains: • com: Stands for a commercial organization • edu: Stands for an educational institution • gov: Stands for a government institution • jut: Stands for an international organization • int: Stands for a military group • net: Stands for a network support centre • org: Stands for organizations not covered in any of the above Each domain name corresponds to a particular IP address. For example, www.google.com is a commercial site. To find the address of a site, the resolution application begins searching with the first-level label, that is, the type of domain attached with the site and after finding the match the pointer moves to the next level of the domain name and in this way to the associated IP address. A hostname is a domain name with one or more IP addresses associated with it. For example, the en.xyz.org. and the xyz.org. domains are hostnames, but the domain 'org.' is not the hostname. The DNS has a hierarchical set of servers, each known as DNS server. The two hierarchies are matched together.

Self-Instructional Material 80 Management Information System and DBMS NOTES The country domain of DNS uses the same format as the generic domain but uses two-character country abbreviations such as uk for United Kingdom in place of the three-character organisational abbreviations at the first level. The second-level nodes can be organisational or they can be more specific national designations. For example, the address anza.cup.ca represents DeAnza College in Cupertino in California in the United States. URL This stands for Uniform Resource Locator, which provides the address of a resource or file that is available on the Internet. It has three parts: protocol, DNS name of the host and name of the file. In the URL 'http://www.example.com/define/u/url.shtml', 'http:// ', provides the protocol; 'www.example.com' is the domain in which the main domain is, while; 'www' refers to a computer or a resource. '/define/u/url.shtml' is the location of a specific file on that server. Browser A browser is an application that is used to search and navigate on the Internet for accessing information. Commonly used Web browsers are Internet Explorer, Netscape Navigator, and Mozilla Firefox. These browsers can display text, graphics, audio and video. 3.3 CONCEPTS OF DATABASE This section discusses the various concepts regarding databases. 3.3.1 Differences with Traditional File Organization Traditionally, a file organization system was maintained to store records and information for further use, before smart computers were developed. At that time, concepts of data files were also in use and maintained in paper work. Files which were prepared manually were not easy to handle. One always feared that records and information may get spoiled. After the 70s, people became familiar with computers because they were developing rapidly. Then, the data was entered through the keyboard to the computer memory. Nowadays, computers are being used in small and big organizations. 'File organizations' concept is being used in computers to overcome this problem. Basically, it is a type of system which searches specific records in the file. Therefore, files may be organized in a sequence to find the specific record. The concept of a file can be used for various purposes, such as to add the record/information, update the record/information and delete the record/information. The three methods of file organization are given as follows: File Types Functions Sequential Files are organized sequentially, or one after other. Index Sequential Files are storage sequentially but may be accessed in a random manner. Relative It is known as direct file organization and can have multi- correspondence with the physical positions of the records for relative organization. Hence, they are known as random files. 3.3.2 Approaches to Data Management Conventionally, before database systems were introduced, data in software systems was maintained using files. In this approach, the needed data is stored locally and programs are developed for each type of application. Check Your Progress 1. What is the main objective of a modern database? 2. What is OLAP? 3. What is a browser?

Self-Instructional Material 81 Management Information System and DBMS NOTES Terms related with the file processing system The following terms are related with the file processing system: •••• Data, which is raw facts, is provided to the computer in terms of bytes. •••• Data item is the smallest named unit of data that has meaning in the real world. Examples include employee name, address and employee code. Traditionally, the term, data item, is called field in data processing and

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is the smallest unit of data that has meaning for its users. Record is

a set of related data items (fields) organized in a well-defined structure treated as a unit by an application program. The structure of a record depends on: o Items to be included: their characteristics, variability, prevalence in file o The intended use(s) of the information: time requirements, overlapping or conflicting requirements o Update characteristics, e.g., frequency, growth, deletion and modification, time constraints, etc. o Links to other records/files/systems o Computing environment like operating system, languages, hardware, etc. •••• File is a collection of all occurrences (instances) of similar type of records, i.e., it is a group of records of a single type. Advantage and disadvantages of file processing system In file-based systems, an organization stores information as groups of records in separate files. These file-based systems consist of a few data files and many application programs. Data files are organized to facilitate access to records and ensure their efficient storage. In a file-based system, there are two types of records—logical records and physical records. A logical record is a collection of related data items treated as a conceptual unit independent of how or where the information is stored. A physical record is a contiguous area of storage space defined by the characteristics of storage devices and operating systems and includes all the bytes, which will be read/written by a single command to the I/O device. A file processing system relies on the basic access methods of the host operating system for data management. A file processing system can only request for data from the operating system by demanding a specific logical record. The operating system keeps track of the relationship between the physical and logical records and the location of the physical records in a specific file. The application program locates fields within the logical records. A progam in a file processing system takes less time to execute than an equivalent program written in a high-level language because the sort, merge and report generation features are already in-built in the file management software. Besides, the cost of software development is less. Such file-based approaches provide improved automated data processing and, hence, are an improvement over the earlier manual paper record-based systems. However, a file processing system suffers some significant disadvantages, which are as follows: •••• Data redundancy and inconsistency: A major drawback in the traditional file system environment is non-sharing of data. It means that if different systems of an organization are using some common data, they do not share it. Instead, each system stores data in separate files. Often, the same information is stored in Self-Instructional Material 82 Management Information System and DBMS NOTES more than one file. This redundancy in storing the same data in multiple places leads to several problems. First, this leads to wastage of storage space and poses a serious problem if the file processing system has to manage a large amount of data. Second, it leads to the duplication of effort, as one needs to perform several updates. Third, data inconsistency leads to a number of problems, including loss of information and incorrect results. •••• Difficulty in accessing data: A file-based system does not provide users with ad hoc information requests as most of the information retrieval possibilities are implemented based on pre-determined requests for data. In today's competitive business environment, apart from scheduled requests, it is important that unexpected queries are also addressed. A new application program often requires an entirely new set of file definitions. Even though an existing file may contain some of the needed data items, the application often requires a number of other data items. As a result, the programmer has to recode definitions of the required data items from the existing file as well as definitions of all new data items. This creates a need for excessive programming. Therefore, conventional file processing systems do not allow a convenient and efficient retrieval of the required data. •••• Data isolation: Data is scattered across various files, in different formats. In a file processing system, it is difficult to determine the relationships between the isolated data in order to meet user requirements. To tackle such situations, first, the files have to be evaluated by analysts and programmers to determine the specific data requirement from each file and the relationships between the data. Then applications have to be written in a third-generation language for processing and extracting the required data. Imagine the work involved if data was required from several files! •••• Program–data interdependency: In a file-based system, data is organized in the form of files and records. Files and records are described by specific formats and access strategy, which are coded into an application program by programmers. Such application programs are data-dependent. Consequently, in such an environment, any change in data structure or format requires appropriate changes in all the concerned application programs. This makes change very problematic for the designers and developers of the system. •••• Atomicity problem: In many applications, which have already been implemented, it is not easy to verify that data has been restored to its last consistent state following the detection of a failure. •••• Integrity problem: Data integrity means correctness or accuracy of data. It ensures data accuracy. Data values stored in a file system may have to satisfy certain constraints. Programmers enforce these types of

have to be added, it is difficult to change the program so as to enforce them, quickly and effortlessly. •••• Security problems: In conventional systems, applications are developed in an ad hoc manner. At times, different components of the operational data are accessed by different parts of a firm. In an environment of this type, it can be quite difficult to ensure / enforce security. •••• Concurrent access anomalies: If the system allows multiple users to update the data simultaneously, the interaction of concurrent updates may result in
Self-Instructional Material 83 Management Information System and DBMS NOTES inconsistent data. In the traditional file system, such concurrent access anomalies cannot be avoided without a huge programming effort. All the above limitations can be attributed to the following main factors: ••••

In such an environment, any change in data structure or format requires appropriate changes to the application programs. •••• There is no control over the access and manipulation of data beyond that imposed by the application programs. 3.3.3 Database Management System: A Better Alternative With a Database Management System (DBMS) the scenario is totally different. This software allows application programs to deal with data field names irrespective of the location of the fields within the records, the location of the records within a file, and of the file within a device. In a DBMS, all files are integrated into one system, thus making data management more efficient by providing centralized control on the operational data. Database management systems are not only used in commercial applications, but also in many scientific/engineering applications. Database A database is a place where data can be stored in a structured manner. It is a shared collection or batch of data that is logically related. It is designed to meet an organization's information requirements. A database is a complex data structure. It is stored in a system of mutually dependent files. These files contain the following information: 1. The set of data available to the user, also called 'end-user data.' It is the real data, which can be read, connected and modified by the user (if he has the corresponding rights). 2. The data describing the end-user data is called 'metadata'. Here, the properties (e.g., their type) and the relative relations of the end-user data are described.

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Database management system (DBMS) It is a software system that allows users to define, create and maintain

a database
as well as control its access. It can be called a collection of interrelated data (usually called database) and a collection or set of programs that helps in accessing, updating and managing that data (which form a part of a database management system). The primary benefit of using a DBMS is to impose a logical and

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structured organization on data. A DBMS provides simple mechanisms for processing huge volumes of data because it is optimized for operations

of this type. The two basic operations performed by the DBMS are as follows: •••• Management of data in the database •••• Management of users associated with the database Management of the data means specifying how data will be stored, structured and accessed in the database. This includes the following:
Self-Instructional Material 84 Management Information System and DBMS NOTES •••• Defining: Specifying data types and structures, and constraints for data to be stored •••• Constructing: Storing data in a storage medium •••• Manipulating: Involves querying, updating and generating reports •••• Sharing: Allowing multiple users and programs to access data simultaneously Further, DBMS must offer safety and security of the information stored, in case unauthorized access is attempted or the system crashes.

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If data is required to be shared among many users, the system must ensure that possible anomalous results

are avoided. Management of database users means managing the users in such a way that they are able to perform any desired operation on the database. A DBMS also ensures that a user cannot perform any operation for which he is not authorized. In short, a DBMS is a collection of programs performing all necessary actions associated with a database. There are many DBMSs available in the market such as Access, dBase, FileMaker Pro, Foxpro, ORACLE, DB2, Ingress, Informix, Sybase, etc. A database application is a program or a set of programs that interacts with the database at some point in its execution. It is used for performing certain operations on data stored in the database. These operations include inserting data into a database or extracting data from a database based on certain conditions, updating data in a database, producing data as output on any device such as screen, disk or printer. A database system is a collection of application programs that interacts with the database along with DBMS and the database itself (and sometimes the users who use the system). Database systems are designed in a manner that facilitates the management of huge bodies of information. A database clearly separates the physical storage of data from its use by an application program to attain program–data interdependence. The user or programmer who uses a database system is unaware of the details of how the data are stored. Data can be changed or updated without effecting the other components of the system. 3.3.4 DBMS Services A DBMS is mainly used for data and database management. The processes of database management and data management are complementary. The responsibility of data management includes data and its structure as well as the integration of data and processes. On the other hand, database management, covers the security, physical implementation and maintenance of the physical databases. It is the responsibility of database management to manage and enforce the enterprise's policies related to individual databases. Almost all the additional utilities and services outlined here are provided by most database management systems: •••• Enforcement of integrity: It is necessary for the data values stored in a database to be consistent in a certain way. The balance of a bank account, for instance, may never be below a specific amount, say Rs 1000. Integrity can be maintained by a centralized control of database. It also allows the DBA to define validation procedures that need to be carried out whenever an attempt is made to update, that is, modify, create or delete.

Self-Instructional Material 85 Management Information System and DBMS NOTES •••• Transaction management: At times, a single logical unit of work is performed by numerous operations on the database. Transaction is an action that is used to perform some manipulation on data stored in the database. DBMS is responsible for supporting all the required operations in the database; it also manages the execution of transactions so that only authorized actions are performed. The execution of transactions requires Atomicity, Consistency, Isolation and Durability (ACID) properties. Either all operations of a transaction will be executed or none of the operations will take effect (atomicity). As a result of a transaction, data records are accurate (consistency). When two or more transactions run concurrently, their effects must be isolated from one another. If a transaction has completed its operations, its effect should not be lost even if the system fails immediately after the transaction is complete (durability). In case of failure, abandoning the partial transaction and re-applying it becomes necessary. Also, in the event of failure, the database should be able to restore itself to a consistent state. •••• Backup and recovery: To ensure the restoration of the previous state in case of a logical or physical corruption or data loss, a DBMS keeps back-up copies of the database. It keeps a log of all the operations performed on the database so that the database can be restored up to the last consistent state after the system's failure. In such cases, database can be updated using logs. •••• Security management: The security management done by a DBMS is as follows: oooo Prevents unauthorized database users from accessing the database. oooo Prevents unauthorized users from accessing any part of the database information or manipulating data. This control is normally done using sub- schemas and user views or by applying access rights. oooo Protects the data to prevent unauthorized users from reading or understanding the content of the database. Data encryption is used to protect information stored on a disk as well as information exchanged on a network. •••• Concurrency control: Multiple users and/or programs can simultaneously access a single database. Some of the major issues addressed by the concurrent access to data include the following: oooo A wrong view of the database by one user while the database is being updated by another user. oooo Updation by multiple users, concurrently, may lead to an inconsistent state or result. A DBMS must ensure that such concurrent anomalies are avoided. •••• Storage management: Data has to be stored externally on a high-speed, random access device. The users do not have to worry about the place and manner of data storage. This is because they can rely on DBMS to do that. These details are simplified by DBMS. The effectiveness of a DBMS can be measured on the basis of its efficiency and speed in storing and retrieving data. Efficiency can be measured in two ways—space and speed. Under normal circumstances, you can have either one of them, not both. Database manager is a component of DBMS, which addresses such problems. All storage and retrieval related issues are dealt with by this component.

Self-Instructional Material 86 Management Information System and DBMS NOTES •••• Restructuring: Any change in the database schema may result in inconsistency in the database. Restructuring is a utility for transferring the old database into a new instantaneous database under a new schema. A comparison of the file processing system and DBMS has been done in Table 3.1. Table 3.1 File Processing System versus Database Management System DBMS File-processing system It is a shared set of data that is logically related. The data is designed to meet the information requirements of an organization. It is a set of application programs that serves the end-users in various ways, such as by producing reports. Each program defines and manages its own data. Redundancies and inconsistencies in data are reduced due to single file formats and duplication of data is eliminated. Redundancies and inconsistencies in data exist due to single file formats and duplication of data. Data is easily accessed due to standard query procedures. Data cannot be easily accessed due to special application programs that are required to access data. Isolation/retrieval of the required data is possible due to common file formats and the provisions to retrieve data easily. Data isolation is difficult due to different file formats, and also because new application programs have to be written. Program and data are independent. There is a dependency between application programs and data because, definition of data is embedded in the application program rather than stored separately. Integrity constraints, whether new or old, can be enforced as per requirements. Data integrity is determined by the data itself. Introduction of integrity constraints is tedious and new application programs have to be written in order to maintain data integrity in each application. Atomicity of updates is possible. Atomicity of updates may not be maintained. Several users can access the data at the same time, without any problems. Concurrent access may cause problems such as inconsistencies. Security features can be easily enabled in a DBMS. It may be difficult to enforce security features. Cost of the system depends on application. It involves high cost as additional hardware is needed and conversion of the existing one is required. A DBMS is usually a software of considerable size, adding to an overhead. Size of the software is small as compared to DBMS. 3.3.5 DBMS Users •••• Database Designer: Before implementing a database and populating the database with data, it is important to identify the data that has

A database designer does the aforementioned tasks

They analyse and integrate all external views from different groups of users and their data and processing requirements. It is their responsibility to identify the integrity constraints during the database design. •••• Data administrator (DA): A non-technical person who is responsible for managing the data resource of an organization and deciding its policies. •••• Application Programmer: A computer professional who writes application programs through which a user can interact with the system. Application programmers use several tools such as Rapid Application Development (RAD) tools to construct forms and reports without application programs. Sometimes,

Self-Instructional Material 87 Management Information System and DBMS NOTES they interact with the system through DML calls, which are embedded in a program written in host languages. This category of database users has a clear idea of the structure of the database and knows clearly about the needs of the organizations. •••• Database Administrator (DBA): The database administrator (DBA) is the person (or a group of people) responsible for the overall control of a database system. Once database is installed and is functioning properly in a production environment of an organization, the database administrator takes over and performs the following DBA-related activities: o Database maintenance o Database backup o Grant of rights to database users o Managing print jobs o Ensuring quality of service to all users Routine work Routine work performs the following: •••• Acts as liaison with users to ensure that the data they require is available and writes the necessary external schemas and conceptual/external mapping (again using DDL) •••• Responds to modifications in requirements, monitors performance and modifies details related to storage and access. It thereby organizes the system in a manner that will provide the best performance for the organization. End-users End-users are those who use the DBMS for querying, updating generating report. They can be classified into the following categories: •••• Native

by the application programmer. Tellers in a bank, reservation clerks for airlines, hotels, etc., are the native users. •••• Sophisticated users interact with the system without writing a program. Instead they form their requests using database language especially DML. Other tools they use are OLAP and data mining tools, which help them summarize data in different patterns, occasionally accessing the database using database query language. •••• Casual users are those who access the database occasionally and have different needs each time. They use a sophisticated query language. A database administrator interacts with the database designer during the database design phase so that he has a clear idea of the database structure for easy future reference. •••• This helps the DBA perform different tasks related to the database structure. •••• The DBA also interacts with the application programmers during the application development process and provides his services for better design of applications. •••• End-users also interact with the system when using application programs and other tools. Check Your Progress 4. List the terms related with the file processing system. 5. What does the management of data include? 6. Who is a data administrator?
Self-Instructional Material 88 Management Information System and DBMS NOTES 3.4 DBMS AND ITS ADVANTAGES Database management systems are complex systems. To understand database concepts and the structure and capabilities of a DBMS, it is useful to examine the architecture of a typical database management system. 3.4.1 DBMS Architecture There are two different ways to interpret the architecture of a typical database management system: (i) the logical DBMS architecture that deals with the way data is stored and presented to users and (ii) the physical DBMS architecture that is concerned with the software components that make up a DBMS. 1. Logical DBMS Architecture The logical architecture of a DBMS is a three-level architecture. It was suggested by

logical architecture describes how users perceive data in a database. DBMS provides the user with an abstract view of data. Users can access and manipulate data without worrying about where it is located or how it is actually stored and maintained. This is done by defining levels of abstraction. The three levels of abstraction, are as follows: •••• Physical or internal level is

in a physical media. It provides a low-level description of the physical database. •••• Logical or conceptual level is the next higher level of abstraction. It describes the stored data and its interrelation. •••• External or view level is the lowest level of abstraction as seen by a user. It provides a window on the conceptual view, which allows the user to see only that data which of interests him. That is, this level of abstraction describes only a part of the entire database or a subset of the database. The following diagram shows the logical architecture for a typical DBMS: Physical storage Figure 3.4 Logical Architecture of DBMS
Self-Instructional Material 89 Management Information System and DBMS NOTES The three-level database architecture allows a clear separation of data representation as the users see it and the physical data structure layout. This separation of different views of data is flexible and adaptable. This flexibility and adaptability is known as data independence. Since a schema defines each view, there exist several schemas in the database partitioned according to the levels
of abstraction.

The conceptual schema defines this conceptual view. There is only one conceptual schema per database.

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Each external view is described by means of a schema called an external schema or

a subschema. Any number of external schemas can be defined and they can overlap each other. Mapping between the Levels Mapping is the transformation of requests and results between different levels of abstraction. It can be conceptual/internal or external/conceptual. The conceptual/internal mapping exists between the conceptual and internal levels. It defines the correspondence between the records and the fields of the conceptual view and the files and data structures of the internal view. If the structure of the stored database is modified, then a corresponding change must be made in the conceptual/internal mapping to ensure that the view from the conceptual level remains as it is. In other words, if the physical structure of the database is modified, the DBMS is aware of it and continues to provide the same logical view as it did before. This is called physical data independence. External conceptual mapping exists between the external and conceptual levels. This defines the correspondence between a particular external view and the conceptual view. If the structure of the database is modified at the conceptual level, then the external/conceptual mapping must also change accordingly so that the view from the external level remains constant. This mapping provides a logical data independence for the database. Two types of data independence can be defined with respect to the three-level architecture, that is, logical data independence and physical data independence. The ability to modify the conceptual scheme without modifying the external schemas or application programs is called logical data interdependence. At this level, changes are usually made to improve performance. The ability to modify the internal scheme without changing the conceptual schemas or external schemas is known as physical data interdependence. If the conceptual view is separated from the internal view, it allows the provision of a logical description of the database without any need for specifying physical structures. Modifications to the internal schema may be required because some physical files need reorganization. This is usually done when the logical database structure is modified. Sometimes, it is needed to make a change in the logical structure of the data. 2. Physical DBMS Architecture Physical DBMS architecture describes the related and interconnected software components of a DBMS. At an extremely basic level, the physical DBMS architecture can be split into two parts: the back end and the front end. Management of the physical database and provision of relevant support and mappings for the internal, external and conceptual levels is the responsibility of the back end. In addition, the back end is Self-Instructional Material 90 Management Information System and DBMS NOTES also responsible for other such advantages of a DBMS as access control, security and integrity. The front end is really just any application that runs on top of the DBMS and acts as a user interface. These applications may be provided by the DBMS vendor, the user or a third party. The back end can be further divided into functional software components, which are as follows: DML precompiler: It converts Data Manipulation Language (

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DML) statements embedded in an application program to normal procedure calls in

a host language. Through the DML precompiler, DML commands and application programs written in the host language are separated. DML commands are sent to the DML interpreter for translating into an object code for database access and the rest of the program is sent to the compiler of the host language. Object codes for the commands and the rest of the program are combined together and sent to the DBMS engine (also called database manager) for execution.

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The precompiler must interact with the query processor in order to generate an appropriate code.

The precompiler interacts with the query processor. DML compiler: It translates DML statements into low-level instructions that a query processor understands. DDL interpreter or compiler: It interprets Data Definition Language (DDL) statements and records definitions into a data dictionary.

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Query evaluation engine: It executes low-level instructions generated by the DML compiler.

It mainly deals with solving all problems related to queries and query processing. It helps the database system facilitate access to data. Database manager: It

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is a program module that provides an interface between low-level data (stored in the database) and the application programs and queries which are submitted to the system.

The functions of a database manager include: • Efficient storage, retrieval and updation of data • Interaction with the file manager • Ensuring a state of consistency in the database irrespective of system failures • Maintenance of integrity controls and user authority for data accession File manager: It manages the allocation of disk space and data structures which are used to represent information on disk. In addition, several data structures are required to implement the physical system. • Data: It is stored in data files, which is stored in the database itself. • Data dictionary: This is a critical element in DBMS. The results of compilation of DDL statements are

which documents data in a database. A data dictionary contains metadata (data about data). Metadata is data about the storage details of a database. • Indexes: To improve the performance of a DBMS, a set of access aids in the form of indexes are usually provided in the database systems. An index is a data structure that helps access data through a given part of their value. It
Self-Instructional Material 91 Management Information System and DBMS NOTES provides fast access to data. Several techniques are used to implement indexes. However, each technique is specific to a particular database application. A DBMS provides commands to build, maintain and destroy such indexes. • Statistical data file: The query processor uses statistical data to optimize queries. • Log file: Each log record comprises the values for database items before and after a modification and it can be utilized for the purpose of recovery. 3.4.2 Advantages of DBMS A DBMS has three main features that provide a number of advantages for data management: • Centralized data management • Data independence • Data integration The following are the advantages of DBMS: • Centralized control on data and data source: In a DBMS, all the files are integrated into one system thus making data management more efficient by providing centralized control on the operational data. DBMS has a number of advantages including reducing redundancy, avoiding inconsistencies, sharing of data, giving better service to users, enforcing standards, etc. • Data consistency: Minimal data redundancy means improved data consistency. • Data independence: Data independence

technique. The provision of data independence is a major objective for database systems. If the data is well designed, the user can access different combinations of the same data for query and report purposes. • Data integration: Since related data is stored in one single database, enforcing data integrity is much easier. In a DBMS, integrity rules can be enforced with minimum programming in the application programs. • Data sharing: Related data can be shared across programs since data is stored in a centralized manner. This provides improved data sharing, data accessibility and responsiveness. Even new applications can be developed to operate on the same data. • Access control: A DBMS should provide facilities for protecting the security and privacy of data from unauthorized users. • Ease of application development: A DBMS provides increased productivity for application development. The application programmer is not required to build the functions that handle issues such as data integrity, security and concurrent access. All that a programmer is required to do is implement the application business rules. This makes the development of application more convenient. • Reduced maintenance: Though data in a database can be shared by many applications and systems, maintenance is minimal and easy due to the centralized nature of the system.
Self-Instructional Material 92 Management Information System and DBMS NOTES 3.5 CLASSIFICATION OF DATABASE SYSTEMS A database system is a computerised record-keeping system that allows you to electronically organize and manipulate data in a fast and secure way. It is a kind of a software program that keeps records and helps store and manipulate data in the interrelated tables of a database system. It allows you to store and maintain data, using three levels of data abstraction. The interrelated table allows you to maintain the data of an organization using computers. In a database system, the data is spread over multiple sites. The sites are connected by some form of communication network. You can classify databases on the basis of various factors, such as degree of homogeneity. If all the servers or individual local DBMS as well as all the users use an identical software, then it is classified as homogeneous database system and heterogeneous database system, respectively. Homogeneous database systems A homogeneous database system is basically a network consisting of two or more databases. These databases use the same software and reside in multiple machines. The following figure illustrates a homogeneous database system that connects three databases: ho, mkt, and purchase. ho.com Marketing Head Office mkd.com Distributed Database purchase.com Purchase Figure 3.5 A Homogeneous Database A database environment defines an application which can simultaneously access or modify existing and specified data in the database tables. Any query received from a manufacturing client on the local mkt database can retrieve the joined data from the products table existing on the local purchase database and the dept table on the remote ho database. The location and platform of the databases are transparent for the client application. In the database system, synonyms can be created for remote objects so that the users can access them using the same syntax as for local objects. Heterogeneous database systems In a heterogeneous database system, at least one of the databases uses different software from the others. For example, if all the databases in a database system are using an SQL server and one of them is using some other non-SQL Server Database system, then it constitutes a heterogeneous database system. To the application, the heterogeneous database system appears as a single, local SQL Server database. The local SQL server hides the distribution and heterogeneity of the data from the user. The

Self-Instructional Material 93 Management Information System and DBMS NOTES SQL server accesses the non-SQL database system using the SQL server heterogeneous services in conjunction with an agent. A heterogeneous service agent is the process through which an SQL server connects to a non-SQL server system. An agent can reside in the following places: • On the same machine as the non-SQL server system • On the same machine as the SQL server system • On a machine different from either of the above two server systems 3.5.1 Types of Database Models File systems of various degrees of complexity support information storage and processing. Some enterprises built their own independent files which have related and overlapping data and data processing actions become necessary for linking data from several relevant files. Hence, design data structures and database management systems were developed to support automatic linking of related files. The following three database models were planned and developed to support linking of different types of records: (1) Relational model: In this model, the data is represented in simple tabular form. (2) Hierarchical model: In this model, data record types are represented in a tree- like structure. (3) Network model: In this model, the arbitrary linking of record types is done. 1. Relational Model Relational database management system, or RDBMS, is a database model developed by E.F. Codd. A relational database supports a defined data structures, storage and retrieval operations and integrity constraints. In this type of database, the data and its relations between them are organized in tabular forms, where each table contains a set of records. In a relational model, the described particular entity is provided by the set of its attribute values and is stored as one row of the table or relation. This is also termed as linking of n attribute values to provide a significant depiction of a real-world entity or a relationship between such entities to form a tuple which is similar to a mathematical n-tuple. This relational approach also helps in solving queries (i.e., requests for specific information) which involve different tables and provides automatic linking across these tables by means of a 'join' operation. The join keyword checks and combines records which have identical values of general attributes. The relational approach is popular and is the most widely used database for storing financial records, manufacturing and logistical information, personnel data, etc. The following are the properties of a relational table: •

Hence, a relational database is termed as a collection of relations or tables. A diagrammatic representation of the relationship between tuple, attribute and relation is as follows:

Self-Instructional Material 94 Management Information System and DBMS NOTES A relation is termed as a group of tuples which have similar attributes. A tuple represents a specific object and the stored information about it. These object are physical objects or concepts. A relation is defined as a table to organize defined rows and columns. Applications are performed on any data by giving specific query commands and these commands use set functions; for example, select is used to detect tuples, project is used to detect attributes, and join is used to combine the required relations. Relations are modified with the help of the insert, delete and update operators. Users can request for relevant data from an existing database by simply asking a query which is written in a special language, SQL. To answer a query, the database responds with a result set which includes rows that show the answers to the query. Thus, a simple query can return all the rows from a table, or the rows can be filtered to return the specific result required. Data from different tables can be combined into one table using join. This operation is performed by using all possible combinations of rows, i.e., the Cartesian product and then filtering out the required result. The uniqueness and flexibility approach of relational databases helps programmers to write the desired queries and this feature is widely used by business enterprises. 2. Hierarchical Model The hierarchical data model is used to organize the data in a tree-like format by maintaining a hierarchy of a parent data segments and its related child data segments. This format specifies that a record may contain repeated information in the child data segments. Each parent data segment can have many child data segments but each child data segment has only one parent data segment. Data is a sequence of records that combine the field values attach to it. It gathers all the occurrences of a particular record as a record type. These record types are considered to tables in the relational model and each individual records is considered equal to row. The hierarchical model uses parent- child relationships to create a link between these record types. All the attributes of a particular record are given under a specific entity type. An entity type in a database is considered equivalent to a table in which each individual record is depicted as a row and attribute as a column. This is represented by trees using 1:N mapping between the record types. Hierarchical database management systems were popular from the late 1960s through the 1970s, with the support of IBM's Information Management System (IMS) DBMS. 3. Network Model The network data model became popular parallely with the hierarchical data model. The network model is also a database model and is considered to be a readily adaptable way of listing objects and their relationships. Originally it was developed by Charles Bachman and was developed using standard specification given by the CODASYL (Conference on Data Systems Languages) Consortium, published in 1969. CODASYL

Self-Instructional Material 95 Management Information System and DBMS NOTES developed the first specified network database model which was followed by a second publication in 1971 and which became the basis for most implementations. The CODASYL network model was structured on the mathematical set theory. In the hierarchical model, the data is structured as a tree of records, where each record has one parent data segment and many children data segments, but in the network model, each record has many parent and child records and forms a lattice structure. The network model supports model relationships between entities. Though this model was widely used and implemented, it was not successful due to two reasons. First, IBM preferred the hierarchical model based on semi-network extensions for their established products IMS and DL/I. Second, it was replaced by the higher-level relational model which has given comparatively more declarative interface. 3.5.2 Schema and Subschema The overall

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description of a database is called database schema, which is specified during database design and is expected not to change

very frequently. The values of a data item can be fitted into a framework.

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A database schema includes such information as follows: • Characteristics of data items • Logical structure and relationship among those data items • Format for storage representation • Integrity parameters, authorization and backup

policies
A subschema is a schema's proper subset and is designed to support 'views' belonging to different classes of users in order to hide or protect information. It refers to the same view as schema but it is applicable to those data types and record types, which are used in a particular application or by a particular user. Since information is inserted, deleted or updated, database changes over time. The collection of data or information stored

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in the database at a particular moment of time is called an instance, state or a

snapshot of the database. Database schema and database state are two different things. The existing state of the database, with no data, is the empty state. The initial state of the database is obtained when data in the database is first inserted. The DBMS is responsible for ensuring that every state is a valid state satisfying the structure and constraints specified in the schema. Sometimes, a schema is referred to as an intension, and a database state as an extension of that schema. Data Dictionary Schema (defines one database) Subschema Subschema Schema (defines one database) Subschema Subschema Figure 3.6 Schema and Subschema
Self-Instructional Material 96 Management Information System and DBMS NOTES 3.5.3 Data Dictionary A data dictionary can be treated as a special file which stores information about an organization's data contained in its database. This information is called metadata (which means data about data). It is sometimes termed as system catalog that documents the data in the database. In a DBMS, the detailed structure and organization of each file is stored in the system catalog. The two terms, system catalog and data dictionary, are used interchangeably. A system catalog is a repository that integrates metadata. A data dictionary is a repository that manages metadata. It is a part of the system catalog that is generated for each database. A data dictionary can function in a variety of ways, which are as follows: •••• Active (Integrated): This is

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always consistent with the current structure and definition, maintained automatically by the system itself. •••• Passive (Non-integrated): It is used only for documentation purposes and

is not used by the DBMS software. It is simply a self-contained application and a set of files used for documenting the data processing environment. It is not consistent and

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is managed by users of the system. It also modifies whenever the structure of the database

changes. 3.5.4 Database Languages DDL and DML are the two important database languages.

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Data definition language A database scheme is specified by a set of definitions, which are expressed by a special language called Data Definition Language (

DDL). The
data definition language allows creation and deletion of the structures of database objects as well as provides facilities for defining and altering defined physical data structures. CREATE, DROP and ALTER statements are the most frequently used DDL statements. The definition also includes constraints which are a set of rules maintained for the integrity of a database. A DDL statement CREATE TABLE EMPLOYEE (FNAME VARCHAR (15), LNAME VARCHAR (15), ECODE CHAR(5) PRIMARY KEY, DATE_JOIN DATE, SEX CHAR, SALARY NUMBER (10,2), DNO VARCHAR (5) REFERENCES DEPARTMENT (DNUMBER));

such as View Definition Language (VDL), Storage Definition Language (SDL), etc., may exist specify to views and storage structures. Databases where

An SDL statement in ORACLE CREATE TABLESPACE payroll DATAFILE 'C:/ACTS/payroll.tsp' SIZE 10M DEFAULT STORAGE (Self-Instructional Material 97 Management Information System and DBMS NOTES INITIAL 10K NEXT 50K MAXEXTENTS 999 PCTINCREASE 10); In true three-schema architecture,

An example of a VDL statement is as follows: CREATE VIEW sales AS SELECT * FROM employee WHERE dno = 'D04'; However, in most DBMSs, DDL is used to specify both the conceptual and external schemas. Data manipulation language

The
Data Manipulation Language (

modifying the existing data, are activities that comprise data manipulation. A query refers to a statement in the DML that is used for data retrieval from the database. A query language is a subset of the DML, used to pose a query. However, the terms, DML and query language, are used synonymously. Examples of DML statements are as follows: SELECT ECODE, ENAME,DNO, SEX FROM EMPLOYEE; DELETE FROM EMPLOYEE WHERE ECODE ='E01'; UPDATE EMPLOYEE SET DNO ='D04' WHERE ECODE='E03'; DML

P/LI. Whenever DML statements are embedded in a general-purpose programming language, that language is called a host language and the DML is called a data sublanguage. There are two types of DML, which are as follows: Low-level or Procedural: The user has to specify the required data and the manner of retrieving it. Examples are SQL, Quel. High-level or Non-procedural: The user has to specify the required data without specifying the manner of retrieving it, for example, datalog, QBE. In most existing DBMS, the external view of data

In an integrated environment a uniform collection of constructs forming a part of the user's programming environment, is used to define and manipulate. Note: In most DBMSs, the VDL, DDL and DML are not considered separate languages but comprehensive integrated languages for conceptual schema definition, view definition and data manipulation. Storage definition is kept separate to fine-tune the performance, usually done by the DBA staff. An example of a comprehensive language is SQL, which represents VDL, DDL, DML as well as statements for constraint specification, etc.

Self-Instructional Material 98 Management Information System and DBMS NOTES When DML commands are embedded in a general-purpose programming language, the programming language is called a host language and the DML is called a data sublanguage. 3.5.5 Data Abstraction A DBMS must have some means of representing data in a way that the user can easily understand it. A DBMS provides users with the conceptual representation of data. The system hides certain details regarding data storage and maintenance and data is retrieved efficiently. This is perfomed by defining the various levels of abstraction at which the database may be viewed. 3.5.6 Logical and Physical Views of Data Separating the logical and physical structures of data is one of the main features of the database approach. The term, 'logical structure', indicates the manner in which the programmers view data whereas the physical structure refers to the manner in which data is actually stored in the storage medium. A logical view of data expresses the way a user thinks about data. Usually, it is expressed in terms of a data model. A physical view of data is the way data is handled at a low level, i.e., its storage and retrieval. Specifically stated, it is expressed in terms of specific locations in storage devices plus techniques used to access it. A set of logical constructs that can help describe the structure of a database, that is, its data types, constraints and relationships, is referred to as a data model. It is also a set of basic operations that specify updates and retrievals in the database. A data model is used to refer to a set of general principles for handling data (Tsitchizris and Lochovsky, 1982). The set of principles that defines a data model may be divided into the following three major parts: • Data definition: a set of principles concerned with how data is structured • Data manipulation: a set of principles concerned with how data is operated upon • Data integrity: a set of principles concerned with determining which states are valid for a database 3.6 MODERN AND ADVANCED DATABASES Advanced database is a process, which is used to break up a distributed database into logical units. These logical units are known as fragments, and can be assigned to various sites of a distributed database for storage purposes. They can be defined as relations that are stored at a particular site. They can be a collection of a number of interrelated databases, which are spread through a computer network. They are used to improve the reliability and the performance of a database. Advanced databases consist of many stages for designing and developing a database. These stages of database life cycle help understand those problems, which occur during designing and developing a database. They also provide a way for solving these problems. The various stages of the database life cycle are as follows: • Initial study of a database • Database design Check Your Progress 7. List the three main features of DBMS. 8. What information does a database schema include? 9. What is the main feature of the database approach?

Self-Instructional Material 99 Management Information System and DBMS NOTES • Implementing and loading a database • Testing and evaluating a database • Database operation • Maintenance and evaluation of a database 1. Initial Study of a Database In the initial study stage of a database, the information required by it is gathered and stored. The requirements of the database and its functions are analysed. You also need to identify the problems and limitations related to the database. 2. Database Design In the database design stage, the Entity-Relationship (E-R) model of the database can be designed. An E-R model is used to represent the logical structure of a database in the form of a diagram. This diagram is known as an E-R diagram, and it consists of many shapes such as oval, rectangle, arrows and diamond, to represent attributes of the database, entity of the database, relationship between entities and the scope of the entities. Thereafter the E-R model of the database is checked to verify if it is correct. For this normalization is used. This helps remove redundancy and provides consistency to the entities in the database. The result is used to update the E-R diagram. The next step is to define the set of tables, which are required to manage the data in the conceptual level of the database. After defining all the tables of the database they have to be created using different languages of RDBMS. You can also specify primary key, foreign key, different constraints and integrity rules such as not null and unique for the tables in a database. 3. Implementing and Loading a Database This stage first requires the organization of storage files over a storage medium. This is known as file organization. It provides a way of storing data in a storage medium. The selection of file organization depends on (i) the speed at which data can be accessed (which should be maximum) and (ii) the amount of space, (which should be less) used by the medium for storing data. File organization also helps control access of data according to the user. There are also other considerations such as physical mapping of data in the storage medium and indexing of data, for selecting a file organization for a database. In this stage, one also has to design the required queries and reports for the database. Queries are made to retrieve the desired information, while reports are used to represent information to the user. The next step is to design a user interface to interact with the database. The user interface is used to accept data from the end-user and to store that data in a database. The exercise of designing a user interface is also known as screen designing. A developer can design a user interface according to his requirements. 4. Testing and Evaluating a Database After implementing and loading a database, the next stage is to test and evaluate it. It is very essential to test a database before it is made available to the users. All the structures and screens that have been designed for a database need to be tested to see if they are correct. You also need to test the validations that have been used for a database. Testing helps identify the errors in a database and rectify them. The identification of errors at an early stage helps reduce the cost of correcting an error.

Self-Instructional Material 100 Management Information System and DBMS NOTES 5. Database Operation A database is made operational in the actual environment after it has been tested and evaluated. Users are supplied with the complete database and are also trained to use it. A user can use the database to store and retrieve data in the database. 6. Maintenance and Evaluation of a Database This stage maintains the database to meet the changing requirements of the users. It is performed by changing the database according to the changed user requirements. Therefore it needs to be updated, constantly. However, before incorporating changes it is very important to ascertain whether or not changes can be made to it. Advanced databases basically work with two themes known as distributed database system and data mining. Of these, data mining will be discussed in Section 3.8. The distributed database system is explained in the following paragraphs. 3.6.1 Distributed Database System A distributed database system comes in the category of advanced databases because of its enhancing features. It involves

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a combination of two technologies: (i) database technology and network and (ii) data communication technology. It provides the advantages of distributed computing to the field of database management.

The

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components are interconnected by a computer network and work together to perform the

assigned tasks. The distributed advanced databases

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are used for several reasons such as organizational decentralisation and cost-effective processing. The advantages of

distributed advanced databases are as follows: • Increased reliability and availability • Improved performance

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Increased reliability and availability Reliability is a measure of the possibility that

defines a system which is running at a given point of

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time. On the other hand, availability is a measure of the possibility that the system is continuously serving the queries made to it during a time interval. When you use DDBs, which are spread over several

other sites, if one site fails then it helps you connect to the other sites which

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continue to function normally. But the data and software that resides in the site which has failed cannot be accessed, without affecting the performance of the other sites in the distributed database. This quality improves reliability and availability. A distributed DBMS fragments the

existing database and keeps the data closer to the related site where it is most required. As database which is large in size is fragmented and distributed over many other sites. The fragmented databases are referred as smaller databases at each site where they exist.

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The queries and transactions that access data from smaller databases perform better. In addition, when the database is fragmented into smaller databases, each site requires less overhead transaction

to execute a query. The following figure shows the distributed database architecture.
Self-Instructional Material 101 Management Information System and DBMS NOTES Site 2 Site 3 Site 5 Site 1 Site 4 Communications Network Figure 3.7 The Distributed Database Architecture Distribution is transparent in a DBMS, i.e., it hides

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the details of where each file is physically stored within the system.

Any user on the network can access a file sitting on his terminal regardless of where the file is actually stored. The various features of data transparency are: • Distribution or network transparency: In this type of transparency, the user is not concerned with the network details. It can be of two types: either location transparency or naming transparency. In location transparency the command used to perform a task does not depend on the location of the data and the location of the system from where the command is issued. Naming transparency means that if you specify a name for an object, the named object can be accessed unambiguously without any further specifications. • Hardware transparency: It enables the same DBMS to run on different hardware platforms. It is necessary because the real-world computer installations involve a wide range of machines that include IBM machines, ICL machines, HP machines, personal computers and workstations. Hardware transparency helps DBMS integrate data in those machines so that they can be presented to the users as a single-system machine. • Replication transparency: It enables copies of data to be stored in multiple distributed sites. In other words, it allows creation and destruction of data replicas in response to the user requests. Replication transparency has two advantages. First, it enhances the performance of the database, for example, applications accessing the database can use local copies of data instead of trying to access the data in the remote locations. Secondly, it increases the availability of data of the DBMS, as due to replication transparency, data becomes available on multiple client machines. However, apart from these advantages, replication does also have disadvantages. The major disadvantage of replication is encountered each time a replicated data is updated. It is because, when you update a replicated data, you also need to update every single copy of that replicated data.
Self-Instructional Material 102 Management Information System and DBMS NOTES • Fragmentation transparency: It enables a user to work while he/she is unaware of the existing fragments of the data in the database. Fragmentation transparency also implies that the users can view the data as logical combinations, which is done by using suitable joins and unios. Here, the system optimizer is responsible for determining the fragments that can be physically accessed by the users. A DBMS supports data fragmentation whenever a relation variable in the DBMS is divided into fragments or pieces for the purpose of physical storage. Fragmentation helps enhance the performance of DBMS by allowing data to be stored at the location from which it is most frequently used. This reduces the traffic in the network as the operations that are performed on the data are local. Basically, there are two types of fragmentations: horizontal and vertical. Horizontal fragmentation can divide a relation or table into sets of rows. Vertical fragmentation can divide a relation or table into subrelations. Each subrelation is considered as a subset of columns of the original relation. Fragmentation transparency has special features that make the user aware about the existing fragments. • Transaction transparency: It helps to maintain consistency of data by coordinating different functions of an object. These functions are used to define various transactions and their dependencies in the database. You need to add different check points at various states of an object to define the functions of the object. • Failure transparency: It refers to the extent to which errors and related recoveries of a distributed database are invisible to users and applications. If a server fails, then failure transparency helps in automatically redirecting all the users connected to the failed server to a different server in such a manner that the users never notice the server failure. In other words, failure transparency is used to tolerate fault failure and problems of the distributed database. It does so by defining different conditions of the database that can cause problems. To tolerate the problems of databases, the failure transparency includes various steps such as locating an object with its related possible problems, using check points and recovery functions to detect and recover the problems and providing stability to an object using the replication function. Failure transparency is one of the most hard-to-achieve transparencies as it is very difficult to determine whether a server has actually failed or is responding to requests, but very slowly. • Performance transparency: It allows reconfiguration of the distributed database system to match the varying loads on the system to improve its performance. It also helps in executing distributed queries in the distributed system using a distributed query optimizer. • Heterogeneity transparency: It is used to access the database of a single computer of the DDB system. • Migration transparency: It allows movement of data in a distributed database system without affecting the operations performed by the users as well as the application programs. Examples of migration transparency include Network File System (NFS) and Web pages available in the World Wide Web (WWW). • Access transparency: It enables users to access local and remote data from a distributed database system using the same operations. Various examples of access transparency include: o Various file system operations in NFS o Queries performed in SQL o Navigating though the various Web pages on the Web
Self-Instructional Material 103 Management Information System and DBMS NOTES • Location transparency: It allows users to access data without knowledge of the actual location of the data. In other words, users can work on any data as if it were present on their local site. Location transparency is useful in distributed databases as it simplifies the terminal activities and user programs. Here, data can move from one location to another so that it can respond to changing performance requirements. Examples of location transparency include: o Operations of file systems in NFS o Web pages available on World Wide Web. o Tables contained in a distributed database 3.7 DATA WAREHOUSING 3.7.1 Overview of a Database Warehouse A database

which supports the management in the decision-making process. The term 'subject-oriented' refers to the data type that gives specific information about a particular subject and not about the company's ongoing operations. The term 'integrated' suggests that the data is collected from different sources for the data warehouse and then merged into a coherent whole. The term 'time-variant' suggests that

data in the data warehouse is identified by a specific time period. Non-

volatility of data suggests that data in a data warehouse is stable. Although more data can be added to a database, cannot be removed. 3.7.2 Evaluation of a Data Warehouse A data warehouse can be evaluated or judged on the basis of the features of the elements that the data warehouse uses. The software used by the data warehouse can also be used for evaluation. The elements of a data data warehouse are as follows: • Design tools: The design tools should have dimensional modelling intelligence. It should also have the ability to share a metadata repository so that data warehouse can be implemented properly. These tools should also support the generation of Data Link Library (DLL) for the building of a data warehouse. • Metadata repository: The metadata repository needs to support change management for proper data warehouse implementation. It should also be a single and integrated repository which is easy to navigate. • Databases: The databases used in a data warehouse should have a database engine with features that support star joins and multi-table joins. • Replication: The replication process used in a data warehouse should be easy to use and powerful. The tools for the replication process should simplify the task of making changes in a data warehouse. • Ad hoc queries and reports: Ad hoc queries and reports should be generated using tools which make it easy for users to group items into a catalog. These tools should allow report definitions to be saved and shared. They should also provide administrative features which help deploy updated report definitions and catalogs. • Online Analytical Processing (OLAP): This is a special technology that uses a multidimensional data representation methodology called cubes for providing Check Your Progress 10. What is an advanced database? 11. List the advantages of distributed advanced data systems. 12. What is the function of location transparency?
Self-Instructional Material 104 Management Information System and DBMS NOTES access to the data collected in a data warehouse. Cubes replicates data and fact tables in the specified dimension in the data warehouse. The tools used for OLAP should provide a user interface that supports data visualization and presentation of data in the form of a business model. 3.7.3 Rules for a Data Warehouse The various rules for a data warehouse are as follows: • The tools for extracting, cleaning and transforming data should be selected properly because 80 per cent of the time in a data warehouse is spent on these activities. • When building a data warehouse, a user should be questioned about the information that will required subsequently and not the information that is required at present. • You need to determine whether or not the data warehouse is required to store data which is not kept in any transaction processing system. • A method has to be determined which will validate data for the warehouse which is not being validated by any transaction processing system. • Users of the data warehouse need to be trained and it must be ensured that they apply their training when using a data warehouse. • A mechanism to handle the increased number of requests for reports has to be determined. • A method for handling conflicting business rules which may develop around data warehouse users, has to be determined. 3.7.4 Building a Database for a Data Warehouse You can create a database in a data warehouse after you have created or designed the warehouse schema. You need to create fact tables, dimension tables, and indexes for the key fields of all the tables. The database schema of a data warehouse is simple as compared to a data preparation area or online transaction processing (OLTP) databases. The star schema has one fact table and many dimension tables and the snowflake schema adds secondary dimension tables. Multiple fact tables and some dimension tables are present in more complex data warehouses. You can have some dimension tables common to all fact tables, and others that are specific to a single fact table. Financial and sales information, for example, are a part of the same data warehouse but have different natures. Hence you need different fact tables for them. Certain dimension tables, such as the customer dimension table, are common to both financial and sales information, but others like sales force and locations are specific to an individual fact table. (a) Dimension Tables The tables containing attributes that describe a fact record in a fact table are known as dimension tables. Some attributes are used to provide descriptive information and the others describe how data in the fact tables summarize provide useful information. A dimension table contains hierarchies of attributes that help in summarization. For example, a dimension table contains product information, it also contains the categories of products, such as food, drink, inconsumable products and each product is further divided into a number of items till the last individual product is reached.

Self-Instructional Material 105 Management Information System and DBMS NOTES Dimensional modelling produces dimension tables that contain fact attributes. For example, an employee dimension table contains data about employees, a client dimension table contains information about clients and a store dimension table contains information about stores. You can use the columns of a dimension table to do a hierarchical categorization of the information. Table 3.2 lists the columns in a store dimension table that specify the hierarchical level. Table 3.2 Columns in a Store Dimensional Table Columns Description Store_country It tells the country name of the store. This is the country level of the hierarchy. Store_state It tells the state of the country. This is the state level of the hierarchy. Store_city It tells the city where the store is located. This is the city level of the hierarchy. Store_name It specifies the name of the store in a readable form. Store_id It specifies the individual store. This field has the primary key of the dimension table and is used for joining it to the fact table. (b) Indexes A numerical scale is used to compare variables with one another or with some reference number. Indexes are as important in data warehouse performance as they are in relational databases. You need to create an index on the primary key for every dimension table. You can enhance the performance of queries by indexing columns of the dimension table. You also need to index fact tables on a composite primary key of the foreign key present in the dimension table. (c) Extracting the Data The data used in data warehouse has to be extracted from the operational system that contains the source data. You can initially extract the data in the creation phase. Thereafter data is extracted periodically as and when the data warehouse is updated. This operation becomes easy, if the data is present in a single relational database. But if the data is present in multiple heterogeneous systems, the process becomes complex. The objective of data extraction is to load it in the data warehouse in a consistent and common format. The data in the source operational system needs to be error-free, as errors can affect an organization and its data warehouse. Customer records for which there are no corresponding purchase records to identify the purchase, are errors in the source data and need to be corrected before they are extracted and loaded into the data warehouse. If the errors occur frequently, you need to modify the operational system to reduce the errors. You cannot identify validation errors before the data is extracted from the operational source. This can happen when multiple sources extract data from a single source. You can also identify other inconsistencies in the data, except the errors, after the extraction process is over. Different data sources can use different coding for the same data. You can always use translation tables to fix the data in the extraction operation

Self-Instructional Material 106 Management Information System and DBMS NOTES or during transformation operation. For example, some systems can use three-character codes and some can use two-character codes. You can change either one or both into single-code sets to load into the data warehouse. (d) Preparing the Data for Loading into Data Warehouse During the extraction process, various transformations are completed. Some transformations are done before loading the data into the data warehouse; for example, inconsistent data from heterogeneous sources is formatted and cleansed. Surrogate keys are also incorporated in the tables. Technical transformations can interfere with the operation and performance of the online source system. Therefore, you need to postpone these tasks in order to complete the process of extraction. You also need to perform certain manual operations to make the data precise. You should resolve ambiguous text file entries. You need to eliminate the causes of inconsistencies in the data in the source system itself. You can also use operations to rectify the manual exception so that the rest of the data can be loaded in the data warehouse. Some of the data transformation activities are: • Combination of multiple name fields into one field • A data field that is lengthy needs to be broken into smaller fields • Data mapping from one representation to another, such as YES to 1 and NO to 0 and pin codes from numeric to text. Data mapping from multiple to single representation, such as formats for telephone number and credit rating codes to a common 'Good, Average, Poor' representation • Creation and application of surrogate keys to dimension table records (e) Enabling the Data for Distribution After cleansing and transforming the data into a structure that is consistent with the data warehouse, the next step should be to load the data in the data warehouse. This step precedes the distribution of data into data marts. The steps that enable data distribution are: • Making the data ready for presentation • Loading the data in the data warehouse • Distributing the data to data marts After data transformation is completed, it is loaded into the data warehouse. You can also make final transformations before loading the data. However, you need to complete the transformations before the final data is loaded in the warehouse. Loading data in the data warehouse means populating the tables used by presentation applications of the end-user. Loading of data involves transfer of data from source system, data preparation area or tables to the data warehouse. These operations create a heavy load on the system and you need to complete the loading when the systems are free. After loading, the data should be checked for referential integrity between fact and dimension tables. You need to verify that the record in the fact table relates to the record in each dimension table, for example, that the fact table of product sales is used with the dimension tables for product, customers, time and stores. The sale record in the product table has a corresponding record in each dimension table relating to sales record through a primary key. This verifies that for every sale registered, you can identify the customer record, the product record, and the time and location of the sale.

Self-Instructional Material 107 Management Information System and DBMS NOTES You cannot verify reverse data integrity, as not every record in the dimension table can have a related record in the fact table. When you use a dimension table that does not contain all the fact table records, you need to include a record in the dimension table that relates the remaining facts. You can include a standard record to relate to any sales fact for which there is no sales promotion record. This query joins the promotion table to the sales fact table for that has no corresponding promotion record. Distributing the data to data marts A data warehouse design can include data marts for specific business areas such as warehouse, sales and financial departments. Each data marts contains subsets of the data warehouse data. The data mart uses common shared dimension for preventing inconsistencies in reports and analysis. You can use an employee dimension table in all the data marts, but a financial planning dimension table is most appropriate for financial data marts. The other data marts may contain a particular data to enhance a particular operational database system. You can initially copy all the shared dimension tables and data facts suitable to the data marts, from the data warehouse. The dimension tables, used within the department or group they serve are created locally in the data marts and are unique to them. The dimensions that are used to create reports for comparison from other data marts are shared dimensions. You can manage the shared dimensions centrally and load them from data warehouse tables. You can use various tools to load data marts. Data marts can receive data from master data warehouse for the various data warehouse implementations. They can contribute data to the warehouse data by updating themselves locally for other implementations. Shifting updated data to or from data marts can be simple if you design the data marts to work consistently with the master data warehouse. The use of shared dimensions, standardized schemas and common fact table formats helps in easing the maintenance of data marts. If the master data warehouse updates the data marts, you can design automated tasks to filter the data warehouse, update the data and post the appropriate data subset to each data mart. Applications for the presentation of the data mart need to be adjusted so as to accommodate the new data from the updated data marts. If data marts collect data locally and contribute data to the master data warehouse, you can treat the data mart as an operational data source. You need to bring the data into a preparation area where it will be cleansed and verified before it is posted in the data warehouse. If you manage and design them as an integral part of the data warehouse, you can load the data directly from the data mart into the data warehouse database. The verification process may not be necessary in this case. In either case, you need to update the presentation applications to accommodate the new data from the updated data marts. (f) Technologies to Use a Data Warehouse The role of a data warehouse is to collect and organize business data so that you can analyse it to assist management in business decisions. Previously, access to a data warehouse was limited to the experts who could create complicated queries necessary for retrieving, formatting and summarizing information for analysts and decision-makers. The involvement of the lower levels in the decision-making process generated the need for end-users to access data in the data warehouses.

Self-Instructional Material 108 Management Information System and DBMS NOTES A data warehouse accommodates the requirements of a variety of applications for accessing the data. You need to load an application and configure it before anyone can work effectively with a data warehouse. This work is often carried out or managed by the data warehouse administrator, who needs to incorporate the necessary modifications to meet the requirements of new applications. You can also develop applications for a better configuration and analysis of data in new and powerful ways. These applications require administration and maintenance by the data warehouse administrator. The various technologies that use a data warehouse are: • English Query • SQL Query • Microsoft Office 2000 • a Web Browser • Custom Applications English Query The English Query allows the system (used for developing client applications enabling end–users) to access data in a data warehouse with the use of English words and phrases. The use of English Query application helps to make changes in your relational database. It allows the end-user to pose a query in English and not as a query used in an SQL statement. Note: SQL statements are complex statements used for retrieving information from a database. The English Query Model Editor only appears in the Microsoft Visual Studio version 6.0 environment. You can select the English Query project wizards like the SQL Project Wizard or the OLAP Project Wizard, to create an English Query project and model. Once the basic query model is created, you can test and compile it into an English Query application. Figure 3.8 shows the data flow of the English Query. English Query run- time engine Test tool Model Editor SQL SERVER English Query Save Build SQL Question Load Compiled English Query Model (*.egd) Project (*.eqq) Model Knowledge Data SQL Database structure Figure 3.8 English Query Working

Self-Instructional Material 109 Management Information System and DBMS NOTES Using the English Query Project Wizard, you can include various database structures, such as field names, table names, keys and joins to process information from a database into a project and a model. The model contains related and detailed information that is required for an English Query application which includes the database structure or schema. The model defines the properties of an application and adds the entries, which are defined, to the English Query dictionary. It manually adds and modifies the entities and the relationships when questions are being tested to expand the model. Figure 3.9 shows the model for the English Query application. Model Database objects Properties Dictionary Entity Entity Entity Entity Figure 3.9 Model Diagram for English Query Application The properties check for spelling errors and default a value definition for the whole application. The dictionary adds special words and values from the database. The wizards automatically create semantic objects for the model. The model includes entities and relationships. Tables, fields and OLAP objects usually represent entities. Figure 3.10 shows the relation between database objects and semantic objects. Figure 3.10 Database and Semantic Object Relationship

Self-Instructional Material 110 Management Information System and DBMS NOTES Entity is referred as a real-world object and is represented by a noun, such as customer, city, product, shipment, etc. In databases, tables, fields and analysis services, objects usually represent entities. Figure 3.11 shows the relationships of the entities. Figure 3.11 Relationship of Entities Note: Microsoft Visual Basic or Microsoft Visual C++ is the product of Microsoft used for programming. SQL Query End-users rarely use SQL queries directly for accessing data warehouse data. Analytical queries are complex and require an expert knowledge of the subject. A large data volume in a data warehouse requires advanced SQL techniques for useful performance. An SQL query joins many dimension tables to a fact table which contains a large number of rows and uses aggregate function. The aggregate and group functions impose load on the relational database. This makes the speed of the system slow for analysis. Note: SUM is an aggregate function, which is used in SQL to sum the values of rows of a single column. You can use SQL queries with predefined reports. You need to create secondary tables for optimizing the performance of these queries. Secondary tables are initially designed and populated with data when the data warehouse is being loaded and updated. The techniques for configuring data warehouse information and designing effective SQL queries that address complex analytical tasks are included in Microsoft SQL Server™ 2000. It provides advanced query processing, optimisation techniques and a powerful language, Transact-SQL, for addressing the needs of the data warehouse implementation. You can use simple commands like CREATE, INSERT, UPDATE and DELETE in the SQL query analyser. The CREATE command creates the database objects like tables, views and indexes. The Transact-SQL command creates a table with up to 250 columns, adding up to a total width of 1,962 bytes. Figure 3.12 shows the creation of stud_details table in SQL query analyser.

Self-Instructional Material 111 Management Information System and DBMS NOTES Figure 3.12 The use of CREATE Table Command The INSERT command inserts rows of data to a table. The INSERT...VALUES statement inserts a single row of data to a table using literal values supplied in the SQL string. Figure 3.13 shows the INSERT command for inserting the record in stud_details table. Figure 3.13 The INSERT VALUES Command The UPDATE command enables you to alter the data stored in the existing records. You can execute UPDATE only on one table at a time. If you execute UPDATE without a WHERE clause, all the rows in the table get updated. Therefore, it is always necessary to use a WHERE clause with the UPDATE statement. Figure 3.14 shows the updation of stud_details table.

Self-Instructional Material 112 Management Information System and DBMS NOTES Figure 3.14 The UPDATE Command The DELETE command removes rows from an SQL server table. You will never want to issue a DELETE without a WHERE clause as it will result in deleting all the records from the affected table. You can delete from only one table at a time. Figure 3.15 shows the delete command and the effect of that on the stud_details table. Figure 3.15 The DELETE Command The execution of a DELETE statement with the use of a WHERE clause and the field with secondname = 'Kapoor' is deleted from the stud_details table.

Self-Instructional Material 113 Management Information System and DBMS NOTES Microsoft Office 2000 You can access data in a Microsoft SQL Server 2000 with Microsoft Office 2000 components such as Microsoft Access or Microsoft Excel. The volume of data in the data warehouse decides the special queries and tables you need to create and maintain for the end-user. You can create and maintain these queries and tables as a part of data warehouse. You can use Microsoft Access for various purposes. You can create tables and query those tables by using different tools present in Microsoft Access. Figure 3.16 shows how to create a table using the design wizard in Microsoft Access. Figure 3.16 Creating a Table in Access In Figure 3.16, only four fields are visible with the first field as Emp_ID on which the table has an index that can be seen in the field properties box and you can change every field property from that box. The last two fields not visible in the figure are Dept_ID and Homephone that have the department and the home phone number of the employee. You can open the window by selecting the Tables object from the Objects column and clicking the Design button from the upper left side of the Microsoft Access database window. If the table already exists then first choose the table and then click the design button, you can see the Microsoft Access - [Emp: Table] window as shown in Figure 3.16. You can also query the EMP table by using Queries object from Objects column of the Microsoft Access database window. When you select Query, Click on the Design button from the upper left side then, a window appears. The window shows the tables, queries or both which ever you want to query, and clicking on the ADD button, the selected items appear in the window Microsoft Access – [Query1 : Select Query]. You need to select the fields and define the criteria in the space provided in front of every field. Figure 3.17 shows the window and the selected fields for querying the table.

Self-Instructional Material 114 Management Information System and DBMS NOTES Figure 3.17 Creating Query in Access You can sort the field and can give multiple criteria for the query. When you close the window, you need to provide the name of the query to save it. You can give the desired name or you can simply save the query as Query1. Forms in Access are used when you want to enter more records in a table and on a regular basis, as forms can use different types of tools for entering the records in the table. Figure 3.18 shows the window of the design Form wizard with Form Header, Form Details and Form Footer sections. Figure 3.18 Creating a Form in Access You can add different label names in the header and the footer can display page numbers and other similar details. You can make the forms user-friendly by adding different tools. This helps in managing the form and the details or rows entered through the form in the tables. You can use Microsoft Access for querying and maintaining data in the data warehouse.

Self-Instructional Material 115 Management Information System and DBMS NOTES Web Browser Web browsers provide end-users access to data in a data warehouse because the client uses a standard web browser instead of different applications that need installation, configuration and maintenance. The use of technology will enable you to create interactive applications to query and update data in a data warehouse. Microsoft SQL Server 2000 and their tool such as Query Analyser and English Query, offer a number of ways to query and update data over the Web. English Query applications embedded into Active Server Pages (ASP) can support Web queries in English. You can develop Web applications using the Application Programming Interface (API) provided by SQL Server 2000 and its components. They are easy like displaying a predefined report or executing predefined queries against the data warehouse database or OLAP, or they can be as complex as any directly connected client/server application. 3.7.5 Developing a Data Warehouse for a Credit Card Bank: A Case Study A data warehouse for a credit card bank provides a data-driven approach to market as well as manage, risks and customers of the bank. A data warehouse is a collection of data required to support decision-making in an organization. It allows a credit card bank to integrate data from different sources and store it in a central repository. The integration and storage of data is essential for a credit card bank because a large amount of data is used in the bank. Issues in Developing a Data Warehouse There are many issues in developing a data warehouse for a credit card bank. The first is the determination of tables that should be created for the data warehouse. It has to be seen whether a single table should be used to store the data used or separate tables should be created for different operations performed by credit card bank. The second issue is how to organize the monthly performance data in the data warehouse. Two methods can be used to do this. These methods are as follows: • Organizing the data in a long skinny file: In this method, the data is stored in a data warehouse in the same form in which it was collected. • Organizing data in a wide file: In this method, data related to a specific customer is stored in a single row. The third issue that comes up when developing the data warehouse is the date issue. In the date issue, one has to determine how dates will be stored in the data warehouse. In case of a credit card bank, dates such as campaign date and the date at which the account was first opened, need to be stored in the data warehouse. In order to develop a data warehouse for a credit card bank, these issues need to be analysed. Further a solution has to be found that will address these issues. Building the Data Warehouse To build the data warehouse, there are three tables that need to be created: customer, transaction and history tables. The customer table stores data which helps provide information about the performance of a customer for whom the credit card needs to be issued. The columns that can be included in the customer table are as follows:

Self-Instructional Material 116 Management Information System and DBMS NOTES • customer id: It stores a unique number that identifies a specific customer of the credit card bank. • account number: It stores a unique number that identifies the account of a customer in the credit card bank. • customer name: It stores the name of the customer, who has or wants to hold the credit card of the credit card bank. • address: It stores the address of the credit card bank customer. • phone number: It stores the phone number of the credit card bank customer. • offer detail: It stores information about the offer, which has been provided to a credit card bank customer. The transaction table contains information about each transaction performed between the credit card bank and a customer. The columns that can be included in the transaction table are as follows: • customer id: It stores a unique number to identify a credit card bank customer. • transaction type: It stores the type such as charge and return, of transaction performed for a credit card, which is available to a customer. • transaction date: It stores the date on which a credit card tranaction was performed between the credit card bank and a customer. • transaction amount: It stores the amount for the transaction performed between the credit card bank and customer. The history table contains information related to offers of credit card made to customers. The columns included in the history table are as follows: • customer id: It stores a unique number that identifies a credit card bank customer. • customer name: It stores the name of the credit card bank customer. • address: It stores the address of the credit card bank customer. • phone number: It stores the phone number of the credit card bank customer. • offer detail: It stores information such as date, type of offer and source code related to the offer of credit card made to a specific customer. • offer summary: It stores summary information such as date of first offer and best offer, related to the offers of credit card made to a customer. 3.8 DATA MINING Data mining is a process that helps search for information stored in a database. This process involves the task of sorting a large amount of data in order to select and group the relevant information. Data mining should be considered during the implementation of a data warehouse because data mining depends on the construction of the data warehouse. The data mining process is performed by expert analysts using techniques such as data association rules and data clustering. The association rules are commonly used in the retail sales process to identify products which are purchased frequently by customers; for example, a shop selling different types of cloth can maintain a database to store records of the purchases of its customers. In this case, data mining can be used Check Your Progress 13. What are dimension tables? 14. What are the various steps that enable data distribution? 15. List the various technologies that use a data warehouse.

Self-Instructional Material 117 Management Information System and DBMS NOTES to determine the customers, who favour cotton over polyester and silk. The classes are built on the basis of attributes of objects related to them. Data clustering involves partition of data set into a number of subsets, which contain data having similar attributes. Data mining consists of the following activities: • Extracting, transforming and loading transaction data into the data warehouse system. • Storing and managing data in a multidimensional database system. • Providing business analysts and information technology professionals access to data. • Analysing data by using application software. • Presenting data in a useful format, such as a graph or a table. Data mining enables you to determine various types of unknown entities. Data mining also allows you to predict what is going to happen next. The technique which is used to perform these activities is known as data modelling. It specifies the process which is used for the development of a model or set of examples and mathematical relationships. Data modelling involves the structuring and organizing of various types of data structures. These data structures are usually implemented in a database management system. Data modelling also involves specifying constraints on the data contained in a data structure. The metric Return On Investment (ROI) can be used for measuring the effectiveness and usefulness of the data mining process. The metric ROI is used to calculate the difference between the costs spent on the data mining process and the benefits gained by implementing data mining for the extraction of information. In data mining, you can use algorithms for analysing data and creating models which provide information about this data. You cannot use data mining to predict the characteristics of any new data or to identify the groups of data entities which show similar characteristics. Analysis services available in Microsoft SQL Server 2000 also supports and incorporates data mining algorithms which can analyse relational data and multidimensional data in cubes. The algorithms used for data mining should have the following characteristics: • Scalability: The algorithm used for data mining should be scalable enough so that these can be used for real-world data such as employee and student details. • Work with real-world data problems: Data mining algorithms should perform correctly with problems related to real-world. Examples of such problems include missing attribute values related to real-world data. • Update: Data mining algorithm should have the ability to update the data stored in databases. • Ease of use: Data mining algorithms should be easy to understand and learn so that they can be used by users having little knowledge. (a) Mining Process Data mining or Knowledge Discovery in Database (KDD) can be defined as a process that identifies information and patterns in the data. The KDD process takes data as input and produces output in the form of useful information desired by the user. The KDD process consists of the following steps:
Self-Instructional Material 118 Management Information System and DBMS NOTES • Data selection: Data needed for data mining process can be obtained from different types of sources. It involves retrieving data from databases, files and non-electronic sources. • Pre-processing: Data retrieved from various databases and files can have some incorrect and missing data. Pre-processing involves correcting and removing incorrect data. In case of missing data, pre-processing can ask for data or can predict data using data mining tools. • Data transformation: It involves converting the data collected from various data sources into a common format for further processing. • Data processing: This step allows you to apply algorithms and appropriate techniques on the transformed data to produce accurate results. • Evaluation of the results: This step involves presenting the results obtained through processing to the user. For describing data to the end-users, the following types of visualisation methods can be used: o Graphical: It involves the use of different types of graph structures such as pie charts, line graphs for presenting the result to the users. o Geometric: Various types of geometric techniques such as box plots and scatter diagrams can be used for presenting results to the users. o Pixel-based: Using this technique, a data value can be represented in the form of a uniquely coloured pixel. (b) Objectives of Data Mining The following are the objectives of using the data mining process: • Prediction: Data mining can be used to determine the behaviour of attributes of data. Predictive data mining can be used to perform analysis for buying transactions, which help determine the customers who purchased items during discounts. • Identification of item: In data mining, data patterns are used to check and identify the existence of an item, an activity or an event. For example, intruders, who are trying to break a system can be identified by checking the accessed files, programs and CPU time per session. • Classification: Data mining can be used to partition data to create a number of classes. This feature of data mining can be used in case of supermarket purchase to classify discount-seeking customers, regular shoppers and infrequent customers. • Optimization: Data mining can be used to minimize the use of limited resources such as time, money and materials. It also helps maximize output variables such as sales and profits under a given set of constraints. • Warehouse decisions: Data mining can be used with data warehouse to carry out certain decisions on the data stored in a database. • New pattern extraction: Data mining can be used to extract new patterns, which can not be found by processing the data contained in the data warehouse. (c) Applications of Data Mining in Business Data mining technologies can be used to make decisions related to businesses conducted by an organization. The application areas of data mining in business are:

Self-Instructional Material 119 Management Information System and DBMS NOTES • Data mining is widely used in the field of marketing. In marketing, data mining is used to analyse the behaviour of customers on the basis of their buying patterns. The other areas related to marketing in which data mining can be used include segmentation of customers and stores, design of catalogs and design of advertising campaigns. Data mining is also used to determine marketing strategies. • In the field of finance, data mining can be used to carry out performance analysis of financial investments on assets such as stocks, bonds and mutual funds. It can also be used segment to account receivables and evaluation of financing options. • In the area of health care and medicine, data mining can be used to analyse the effectiveness of certain technologies used for treatment. Data mining can be used to study the ill effects of drugs. With the help of data mining, a pharmaceutical company can easily determine which marketing activity will have a great impact on their sales in the next few months. They can do this task by analysing their current sales, by using the data related to the activities of their competitors in the market, and also by using the information about the local health care system. • In manufacturing, data mining allows the optimization of various resources such as machines, man power and materials. Data mining is also useful to create an optimal design of manufacturing processes, shop-floor layouts and product design. (d) Data Mining Techniques Following are the techniques used for data mining: • Artificial neural networks • Data analysis • Decision trees • Rule Induction Artificial neural networks An artificial neural network can be defined as an interconnected set of artificial neurons, which use a mathematical or computational model for processing the information collected from various sources. An artificial neuron can be defined as the basic unit of an artificial neural network. These take one or more units as input from the knowledge base and combine these units in order to produce an output. Artificial neural can be used to predict the buying habits of the customers. Then, using this data, shoppers or retailers can determine what the customer is going to buy next. Data analysis Data analysis can be defined as a method that transforms data to retrieve some useful information from various data sources. Data analysis can be used in data mining to locate parameters used for measurement and to locate unforeseen patterns hidden in the data. Decision trees A decision tree, also called classification tree, can be defined as a tree-shaped structure, which is used to represent various sets of decisions. These decisions can be further used to generate rules, which can be used for the classification of database. Rule induction Rule Induction is used for the extraction of if-then types of rules from a database. Rule inductions provide a method, which can be used for determining the similarities between Self-Instructional Material 120 Management Information System and DBMS NOTES the objects by scanning the collection of objects. The similarities can be represented in the form of if–then types of rule. Rule inductions use two parameters, support and confidence, to find out similarities between the objects. Support can be defined, as the number of rows specified by the rule and confidence is the percentage of data rows, where the rule is true. The knowledge discovered during data mining can be described in the following form: • Association rules: Association rules are used to relate the presence of a set of data items with another range of values for any other set of variables. Association rules are used to find out elements, which occur frequently within a data set. A data set can be referred as a collection of data stored in a tabular form. In a data set, each column represents variables and each row represents assignment of values for each variable placed in the column. These values can be real numbers, floating-point numbers or integers. Association rules can be used to find solution for the following types of questions: o If a lady purchases a set of earrings, how likely she will purchase a purse? o If a customer purchase mango, then will he buy an apple or an orange? • Classification hierarchies: Data mining process allows you to create the hierarchy of classes by using the existing set of processes and transactions. The following are the examples of classification hierarchies: o A group of people can be divided into various categories depending upon their buying behaviour. o A group of events can be classified into different types according to their time of occurrence. • Categorization: Data mining process allows the segmentation of various types of items and events into different sets of similar types of elements. Following are examples of categorization that occur during data mining: o The given population of men can be categorized into different groups on the basis of their buying habits for shaving cream and shaving gels. o An entire population of treatment data on a disease can be classified into groups on the basis of similarities between the side effects produced. Data Mining Issues The following implementation issues are associated with data mining: • Data integrity: A key issue in data mining is unwanted data from different sources. For example, a bank may maintain credit card accounts on several different databases. The addresses and the names of a single cardholder may be different in each. Software must translate data from one system to another and select the address most recently entered. • Cost: System hardware costs have dropped significantly over the years, but the costs of data mining and data warehousing systems are rising. The more powerful

Self-Instructional Material 121 Management Information System and DBMS NOTES the data mining queries, the greater is the pressure to increase the amount of data being collected and maintained, which further increases the pressure for faster, more powerful data mining queries. This increases the need for larger, faster systems, which are more expensive. • Data quality: Data quality is considered as one of the biggest challenges for data mining. It defines as the data accurate and complete. Data quality can be affected by the structure and consistency of the data being analysed. The presence of duplicate records, the lack of data standards, the timeliness of updates, and human error are some of the significant factors which have an impact on the effectiveness of more complex data mining techniques. To improve data quality, it is sometimes necessary to clean the data, which involves the removal of duplicate records and standardizing data formats. For example changing dates to the format, MM/DD/YYYY, so that it can include both month and year along with the date. • Database structure issue: One of the issues in data mining is that whether it is better to set up a relational database structure or a multidimensional one. In a relational structure, data is stored in tables. In a multidimensional structure, sets of cubes are arranged in arrays, with subsets created according to category. • Changing data: Databases are not assumed to be static. However, most data mining algorithms assume a static database. Therefore, it requires the algorithm to re-run completely anytime the database changes. • Noisy data: Some of the attribute values might be invalid or incorrect. These values are corrected before running data mining applications. • Missing data: During the pre-processing phase of Knowledge Discovery Database, missing data may be replaced with estimates. Other approaches to handle missing data can lead to invalid results in the data mining steps. • Technology: One of the key issues in data mining technology is that it is not a business or at least not technological one, but a social one. It is the issue of individual privacy. Data mining makes it possible to analyse routine business transactions and gather a significant amount of information about individuals' buying habits and preferences. 3.9 SUMMARY In this unit, you have learned that a database management system provides software that allows application programs to deal with data field names, regardless of field location within a record; record location within a file and file location within a device. In a DBMS, all the files are integrated into one system, thus making data management more efficient by providing centralized control of the operational data. You have also learned that database management systems are not only used in commercial applications, but also in many scientific/engineering applications. Data is stored in files that store the database itself. One of the key features of the database approach is to bring about a clear separation between the logical and physical structures of data. Further, the unit discussed the process of transforming requests and results between different levels of abstraction, called mapping. Finally, this unit provided an overview of data warehousing and data mining. These two activities are indispensable to any organization's business. Check Your Progress 16. What is data mining? 17. What activities does data mining consist of? 18. List the implementation issues that are associated with data mining.
Self-Instructional Material 122 Management Information System and DBMS NOTES 3.10 KEY TERMS • Modern database system: It is a type of DBMS that allows and permits high- performance queries along with numerical data analysis over various relational databases. • Data warehousing: It refers to a modern database maintained in an organization with various additional features such as integration and non-volatility of data. • Generic domains: They refer to the domains that are used to provide domain names to the hosts depending upon their generic behaviour. • Database: It is a place where data can be stored in a structured manner. • Logical record: It is a collection of related data items treated as a conceptual unit independent of how or where the information is stored. • Physical record: It is a contiguous area of storage space defined by the characteristics of storage devices and operating systems and includes all the bytes, which will be read/written by a single command to the I/O device. 3.11 ANSWERS TO 'CHECK YOUR PROGRESS' 1. The main objective of modern database is to provide interoperability technique that can run on multiple platforms, such as Windows, Linux, etc. 2. OLAP is a special technology which uses multidimensional data representation methodology called cubes to provide access to the data collected in the data warehouse. 3. A browser is an application that is used to search and navigate the Internet to access information. 4. The following terms are associated with the file processing system: • Data • Data item • File 5. The management of data includes the following: • Defining: Specifying data types and structures, and constraints for data to be stored • Constructing: Storing data in a storage medium • Manipulating: Querying, updating and generating reports • Sharing: Allowing multiple users and programs to access data simultaneously 6. A data administrator is a non-technical person who is responsible for managing the data resource of an organization and deciding its policies. 7. The three main features of DBMS are as follows: • Centralized data management • Data independence • Data integration
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Separating the logical and physical structures of data is one of the main features of the database approach. 10. An advanced database is a process which is used to break up a distributed database into logical units. 11. The advantages of distributed advanced databases are as follows: • Increased reliability and availability • Improved performance 12. Location transparency allows users to access data without their knowledge of the actual location of the data. In other words, users can work on that data as if it were present at their local site. 13. The tables containing attributes that describe a fact record in a fact table are known as dimension tables. 14. The various steps that enable data distribution are as follows: • Making data ready for presentation • Distributing the data to data marts • Loading the data to data warehouse 15. The various technologies that use a data warehouse are as follows: • Using English Query • Using SQL Query • Using Microsoft Office 2000 • Using a Web Browser • Using Custom Applications 16. Data mining or Knowledge Discovery in Database (KDD) can be defined as a process that finds out useful information and patterns in the data. 17. Data mining consists of the following activities: • Extracting, transforming and loading of transaction data into the data warehouse system • Storing and managing data in a multidimensional database system • Providing access to data to business analysts and information technology professionals • Analysing a data by using application software • Presenting data in the form of a useful format such as graph or table 18. The following implementation issues are associated with data mining: • Data integrity • Issue of cost • Data quality • Database structure issue
Self-Instructional Material 124 Management Information System and DBMS NOTES • Changing data • Noisy data • Missing data • Technology issue 3.12 QUESTIONS AND EXERCISES Short-Answer Questions 1. What are the three disadvantages of data redundancy and inconsistency? 2. What is the data abstraction concept? 3. Why do we store data in a database instead of a file? 4. What is a database? What are the elements of a database? 5. Write a short note on the activities that constitutes data mining. Long-Answer Questions 1. Explain the general structure of a DBMS. 2. Describe the concepts of a database schema? 3. What is data dictionary? Discuss its importance. 4. What is the difference between logical and physical data independence? 5. Explain the process of data mining. 3.13 FURTHER READING McLeod, R. Management Information Systems. Chicago: Science Research Associates, 1983. Curry, A., P. Flett and F. Hollingsworth. Managing Information and Systems: The Business Perspective. Oxford: Routledge, 2006. Orna, E. Information Strategy in Practice. Burlington: Gower Publishing Ltd., 2004 Madnick, S.E. (Ed). The Strategic use of Information Technology. New York: Oxford University Press, 1987.
Self-Instructional Material 125 System Analysis and Implementation NOTES UNIT 4 SYSTEM ANALYSIS AND IMPLEMENTATION Structure 4.0 Introduction 4.1 Unit Objectives 4.2 Information System Building 4.2.1 Background of System Development Life Cycle 4.2.2 MIS-Oriented System Development Life Cycle 4.3 Traditional Life Cycle Models 4.3.1 Waterfall Model 4.3.2 Prototyping Model 4.3.3 Spiral Model 4.4 System Design: Principles and Concepts 4.4.1 Design Concepts 4.5 Tools Used for System Design 4.6 Diagrams and Flow Charts 4.6.1 Data Flow Diagram 4.6.2 Entity–Relationship Diagram 4.6.3 Context Diagram 4.6.4 Flow Charts 4.6.5 Input–Output Chart 4.7 System Development and Implementation 4.7.1 Evaluation of Information Systems 4.7.2 Implementation Tasks 4.8

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Summary 4.9 Key Terms 4.10 Answers to ‘Check Your Progress’ 4.11 Questions and Exercises 4.12 Further Reading 4.0 INTRODUCTION

In this unit, you will learn about System Development Life Cycle (SDLC). To understand the development process of information systems, one has to first appreciate the fact that all information systems typically go through a life cycle. It is difficult to develop an information system without understanding SDLC and the various alternative models of system development. A concept similar to SDLC is Software Development Life Cycle (SWDLC), which comprises different models of development. Knowledge of these issues is important for the development of MIS as different models suit different systems and the developer can make an informed choice if he is aware of these issues. You will also learn about basic system concepts. Trends in modern business point to the need for information management in business organizations. Systems are built to manage such information, and these are housed in a computerized platform so that they deliver information in a timely and accurate manner. Information systems, as these systems are called, are designed to help organizations become more efficient through better utilization of these resources. In fact, the systems approach is used as a formal method of problem solving. Finally, this unit will discuss the designing of information systems and the various tools used for this purpose.
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UNIT OBJECTIVES After going through this unit, you will be able to: •

Understand information system building • Understand the traditional life cycle models • Explain the process of system design • List the tools used for system design • Learn how to use diagrams and charts for system analysis and design 4.2 INFORMATION SYSTEM BUILDING 4.2.1 Background of System Development Life Cycle The development of systems on a large scale was first attempted by the Department of Defense (DOD) of the US military and the National Aeronautics and Space Administration (NASA). They were instrumental in developing the framework of a sequence of stages or phases for developing a system. This sequence of distinct stages that a system goes through in its entire life is called system development life cycle (Anderson, 1991). The idea in such frameworks is to understand the detailed issues pertaining to the system in concept development, requirement definition, design, implementation, test and integration, installation and acceptance, and operations. These are done in a structured manner for different levels like system level, subsystem level, specification level, etc. The mechanism of choice for detailed discussion on such issues in the life of a system is called the review process. The key characteristics of SDLC are: each stage has a definite output, the outputs include the plan for taking the process forward, the outputs are ratified, all outstanding issues at each stage are resolved and there is mutual agreement between the rectifiers and the developers on the criteria for acceptance. However, these life cycles are typical of large aerospace projects or military projects. They are meant for only large-scale applications. Typically, MIS applications do not fall under this category. Hence, the MIS-oriented system development life cycle frameworks are a little different. 4.2.2 MIS-Oriented System Development Life Cycle The MIS-oriented system development life cycle is a little different from the SDLC of large-scale aerospace or defense projects. The MIS-oriented SDLC is tailored to suit the requirements of business systems. The MIS-oriented SDLC also has distinct stages and progression from one stage to the next is only allowed after the tasks of the preceding stage have been satisfactorily completed. The direction of progression is linear and unidirectional. The SDLC in this case involves the following distinct stages or phases: 1. System Definition Phase In the system definition phase, the system takes shape and form, logically but not physically. A series of stages and steps are taken to come up with a set of guidelines based on which the system can be constructed. The key steps in this phase are preliminary analysis, feasibility study, information analysis and system design. In this phase, critical
 information about the system and its requirements are gathered from the user, feasibility of such a system is studied and the information is analysed. All this is finally translated into a design or blueprint for the construction of the system. Preliminary analysis Preliminary analysis itself can be segregated into several steps. Preliminary analysis is sometimes called preliminary investigation and is normally conducted before an information system is designed. This is typically the fist step in the life cycle of a system. In this step, the management of the organization is engaged in the process to understand the following: • Problem/issue that the proposed system seeks to solve • Information requirement • Information users, generators and recipients • Frequency of use of information • Volume load on the system (amount of data to be transacted by the system) • Scope of the system • Boundaries of the system The main idea is to understand the broad specification of the proposed system by understanding its requirements, objectives, scope and boundaries. The following steps are taken at the preliminary investigation stage: • Assessment and survey of the situation/environment: This is the stage when the general environment under which the new system will be required to operate is scanned. In this stage, meetings are held with managers at different levels to understand the overall objectives, mandate, charter and background of the organization. The constraints and limitations of the problem are also understood. The management's perception of the problem is understood at this stage. The main tasks in this stage is to understand: o The mission, mandate, charter, objective and background of the organization o The actual organization structure and power centres along with their basic information flows o The boundaries, input, output, etc., of the existing system o The users of the systems and to segregate them according to their role and level of usage of the system o The problem and to define it accurately o The maturity of IS usage in the organization and organization culture o The expectation of the management • Analysis of the current system (if any): In this stage, the existing system is studied in detail for two purposes, which are as follows: o To find the constraints of the system and its shortcomings o To find if the system can be upgraded and reused In this stage, detailed meetings are held with the MIS department personnel and the CIO to assess the performance and the limitations of the current system. A manual of the current system is studied. The user's view about the system is also studied to arrive at conclusions about the current system and the reasons for its upgradation or replacement.

Self-Instructional 128 Material System Analysis and Implementation NOTES • Analysis of the system requirements and a specification of the requirements: This stage defines the requirements of users. This is one of the most important stages in the life cycle of the system as the work done in this stage will shape the development process of the system. If the work in this stage is not done properly, it can cause irreversible damage to the subsequent stages. Active interaction is required at this stage to understand the need and requirement of the user. The user's expectation from the system has to be understood clearly before proceeding with the development process. This stage ends with the deliverable System Requirement Specification (SRS); a formal document identifying the requirements of the system. Information in the SRS document is fed as basic data into the analysis and design stage. Feasibility study Webster's New Collegiate Dictionary defines feasible as 'capable of being done or carried out; capable of being used or dealt with successfully.' As is clear from this definition, feasibility from a systems perspective means whether a system can be developed successfully, given the technical endowment/environment/possibility, resource constraints and organizational desirability. In a feasibility study, analyses whether the system should be developed at all and if yes, then how. This is done with respect to certain dimensions. It is essentially a techno-managerial analysis to establish the capability to successfully complete the development of the system based on ground realities. There are several dimensions of feasibility like technical, economic, organizational, legal, ethical, socio-economic, socio-political, etc. However, the first three are the major dimensions. These will be discussed them in detailed. (i) Dimensions of feasibility Technology: Technical feasibility indicates whether the proposed system can be developed given the present and near future technological state of development. If the current technological environment does not support a system development technically, then the system is deemed to be infeasible. However, in the business context, MIS development rarely faces technical feasibility problems. Technology in such systems is well developed and is not of innovative variety and hence normally is not an important feasibility problem. Economic: After the assessment of technical feasibility, one has to check the economic feasibility of a system. Economic feasibility is the study to find whether the system will be economically feasible for the organization. Several tools to find the economical feasibility of a system are in use; like cost-benefit analysis, net present value, internal rate of return, etc. These techniques are applied to measure the economic cost-benefit and the return on investment of a system. A system will only be economically feasible if the benefit or return from the system is several times more than its cost. Typically, the system should not only recover the cost of development but should give an acceptable return on investment by improving processes, decision-making capability, efficiency, etc., in the organization. Measuring economic feasibility may be difficult in some cases where the benefits are not clearly understood or may be risky or very complicated to calculate. Sometimes, the economic benefit from a system may not be direct but indirect. In such cases, the economic feasibility may be very difficult. Organizational: Organizational feasibility deals with the capability of the organization to operationalize the system successfully. Several issues come to the fore in organizational feasibility analysis. They are as follows:

Self-Instructional Material 129 System Analysis and Implementation NOTES • Whether the organization is mature enough in using information system to warrant implementation of the proposed system? • Are the employees capable of handling a system like the one proposed? • Does the installation of the proposed system hamper work schedule in any manner? • Is the proposed system compatible with related systems in the organization? • Does the installation of the proposed system involve job cuts and large-scale change? Suitable answers to the above issues will indicate whether the system is feasible organizationally. (ii) Steps in a feasibility study The following steps are taken to conduct a suitable feasibility study: Define the objectives of the feasibility study: It is always better to define the objectives of the feasibility study upfront before embarking on the actual study. This clears away any ambiguity and sets the focus of the study. Study the current environment: This is important as the system is going to work under a set of environmental variables and not in isolation and hence the current environment needs to be studied. Analyse the information requirement: Information requirement of the system should be studied as the feasibility of getting such information may itself be an issue. If the proposed system is such that its information requirement is not feasible, then the project becomes infeasible even if developing the system may be feasible. Generate alternative solutions: One must use the opportunity of conducting a feasibility study to come up with alternative solutions as this is the last stage where substantial monetary resources are not required. All stages and phases after this will involve large amounts of material resources. So this in a way is the last opportunity for the organization to look at alternative solutions and since during feasibility study, the entire system is given a re-look, it is also a good time to brainstorm about alternative solutions. Report preparation: This is the last step of feasibility study in which a formal document is prepared indicating the feasibility of the project. If the system is feasible, then the report gives clear indications to that effect. This is a formal document and is referred to by the organization at various stages of the development process. Information analysis This is also called the logical or conceptual design stage as in this stage a thorough analysis of the system (from a logical perspective) is done. The system is segregated in a hierarchy of black boxes (each denoting some functionality). Each box is a module with a specific role in the overall setup. In this step, for the first time, the system takes a conceptual shape. The logical modular design of the system is then discussed with the management and after suitable changes the physical design is prepared. In this stage, the logical design of the system and its interdependencies on its subsystems is designed according to the requirements stated in the earlier stage. This is the stage in which the entire system is fully conceptualized and logically defined in abstract terms in a logical design document. Data flows, data stores and processes, which make the system, are designed and depicted in specific design documents. Subsystems' dependencies and their data flows, data stores and processes are also

Self-Instructional 130 Material System Analysis and Implementation NOTES designed and integrated with the overall system. A complete logical view of the system, which fulfills all requirements, is prepared in this stage. A comprehensive project plan is also prepared in this stage, which includes the time schedules of the development of the system (activity wise), manpower requirement for each activity and timelines thereof, budget, training requirements, testing plan, installation plan, change management plan, resource plan, organization plan and documentation plan. However, the actual content of the project plan may vary with each project depending on the scope and size of the proposed project and the amount of developmental effort that needs invested in the project. System design In this stage, the details of the system are elaborated. Logical and physical design documents are prepared. These design documents contain all implementation details of the system like hardware details, database structures, data structures, network and communication details, application software details, interface details, etc. Details about data sources, input, output, files, processing, testing and information flow are part of the design. In this stage, the entire system is put on paper and explained in diagrammatic terms. A lot of diagrammatic tools are used in this stage to create the design. Understanding of these tools is essential as they are technical tools. A design diagram indicating the physical data flow or a use case indicating the objects and their interrelationships give a better idea to the developer, who is the intended user for the design document. 2. System Construction Phase In this phase, the system is actually constructed. The phase has two steps. The first step is the development of an application program. In this stage, the design document is thoroughly studied and based on the design, an application program is created. This is an activity that requires maximum manpower and material resources in the entire life cycle of a system. Along, with the application program, the procedures to interact with the system are also developed so that various levels of users can interact with the system using different modes of interaction. Application programming In this stage, the actual software that is a major part of the system, is developed. Actual codes (lines of code or LOC) are written in a computer programming language to create the software for the system. The number of LOC determines the size and cost of preparation of the software. A model called the COCOMO model is used before embarking on the project to estimate the project time and cost. Estimation of the software cost and effort is an important exercise, which has to be done before starting the coding process. Function points in the software are identified and the effort required for each function point is estimated. Another alternative is to estimate the LOC and then make an estimate of the time and effort. Programming can be done with a top-down approach or a bottom-up approach depending on the strategy of development. Typically, this step involves the following: • Database design and creation of database structures: Data has to be stored in a data repository. Typically, relational databases are used for data storage. These relational database management systems have to be designed and structures have to be created so that data from the application can be stored in the database. Hence database, tables, views, etc., are created, which is crucial for data storage.
Self-Instructional Material 131 System Analysis and Implementation NOTES • User interface design and development: The user will interact with the system by means of the user interface. This has to be designed in a user-friendly manner and developed according to the design. • Programming to create functionalities: The core functionalities of each module have to be coded. This is done in this step. Based on the design specification and the logical flow of the system, functionalities are coded keeping track of the interdependencies. • Creating connectivity with the database and the application: The application will need to interact with the database by transacting with it. Hence connectivity is required. This sometimes become an important issue as the database may be housed in a different geographical location under a different operating environment than that of the application, thus complicating the data management. • Incorporation of the business logic into the software: The application is developed to suit the process needs and requirements of the business and hence all data validation and processes are according to the business logic of the organization. This has to be incorporated in the software. Typically, this is incorporated in a middle tier. The codes are then tested for errors. Load testing is also performed to check if the software will hold good when the pressure of actual volume of data is loaded onto it. Procedure development In this stage, the user's interaction with the system is laid down. Not all users are allowed to conduct all the functions in the system. Different levels of users will have different accesses. The procedure to access information from the system has to be clearly stated to the user in the form of operating procedures, manuals, etc. This will help the user navigate through the system without any problem. Key tasks are given in a flow chart pattern to help the user gain a fast understanding of the system. 3. Implementation Phase In this phase, the system is implemented in the organization. Implementation is not a straightforward issue; it involves a lot of managerial interventions. Typically, implementation tasks can be the following: •••• Planning for implementation: In this step, the implementation plan is prepared. Action points are spelt out and schedules are prepared. •••• Communicating the implementation: Clear communication is initiated with the user community so that there in no ambiguity. Users must know when to expect the implementation of the new system so that they can prepare themselves for it. ••••

organized such that it can take care of the system. •••• Selecting and procuring the hardware: Steps are initiated to procure hardware; rules and procedures are prepared for this. •••• Procuring the system software: Steps are initiated to procure system software; rules and procedures are prepared for this.

Self-Instructional 132 Material System Analysis and Implementation NOTES •••• Creating and deployinging the database: According to the software design, database is created with all the required structures. Rules and procedures along with security interventions are also formulated. •••• Training users: Training is initiated for the users to enable them to work on the new system. •••• Creating and develop physical infrastructure: Physical infrastructure is created and developed to house the new system. •••• Transiting to the new system: This is the process of transition from the old system to the new system. Major problems can crop up during implementation and the task of an implementer is often that of a fire fighter. Troubleshooting of system and people-related issues in this phase is routine. 4. Operation Phase In this phase, the system is in operation. Therefore, the major task is related to the maintenance of the system in order to ensure that the system functions smoothly. At the beginning of the operation phase, a post audit may be conducted to find out the efficacy of the new system. 4.3 TRADITIONAL LIFE CYCLE MODELS Software Development Life Cycle (SWDLC) is a subset of System Development Life Cycle (SDLC). Indeed, SWDLC is very similar to SDLC, but it deals with only the application software development life cycle of a system. SDLC, on the other hand, deals with the entire process of the development of the system, of which application is just one part – although a very important one. Different types of software development methodologies can be adopted by a system developer. Some popular methodologies are the Waterfall model, Prototyping model, Rapid Application Development model and Spiral model. 4.3.1 Waterfall Model This is a classical model for developing systems. It develops each system in phases and each phase is self-contained. Overlaps are not allowed and the development work flows from one phase to another in a linear manner and progresses only on the completion of work in the preceding phase. The following are the phases through which systems are developed: Requirement analysis phase This phase, analysis the requirements of the system the process involves client interaction and an understanding of the user's perspective. Various techniques of fact finding like questionnaires, interviews and secondary research are used to create a user requirement specification document (see Exhibit 4.1). This indicates the need and expectation of the user from the system. Check Your Progress 1. What are the key steps of the system definition phase? 2. Mention some of the dimensions of feasibility. 3. What is economic feasibility? 4. What steps are taken to conduct a suitable feasibility study? Self-Instructional Material 133 System Analysis and Implementation NOTES Exhibit 4.1: Fact-Finding Techniques There are several fact-finding techniques. Each has its own advantages and disadvantages, and is suited for a specific purpose. Questionnaire: In this technique, the respondent is asked a set of predefined questions. The responses will not lead to new dimensions in the research. However, they will help in qualifying the dimensions on which the researcher has based the questionnaire. Questionnaires can be of several types like open-ended, closed and multiple choice. The most common type is the multiple choice questionnaire in which the researcher not only frames the questions but also limits the choice of responses of the respondent by providing him with a set of choices. This technique is used when the researcher has a clear understanding of the problem and wants the respondent to respond to only those issues that he has identified with only those responses that have already been thought of. Interview: The process of collecting data by directly asking questions to respondents is called an interview. Structured Interview is the process of directly interacting with the respondent to seek responses to an already well laid out set of questions. The process of seeking responses is well structured and the interviewer seeks responses by asking questions in a sequential manner. Since it has a structured process, this technique limits the respondent's choice. It is used when a problem is well understood and a response is sought on select issues regarding the problem under discussion. Unstructured Interview is the process of directly interacting with the respondent to seek responses to questions that have not been laid out already as a result, one question might lead to another. This technique is used when the researcher is not sure of the nature of the problem and has only a superficial knowledge of it. The above techniques may be applied by the analyst to understand the requirements of the system. The requirements can then be specified after analysing them in detail in the software requirement specification report (SRS). IEEE/ANSI has made an ideal format to present SRS, which is given in Exhibit 4.2. Exhibit 4.2: IEEE/ANSI Software Requirement Specification Table of Contents 1.0 Introduction 1.1 Purpose 1.2 Scope 1.3 Definitions, Acronyms and Abbreviations 1.4 References 1.5 Overview 2.0 General Description 2.1 Product Perspective 2.2 Product Functions 2.3 User Characteristics 2.4 General Constraints 2.5 Assumptions and Dependencies

Self-Instructional 134 Material System Analysis and Implementation NOTES 3.0 Specific Functions 3.1 Functional Requirements 3.1.1 Functional Requirement No.1 3.1.1.1 Introduction 3.1.1.2 Inputs 3.1.1.3 Processing 3.1.1.4 Outputs 3.1.2 Functional Requirements No.2 3.1.2.1 Introduction 3.1.2.2 Inputs 3.1.2.3 Processing 3.1.2.4 Outputs 3.1.3 External Interface Requirements 3.1.3.1 User Interfaces 3.1.3.2 Hardware Interfaces 3.1.3.3 Software Interfaces 3.1.3.4 Communication Interfaces 3.1.4 Performance Requirements 4.0 Design Constraints 4.1 Standards Compliance 4.2 Hardware Limitations ... ... 4.3 Attributes 4.4 Security 4.5 Maintainability .... 5.0 Other Requirements 5.1 Database 5.2 Operations 5.3 Site Adaptations ... ... 5.4 Testing Design phase This is an important phase. The requirements are put into a design document to create a conceptual understanding of the system, through different diagrammatic representations, (The system is defined in a specific manner.) It involves design of data structure, architecture, interface representation and algorithmic detail. Different diagrams are used for representing these attributes. The design phase ends with the system specification document, which is a precise specification on the basis of which the system will be developed.

Self-Instructional Material 135 System Analysis and Implementation NOTES Code generation phase This phase translates the design of the earlier phase into software codes to develop the system is developed. The conceptual understanding of the design phase is operationalized in an information technology platform. Testing phase This phase tests the generated codes against the design specifications. It assesses whether the code has been generated according to the desired specification. Also test tests such as toad testing, error correction, etc., are aso performed. Support phase This is the last phase of the system development life cycle in which the system is supported by implementing incremental changes in it. These incremental changes are introduced to adress the changes in the processes or corrects error. Limitations of the Waterfall model The main problem with the Waterfall model is that it does not utilize manpower properly as the tasks are interdependent and some members of the team remain idle. They have to wait for others to complete tasks. In certain real life, software development rarely follows a linear, unidirectional sequential model. In real-world scenarios, the stages must allow some degree of iteration to take place so as to to accommodate changes in client requirements. Another fault with the methodology is that it does not allow changes in the client's requirements. Also, this model must have very good reviewers as any problem left undetected in the methodological stages, may result in a catastrophic failure at the end when the software is ready for launch. 4.3.2 Prototyping Model Sometimes a client is in a hurry to complete the software project. A general set of objectives may be available with the client and the developer has to hastily develop the software. The Prototyping model of software development is used in such cases. The model starts with the process of gathering requirements. The developer and the client meet and discuss the objectives and requirements of the software. Based on this discussion, the developer team makes a quick design that have only bare basic functionalities, which may be deemed mandatory. A hastily created prototype of what a proposed system would be like is made by the developer team based on the broad requirements (which may or may not include objectives, and input and output requirements) set by the client. The developer and the client then meet to check if the prototype of the proposed system works. The client reviews the software and suggests refinements leading to first iteration. This results in an improved prototype. This process is repeated and with each iteration, the prototype matures into a functional software. The prototyping process of software development is, however, not fit for critical projects. It may serve the organization well for small applications that fit into a subsystem to provide it with an additional functionality. However, if such a methodology is applied to a large-scale organization wide MIS development project, it may lead to a faulty development. The main problem of this methodology is that clients, in their hurry, may insist that the software be built based on the early stages of the prototype, when the developer has barely managed to put together a semblance of a system. This may lead to problems at a later stage as long-term issues are neither envisaged nor factored in the early stage

Self-Instructional 136 Material System Analysis and Implementation NOTES prototypes. Also, the developer in his zeal to complete the assignment quickly, may cut corners and use inappropriate components into the prototype. This can affect the long- term sustainability of the software. 4.3.3 Spiral Model The Spiral model of software development falls under the evolutionary models of software development. It was pioneered by Boehm (1988). In this methodology, some of the features of both prototyping and Waterfall models are used. In this model, the software is made in incremental versions. The prototype is not stable in the early versions of the iterations of the software. In fact, in very early versions, the prototype may be just on paper. With iterations, the software begins to take shape and form. In the Spiral model, a set of activities is conducted sequentially, as depicted in Figure 4.1. Planning Risk Analysis - Prototyping Client Evaluation Developing A1 B1 A0 B0 D0 D1 C0 C1 Figure 4.1 SWDLC of Spiral Model In Figure 4.1, quadrant A is where different planning activities are conducted. A risk analysis is done in quadrant B; in quadrant C, various software development activities are undertaken and client evaluation is done in quadrant D. So the Spiral starts with a plan, then a prototype is prepared followed by some activity of software development. The client interaction follows this and based on the feedback, the next round of steps are initiated starting with planning. Thus, the Spiral moves from one iteration to another and after each iteration, the software is improved. The Spiral moves sequentially from A to B to C to D and then to A again for the next iteration. 4.4 SYSTEM DESIGN: PRINCIPLES AND CONCEPTS The fundamental principles of design are as follows: • The first principle of a good design is that it should have an overall macro view of the system rather than a tunnel view: This helps the designer to fit the components and integrate them in the overall design. This will give the designer a comprehensive view. Check Your Progress 5. What is SDLC? 6. What is the testing phase of the Waterfall model? 7. What is the main problem of the Prototyping model?

Self-Instructional Material 137 System Analysis and Implementation NOTES • The design process should be a logical: The design should have steps, which blend with each other, logically. The relationship of logic in the process of design should be unidirectional and strong. • The design should not reinvent the wheel: The design should not tread into territories, which have already been confirmed. The idea is not to revisit an issue, unnecessarily. • The design should be a very close abstraction of the problem: The design should make a clear abstraction of the problem it is supposed to solve. • The design should be uniform and integrated: The design should be integrated uniform throughout. It should not lack links with the system. Nor should it have loose components. • The design should be structured: The design has to be structured in order to be valuable for the developer. The process of design itself and the output from the design process will have to be structured. • The design should be reviewed on a real-time basis to minimize errors: The design should not be allowed to proceed unreviewed. While accepting the fact that design is a creative endeavour, the process around design should be such that mistakes in the design should be pointed out before more time is spent on creating more design around the mistake. 4.4.1 Design Concepts Some major design concepts that are to be adhered to in designing a system are as follows: Abstraction Abstraction is the conceptualization of an issue or problem or entity in terms of some level of generalization without regard to irrelevant low-level details (Wasserman, 1983). At the top level, abstraction is used in broad terms and defined with the variables of the environment. However, at the lower levels, it is defined in problem-oriented and procedure- and implementation-oriented terms. Several types of abstraction are possible at the lower level. They are as follows: • Procedural abstraction: When abstraction is used to define procedural issues. It is a named collection of several sequential procedural steps. • Data abstraction: This is the name of a set of data that defines an object. • Control abstraction: This is a named control mechanism, which has several steps. Refinement This is a top-down design strategy in which design is refined after successive steps. In each step of refinement, instructions are given in greater detail. Refinement helps the designer in elaborating the systems and bringing out low-level details as the design progresses. Modularity Modularity is a concept, which is very important for any system design. It helps the designer to compartmentalize the design into functional compartments. The entire system can be conceived to be composed of a set of modules, each having its own special feature and functionality. Modularity helps the designer to comprehend the Self-Instructional 138 Material System Analysis and Implementation NOTES system better. However, the division of a system into modules comes at a cost. If modules increase in number, then initially the cost/effort per module for creating the system comes down as less dependencies make the system less costly. However, the cost of integration goes up. Thus, the total cost reduces initially but then goes up. Therefore, any system should be divided into an optimum number of modules so as to keep the cost low. Effective modular design in general reduces the complexity of the system by dividing the system into easily understandable modules. These modules, in order to be effective, must exhibit functional independence, cohesion and coupling. Functional independence in a module means that the module is focused on the delivery of some output in a functionally independent manner. It does not interact in a large way with other modules to achieve this goal. Functional independence makes the modules easier to create, maintain and reuse. They work like components in an engineering application, each module performing a task with minimum interaction with other subsystems. These types of modules are easy to create and develop. Cohesion is the degree of singularity of purpose in a software procedure. Coupling is a measure of interconnectivity of modules. 4.5 TOOLS USED FOR SYSTEM DESIGN Systems can be designed with the help of tools and techniques. There are several tools that help a designer to design and graphically/pictorially represent system. The following is a discussion two such tools: 1. Data Flow Diagram (DFD) A data flow diagram is a graphic representation of a system or a portion of a system. It consists of data flows, processes, sources, destinations and stores. All of these are described through the use of easily understood symbols. At the same time, data flow diagrams are powerful enough to show parallel activities. The standard symbols use symbols for people, files, terminals and documents that can be used to discuss a system with users. The two types of data flow diagram are known as physical data flow diagram and logical data flow diagram. Physical data flow diagrams are implementation- dependent. Logical data flow diagrams describe data, processes and events in a different manner. The DFD depicts the flow of events and data within a system but omits a very important part of the system, the structure of the data. Data cannot move from process to process or from process to data without computer programs which explains the structure of the data. 2. Data Dictionary (DD) A data dictionary is the complete and comprehensive definition of all the data elements in a system. It is a source document specifies of all inputs, protocols, outputs, data structures, database structures, meta data and algorithmes. It is repository of all design data about the system. Several description formats are available. One such format requires that for each data item, the following information must be stored in DD: •••• Name: Formal name of the data item/control item according to convention used •••• Alias: Any other name for the same item •••• Use: Where the data/control item is used, by which process and when and for what Self-Instructional Material 139 System Analysis and Implementation NOTES •••• Description: Standard description of the item •••• Additional information: Any other information critical for the item The symbols used in a data dictionary are shown as follows: Symbol Meaning + And * * Delimiters = Is composed of [|]| Or { } n N times repetitions of ( ) Optional data A well-constructed DD is useful not only for design but also for posterity. When the system breaks down for some reason, a DD sometimes comes to the rescue. A DD normally serves as a: • Summary of the documentation • Tool to reduce redundant data • Background for I/O design • Centralized control of all data in the system • Controller of data integrity 4.6 DIAGRAMS AND FLOW CHARTS Diagrams and flow charts are useful tools to analyse and successfully implement a complete system. System designers and developers use many types of diagrams and charts according to the requirements of the system that has to be implemented. These tools make the system more interesting and informative because these illustrate with boxes, text and control flows that are easy for system designers to understand. Diagrams and flow charts are also useful because they communicate information visually. Therefore, they are used in each phase of system design and implementation. 4.6.1 Data Flow Diagram DFD is a powerful tool to understand the functional and information view of a system. It can be of two types—logical data flow diagram and physical data flow diagram. Logical data flow diagram deals with the functional view of the system and defines the system in terms of its functionalities and information flows. It uses the following symbols for such representation: An entity is represented by this A curve like this represents information flow from one entity or process or data store to another Check Your Progress 8. List the fundamental principles of a good system design. 9. What types of abstraction are available at the lower level?

Self-Instructional 140 Material System Analysis and Implementation NOTES Two parallel lines represent data store A process is represented by a circle like this Typically, a DFD of a cheque deposit system may be as Customer depositing a cheque 1.1 Verification of account and deposit into account 1.2 Account management Bank Account-related data (signature, etc.) Bank's account balance A DFD can be represented in various levels of detail. The abstraction provided by a DFD helps in understanding the system. The top-level DFD is called level 0. All the processes of a DFD are numbered and named. All entities, data flows and data stores are named. A DFD is hierarchical in nature and the top-level DFD is called a context diagram. A DFD further breaks down the levels of abstraction and complexity until the atomic level is reached and no more granularity is possible. The numbering convention for processes in a DFD is that the level of the DFD comes first, followed by a dot and then the number of the process. If the process is a subprocess, then this goes on until a process number unique to the process is given. It will be worthwhile to mention here that certain rules are used in a DFD. These are: • The data flows should not intersect • Looping is not allowed. This means that data flowing from process A to process B cannot come back to process A from process B without going though another step in between. • Entities should not directly access data stores. They should go through a process. • Data flows cannot be orphan data flows. This mean that data must terminate to a process or an entity of a data store or another DFD. Logical DFDs are more popular and physical DFDs are rarely used. Self-Instructional Material 143 System Analysis and Implementation NOTES Attributes of a Relationship Descriptive attributes may exist in a relationship. There may be an M:N relationship, for example, 'supply,' between the entity VENDOR and the entity ITEM. The attribute 'StartDate' may be associated with the relationship to indicate the time when a particular employee began working on a particular project. Direction: The direction of a relationship indicates the originating entity of a binary relationship. The source entity is the entity that a relationship originates from. The target entity is where the relationship comes to an end or terminates. Connectivity determines the direction of a relationship. In a one-to-one relationship, the direction is from the source entity to a target entity. If neither of the entities are dependent on each other, the direction will be arbitrary. With one-to-many relationships, the entity that occurs once is the parent. The direction of many-to-many relationships is arbitrary. The Relationship Set borrower may be many-to-many, one-to-many, many-to- one or one-to-one. To distinguish among these types, you can draw either a directed line (à) or an undirected line (†) between the Relationship Set and Entity Set in question. Representing Participation in E-R Diagram

the existence of another entity to which it must be related. There are two types of participation constraints: • Total: It indicates that

Partial: It indicates that the existence of an entity does not depend on its relation to another entity. In E–R diagrams: • Partial participation is denoted by single lines • Total participation is denoted by double lines (or thick lines) School Teacher Partial Total Head of school Figure 4.3 E–R Diagram showing Partial and Total Participation
Self-Instructional 144 Material System Analysis and Implementation NOTES Figure 4.3 illustrates the concept of total and partial participation. Each school must have one head master. So, the entity School participates in the relationship Head of, totally. On the contrary, from among many teachers in a school, only one is chosen to be the head master. So here, the entity Teacher participates partially in the relationship. Cardinality constraint: The lower and upper bounds on the number of relationships in which each entity is allowed to participate is specified. Maximum cardinality: The maximum number of entities that can occur on a particular side of the relationship are indicated by the numbers inside the relationship. Minimum cardinality: This refers to the minimum number of entities that can exist on one side of the relationship. The mapping cardinality of a relationship set depends on the real-world relationships which it is modelling. Minimum cardinality and maximum cardinality pairs enclosed within parenthesis denote cardinality constraint (Figure 4.5). Example: (1,N) (1,N) (0,N) (0,1) EMPLOYEE Are_in DEPT supervise Figure 4.4 E–R Diagram Showing Maximum and Minimum Cardinality 4.6.3 Context Diagram A context diagram (Figure 4.5) is a type of data flow diagram which has one central process that provides the scope of the system. This diagram facilitates a kind of mechanism in which the information is sent to and received from a specified control domain. This diagram contains closed boxes that represent a set of sources and information, and arrows that represent the flow of control. In this diagram, data is maintained by the operations that are processed outside the scope of the domain. The text written above the arrows in the context diagram is the information that is passed between the organization and the external entities. The arrows settled between the boxes explain the directional flow of the information. External Entity A External Entity B Process as a whole Data flow X Data flow X Figure 4.5 Context Diagram

Self-Instructional 146 Material System Analysis and Implementation NOTES 'system' process is involved. For drawing the context diagram, the very first step is to draw and name a single process box that represents the entire system. The next step is to identify and add the external entities communicating directly with the process box. Finally, the resource flows and data flows are added to the diagram. In drawing the context diagram you should only be concerned with the most important information flows. These include the receiving and checking of orders, providing good customer service and paying invoices. The shop manager and staff do not appear as entities at this level because both are set within the system process box. The two levels used in a context diagram are as follows: • Enterprise-Level Context Diagram • Project-Level Context Diagram We will now discuss each of these diagrams in greater detail. 1. Enterprise-Level Context Diagram A context diagram at the enterprise level of detail is referred to as a Business Context diagram. Government User Community Request for Funding Private Sector Private Sector Request for Funding Funding Industry Education community Funding Educational Services Request for Services, Educational Requirements Educational Services Request for Services, Educational Requirements Hardware, Software and Support Request for Hardware, Software, and Support Figure 4.7 Business Context Diagram Figure 4.7 shows the primary relationships between an organization and the external entities with which it deals. It helps to show the main classes of information that the business must manage while dealing with its environment. An alternate approach to creating a single enterprise level diagram is to create individual Business Context diagrams for each major component of the enterprise and then to combine these diagrams to produce the overall diagram. Steps to construct an enterprise-level context diagram The following steps are required to develop an enterprise-level context diagram: • The first step is taken to draw a square shaped box (centre box) centre of the diagram to represent the enterprise. • A list is developed for such external entities as customers, suppliers, government agencies, etc. • The list is revised to keep the diagram simple. This is done by grouping external entities.
Self-Instructional Material 147 System Analysis and Implementation NOTES • The data inputs and outputs are identified between the enterprise and the external entity. • The external entities are identified by a square box on either side of the centre box. • Data flows are drawn with labels that describe the primary relationship between the enterprise and each external entity. • At this stage, it provides supporting documentation for external entities and their inputs and outputs. • Finally, it reviews results with the customer/client. At this stage it gains consensus. The following are the uses of a context diagram at the enterprise level: • The context diagram situates an enterprise with its regulatory environment. • This diagram defines the strategic mission of an enterprise with its subcomponents. 2. Project-Level Context Diagram A context diagram at the project level develops a logical business process by using physical data flows. Basically, it defines the business system showing the flow of input and output data to a central process. It also incorporates the scope of the project. In essence, the project scope confines the relationships with external entities. The external entities are not defined within the scope of the project. The context diagram at the project level is the root of Functional Dependencies (FD) which is defined in detail at the conceptual level. At the point of FD, the context diagram is at level zero. A project level context diagram mainly consists of external entities, central processes and data flows. The details of each factor are described below: • External Entities: They are known as terminators, sources and actors. Basically, these entities could be a person, system or an organization that has a predefined behaviour. They define the business area's sources and destinations of information. • Central Process: The target of analysis is represented by the central or parent process. It is defined as the highest level process receiving inputs of data from external entities. This process facilitates data into outputs to the external entities. During this process, a brief description of the major functionality of the business system is outlined. • Data Flows: Data flows are known as pipelines by which data is interconnected between the external entities and the business processes. The examples of data flow vector are sales report, purchase order, customer profile and final product. Steps to construct a project-level context diagram The following steps are required to construct a project-level context diagram: • The first step is to identify the external entities exchanging information with the business system to reach the target of analysis. If an organizational context diagram exists, external entities and data flows are extracted from there and reviewed. • In the second step, data flows to and from each external entity are identified. • Then, a process box is drawn at the center of the diagram. At this stage, flow of data is used as the criteria for decomposition. At last, business process is treated as a central process that becomes the root of such process decomposition diagram, as function chart or data flow diagram. This central process uses the flow of data as the criteria for decomposition.
Self-Instructional 148 Material System Analysis and Implementation NOTES The following are the uses of a context diagram at the project level: • This diagram defines the scope of the project. • It assesses potential benefits and risk factors. 4.6.4 Flow Charts A flow chart, also called flow diagram, is a graphical or pictorial representation of the complete process (input, process and output) and describes the sequence of steps needed for the required output. A set of basic symbols is used to draw a typical flow chart to represent various functions and sequence of functions with the help of lines and arrows.

In general, flow charts are prepared in the initial stage of the problem-solving process. It presents the complex business logics, written in a natural language, into a pictorial form. Table 4.2 lists the symbols that you can use for creating a system flow chart. Table 4.2 Symbols Used in Flow Charts Symbol Name Description Start or End Specifies the start and end points of a flowchart Arrows Connects different flow chart symbols Process Specifies the condition to be evaluated Input or Output Specifies the input or the output of the process Decision Specifies whether or not the specified condition is true Off-page Connector Helps connect the flowchart drawn on different pages Stored Data Specifies the name of the file stored on the disk Connector Connects two parts of a program The advantages of using a flow chart to represent the logic of a problem are as follows: • It helps all concerned persons such as systems analysts and programmers in developing an intermediate interface for understanding the logic of a system. • It provides an easy and effective approach for preparing a document and analysing the flow of data and control in a system. • It helps verify and validate the developed program for appropriate debugging. Although each flow chart has a single starting point, it can have multiple ending points depending on the program logic. The same shape is used for the start and end points. A title can be added to a flow chart. Flow charts are of various types designed for specific purposes and used by analysts, designers, engineers, managers or programmers. Some flowcharts represent various object types. Sterneckert has defined the following four general types of flow charts: 1. Document flow chart: It shows the document flow through the system. 2. Data flow chart: It shows the flow of data in a system.
Self-Instructional Material 149 System Analysis and Implementation NOTES 3. System flow chart: It shows control at a physical or resource level. 4. Program flow chart: It shows the control in a program within a system. The following sections will discuss system flow charts and structured flow charts in greater detail. System flow charts A system flow chart is a symbolic representation of the solution of a given system design that processes the flow control of the entire system. This flow chart is basically used by system analysts to design a successful system implementation. A system flow charts have the following features: • It shows the sources which generate data and the device used for this. • It shows the various processing steps. • It also shows the intermediate and final output and the devices used for storage. Take for example a system flowchart of an online air-ticket booking system. There would require two master files require for successful system implementation. One of the files is maintained for the administration and the other one for travellers. For this system design, analysts will go through the following questionnaire: • How many flights will be considered for landing and taking off? • Travelling would be taken as a round-trip or one way, and the points of travel (from where to where) will be mentioned. • At what stage in a system flow chart will the classes and choices of meals of travellers be recorded? • How will the system transactions run successfully as a whole? • What type of front-end (applications) and back-end support (database server) will be implemented to design the system? • What will be the total cost of the whole transaction during system implementation? Input Transactions Validate Transactions Error Report Validated Transactions Sort Transactions Master file Sort Transactions Update Financial Report Updated Master File Figure 4.8 Successful Transaction of System Flow
Self-Instructional 150 Material System Analysis and Implementation NOTES In the flow chart shown in Figure 4.8 after the transactions have been input, the control will validate these transactions. If any error occurs at this stage, an error report will be displayed, otherwise the validated part will be checked completely. Transactions will be sorted either in ascending or descending order to make the master file (see Figure 4.9). This file is maintained and updated by the system analyst at regular intervals. Finally a financial report is generated to show the total cost during system implementation. Sorted transaction file Master file Pay slips Update Update master file Management statistics Key Disc file Tape file Printed output Figure 4.9 Sorted Transaction File in System Flowchart Structured flow charts Structured programming was introduced between 1960 and 1970. This was also the beginning of structured flow charts. The need for structured flow charts was felt when the structured programming paradigm evolved. It is based on the mathematically proven concept that only three types of control structures—sequence, decision or selection and iterative or looping—are sufficient to solve all problems. The types of sequential decision structures are input or output process and subroutine call. A decision structure may be either single branch or double branch and case. The latter is also used for multi branching. Structured flowcharts make statements that are executed in sequence, i.e., one after another. Decisions make two blocks of program code and their execution is subject to a test for some condition. Loops are also called iterations, and these make one or more statements and are executed repeatedly as long as a specified condition is true. The four types of iterative structures are: (i) test at the top, (ii) test at the bottom, (iii) counting and (iv) user-controlled exit. Structured flow charts are used for the following reasons: • They require less time for comprehension. • They lead to fewer errors in understanding the system. • They help in better understanding of an algorithm. • They reduce the time in answering questions on algorithms. • They reduce the frequency of referring to an algorithm.
Self-Instructional Material 151 System Analysis and Implementation NOTES NO YES Is

Flow chart using the GOTO statement Structured flow chart with GOTO removed (b) Figure 4.10 Structured Flow Charts Figure 4.10 shows the logic of a structured program, illustrated by structured flow charts, that flows smoothly from top to bottom. Advantages of structured flow charts The advantage of a structured flow chart lies in the creation of correct programs which are easy to write, understand and modify. • A modular design improves the programmer's productivity. This makes them look at the big picture first and details later. It is possible to multi-program; several programmers can work on a single, large program, each working on a different module. Structured programs can be understood more quickly than standard programs. • Each procedure performs just one task and, hence, a procedure can be checked individually. Sometimes, the logic of such a flow chart has too many details and, hence, is difficult to follow. • The relationship between the various procedures depicts the modular design of the flow chart. • A correctly designed and structured flowchart is easily understood by another programmer. 4.6.5 Input–Output Chart The input–output chart (Figure 4.11) is an important tool that is used to visualize the flow of order during the design and implementation of a system. It is generally associated with the funnel model that basically filters the output. The output is calculated in standard hours as per input parameters. This chart is an ideal tool to visualize dynamic processes along with leading time and due date deviation. The input and output slopes in the chart are plotted in accumulated curves. Each step indicates an operation finishing date in the system design. The input curve represents the task which has to be processed during

Self-Instructional 152 Material System Analysis and Implementation NOTES system implementation. Since there is no capacity loss, the output curve is defined as the potential capacity as per the system technology used. The throughput time is equal to the horizontal distance between the average input and output slopes. The values that are inserted—such as design phase tasks, deadlines, cost factors and management level people—occur in an input chart. The input chart helps to: • Assess information needs for planning, monitoring and evaluating the system • Decide the levels of information groups, information frequencies and content • Categorize data items to ensure the system's flexibility and adaptability by serving the lowest level of management Work Target output during observation period Target output curve Preliminary backlog Actual output curve Observation period Past Furture Reference date Time Backlog Capacity Figure 4.11 Input-Output Chart Types of output charts If the input and output targets are fixed then it is easy for designers to show both scenarios in one chart. Otherwise, after analysing the complete system, designers display the probable output in different types of output charts. The output charts are as follows: Line Graph Line graph is used to display data or information of the progress of system implementation and design. It is most useful in displaying data or information that changes continuously over time. If you are saving a summary output file and have defined subplot areas, line graphs are available for each subplot in addition to the whole plot. Subplots are not available in detailed output files. Histogram System designers produce an output file on grid-based histograms where each grid shows the output of the designing phase of a system. Tree Map A tree map is used in system implementation. It indicates the progress of each task that had been assigned phase wise. The larger circle indicates important and valuable tasks, where as smaller circles indicates sub tasks.

Self-Instructional Material 153 System Analysis and Implementation NOTES Tables Sometimes, system designers display the output in a tabular format along with a small summary of the system designing phase. This helps the clients to understand the system, better. 4.7 SYSTEM DEVELOPMENT AND IMPLEMENTATION Information system evaluation is based on a system's ability to deliver the right information at the right time. 4.7.1 Evaluation of Information Systems The attributes on the basis of which an information system is evaluated are: • Timeliness: It measures the appropriateness of the time at which the information is provided by the system. Sometimes, information may exist in the information system but its retrieval may be delayed, which leads to an erosion in its value. Timeliness is a key attribute in evaluating information systems. • Content: The content of information is another criteria used to evaluate an information system. Information should be given in its complete form without being truncated. The decision-maker can thus being fully informed. • Format: The format of the information should be such that a decision from such information is its logical corollary. High-priority items must be highlighted for action, and visualization of information should be provided. The information should be provided in a manner that it gives insight as well as information to the user. • Cost: It is a key factor for evaluating information systems. The cost of getting the information, developing the system, and maintaining and operating the system are all costs to the organization. If the information system performance does not justify the cost sunk into it, then the information system is of little use. • Intangible benefits: The introduction of an information system might bring about an improved work culture in the organization. These are benefits that should be factored while evaluating the information system. 4.7.2 Implementation Tasks

They follow a set programme to implement a system on site. The implementation task includes the following stages: 1. Creating an Implementation Plan An implementation plan is a series of action-oriented steps that enable the implementation to proceed smoothly. It includes the following steps: • Creating a master schedule of activities that need to be implemented •

Check Your Progress 10. How is a derived attribute represented in an E–R diagram? 11. What does the attribute StartDate indicate? 12. What is a system flow chart? 13. Why are structured flow charts used?

Self-Instructional 154 Material System Analysis and Implementation NOTES 2. Communicating the Plan Communicating the plan enables users

to understand the time frame for installing the new system. Communication plays a vital role in implementation, and without proper communication from senior management on the installation and implementation of the new system, management of change is difficult. Resistance to change-related issues

emerge. Communicating the implementation plan to the users prepares

them mentally for change. The communication should be formal so that rumours cannot be spread about the system. The communication process can take place in several phases.

Senior managers can briefly describe the problems that

the new system will tackle, and leave detailed briefings to division heads. The communication process also indirectly indicates the role each employee is required to play in the implementation process. 3. Organizing the MIS Department The MIS department is the custodian of the new system. Hence, it has to get organized to support the new system.

Organizing the MIS

department is therefore necessary before the new system becomes operational. The roles of MIS department members have to be clearly laid out.

An effort has to be made to ensure that their roles are understood by each member of the MIS department. Training has to be provided to those who need it

so that they can help others. This process begins much before the actual implementation process, as it entails some hiring and training. Thus lead time

is required. This enables MIS staff to support the implementation team, if required,

when the implementation process starts. It also enables the MIS staff to understand the new system as they get hands-on experience in its implementation. 4.

Selecting and Procuring of Hardware The selection and procurement of hardware is important, as it involves monetary investment. Hardware should be selected and procured in such a manner

that the organization gets the best deal. This process of selection and procurement varies greatly with each firm, depending on its size, the industry in which it operates and its management. However, typically, the following procedure is followed: • Preparing a vendor list: A list of reliable vendors is prepared after analysing the organization's experience with various vendors or based on

a

list of vendors prepared by an organization of repute or a regulatory body. The selected vendors are chosen after a careful check of their credentials and goodwill in the market. This is essential, as the vendor relationship is based on trust and compromise and not only on the basis of strict commercial terms. • Preparing the request for proposal: The implementation team prepares the request for proposal (RFP) document based on its understanding of the hardware required to run the new system. The RFP must contain technical details about the required hardware systems, including specifications, make, performance expectations, warranty and service quality requirements. This document is prepared by the implementers in consultation with the development team, the management of the organization and the MIS team, so that the need for each specification is well established and there is no scope for dissent. The consultative process results in the RFP technical document. The RFP also includes commercial details, which the implementation team prepares in consultation with the management of the organization. The RFP is a quasi-legal document in some countries, and legal opinion is normally sought before sending it to the enlisted vendors.

Self-Instructional Material 155 System Analysis and Implementation NOTES • Sending the RFP

to vendors: After the RFP is prepared, it is sent to the selected set of vendors. The mode of communication could be an advertisement in print or electronic media or a letter, with a deadline for submission of proposals. • Evaluating the RFP: This could be a difficult

and lengthy process. Bids are first checked for errors and those found to be correct are evaluated on the basis

of cost and quality. A score-based system of evaluation is used to rank vendors' proposals. Scores are assigned to each attribute of a vendor's proposal, such as cost, goodwill, track record and service quality guarantee. Based on the weightage given to each attribute, a composite score is prepared, which is used to evaluate the proposals. Whatever the methodology for evaluating the proposal, the same evaluation criteria

must be applied to all proposals. • Selecting the

vendor: Based on the evaluation, a single vendor or a select set of vendors, is chosen

to deliver the

hardware. Contract negotiations and price negotiations are held with this select group of vendors, and

a contract is signed after the negotiations conclude successfully. 5. Procuring the Software A new system is created on the basis of certain assumptions made regarding the operating system used by the organization. System software is procured in a manner similar to the way hardware is procured. However, the choice of the operating system is made at the design stage itself, when the IS is designed keeping a particular operating system (OS) in mind. Therefore, the implementation team does not have to prepare a specification for the system software—it just has to procure a certain number of copies from a reliable and legal source. 6.

Creating the Database The new system will have data stores. In modern systems, data stores are

actually databases. These databases are relational database management systems and are

a separate application software package. The database and its structures, such as tables and queries, have to be created to enable it to store data. The implementation team creates the database, its structures and rules, so that the information system being implemented can be plugged into the database and

made operational as soon as possible. 7. Training Users Implementation goes beyond installation. Users have to be trained to use the new system, otherwise the implementation process will not work. Training needs are assessed

persuade the management to improve the infrastructure if the new system requires it.
Self-Instructional 156 Material System Analysis and Implementation NOTES 9. Transiting

correctly, it leads to several problems.

SUMMARY In this unit, you have learned about the system development life cycle. The concept of SDLC was developed by DOD and NASA for developing large-scale systems. However, the MIS-oriented SDLC is a little different from that developed by DOD and NASA. In the MIS-oriented SDLC, the system goes through several phases of development the first of which is the system definition phase. This is followed by the system construction, system implementation and system operation phases, in that order. You have also learned about the systems concept, its types and approaches. Changes in the modern business environment has necessitated corresponding changes in business organizations, making them data dependent. Systems are being used in all organizational activities and can also be used to solve problems. Finally, the unit also discussed system design and the various tools used for it. This is very significant as design helps create the blueprint on which the development of the system is based. 4.9 KEY TERMS • System development life cycle: It refers to the sequence of distinct stages that a system goes through in its entire life. • Feasability: From a systems perspective it means whether a system can be developed successfully, given the technical endowment/environment/possibility, resource constraints and organizational desirability. • Interview: It is the process of collecting data by directly asking questions to respondents is called an interview. • Structured interview: It is the process of directly interacting with the respondent to seek responses to an already well laid out set of questions. • Unstructured interview: It is the process of directly interacting with the respondent to seek responses to questions that have not been laid out already. • Abstraction: It is the conceptualization of an issue or problem or entity in terms of some level of generalization without regard to irrelevant low-level details. • Data flow diagram: It is a powerful tool to understand the functional and information view of a system. • Cohesion: It is the degree of singularity of purpose in a software procedure. Check Your Progress 14. What are the attributes on which an information system is evaluated? 15. What is an implementation plan?
Self-Instructional Material 157 System Analysis and Implementation NOTES 4.10 ANSWERS TO 'CHECK YOUR PROGRESS' 1. The key steps in the systems definition phase are preliminary analysis, feasibility study, information analysis and system design. 2. There are several dimensions of feasibility, such as technical, economic, organizational, legal, ethical, socio-economic, socio-political, etc. 3. Economic feasibility is the study to find whether the system will be economically feasible for the organization. 4. The following steps are taken to conduct a suitable feasibility study: • Defining the objectives of the feasibility study • Studying the current environment • Analysing the information requirement • Generating of alternative solutions • Reportings preparation 5. SDLC deals with the entire process of the development of the system, of which application is just one part although a very important one. 6. The testing phase of the waterfall model tests the generated codes against the design specifications. It assesses whether the code has been generated according to the desired specification. Tests, such as toad testing, error correction, etc., are aso performed. 7. The main problem of the prototyping model is that clients in their hurry may insist that the software be built based on the early stages of the prototype, when the developer has barely managed to put together a semblance of a system. 8. The fundamental principles of a good system design are as follows: • It should have an overall macro view of the system rather than a tunnel view. • It should be a logical. • It should not reinvent the wheel. • It should be a very close abstraction of the problem. • It should be uniform and integrated. • It should be structured. • It should be reviewed on a real-time basis to minimize errors. 9. Several types of abstraction are possible at the lower level. They are as follows: • Procedural abstraction • Data abstraction • Control abstraction 10. A derived attribute is represented as an attribute with dashed or dotted lines. 11. The attribute 'StartDate' may be associated with the relationship to indicate the time when a particular employee began working on a particular project. 12. A system flow chart is a symbolic representation of the solution of a given system design that processes the flow control of the entire system.

Self-Instructional 158 Material System Analysis and Implementation NOTES 13. Structured flow charts are used for the following reasons: • They require less time for comprehension. • They lead to fewer errors in understanding the system. • They help in better understanding of an algorithm. • They reduce the time in answering questions on algorithms. • They reduce the frequency of referring to an algorithm. 14. The attributes on the basis of which an information system is evaluated are as follows: • Timeliness • Content • Format • Cost • Intangible benefits 15. An implementation plan is a series of action-oriented steps that enable the implementation to proceed smoothly. 4.11 QUESTIONS AND EXERCISES Short-Answer Questions 1. List the phases in an MIS-oriented development life cycle. 2. State the rules for a data flow diagram. 3. What is a control variable? 4. What are the advantages of using a flow chart to represent the logic of a problem? Long-Answer Questions 1. Explain the MIS-oriented SDLS. 2. What is the spiral model? Discuss in detail. 3. Explain the principles of system design. 4. Explain the concepts of system flow charts and structured flow charts with suitable examples. 4.12 FURTHER READING Pressman, R.S. Software Engineering: A Practitioner's Approach, International Edition. Singapore: McGraw-Hill, 2001. Page-Jones, M. The Practical Guide to Structured Systems Design, 2nd edition. New Jersey: Prentice-Hall Inc., 1988. Madnic, S.E. (ed.). The Strategic use of Information Technology. New York: Oxford University Press. 1987.
MODULE - 2
Self-Instructional 160 Material Application of Information Systems NOTES
Self-Instructional Material 161 Application of Information Systems NOTES UNIT 5 APPLICATION OF INFORMATION SYSTEMS Structure 5.0 Introduction 5.1 Unit Objectives 5.2 Application of Information Systems in Functional Areas 5.2.1 Marketing MIS 5.2.2 Financial MIS 5.2.3 Operations Management MIS 5.2.4 Human Resource MIS 5.2.5 Manufacturing MIS 5.2.6 Application of Information Technology in Banking 5.2.7 Application

60% **MATCHING BLOCK 131/190** W

of Information Technology in other Areas 5.3 Summary 5.4 Key Terms 5.5 Answers to 'Check Your Progress' 5.6 Questions and Exercises 5.7 Further Reading 5.0

INTRODUCTION This unit will discuss the role of information systems in the various departments of an organization. You will learn about marketing, financial, human resource and production MIS. Among other things, the unit will discuss the subsystems that comprise a marketing MIS, the relationship of financial MIS with other departments and the sub-systems of an operations management MIS. Moreover, you will also study the application of information systems in banking and certain other areas. 5.1

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UNIT OBJECTIVES After going through this unit, you will be able to: • Understand the application of

information systems in various functional areas • Understand what comprises financial MIS • Analyse the application of information systems in banking and other areas 5.2 APPLICATION OF INFORMATION SYSTEMS IN FUNCTIONAL AREAS 5.2.1 Marketing MIS Marketing is about interacting with customers, educating them about a product or service and its related benefits, ensuring the fulfillment of their needs and, of course, expanding the customer base. A marketing department uses marketing MIS to help it take decisions in the marketing domain. In this type of system the information is mostly of a transaction type.

Self-Instructional 162 Material Application of Information Systems NOTES Marketing MIS helps to effectively manage the marketing department in an organization. Its primary role is to provide relevant information to the marketing department managers so that the department can function efficiently and effectively. The system should provide different reports to help the managers understand the ground realities so that they may take appropriate measures. The marketing management information system may itself consist of several subsystems. Each of these subsystems perform a specific task and supply specific information to the users. Some of the subsystems use advanced analytical models to provide information about present ground realities as well as the likely scenarios in the future. The subsystems that make up a marketing MIS are as follows: Marketing intelligence subsystem is a subsystem which is responsible for gathering necessary information from transaction-level data to help in the marketing process. A marketing intelligence subsystem is an input subsystem of the marketing MIS. It filters data and helps store critical information. Sometimes the input coming into this subsystem comes from a competitor. The competitor's transaction data and market-related intelligence data are collected and filtered in this subsystem. This subsystem works as a key information provider for other subsystems in the marketing MIS. Market research subsystem is involved with the input side of the marketing MIS. The role of this subsystem is to gather data on consumers, markets and competitors by conducting surveys. The clandestine nature of marketing intelligence is not exhibited in this subsystem. Work of this subsystem is above board and ethical. It collects and analyses key data about the marketing process of the organization as well as the market scenario. Sales subsystem provides information which helps the management of a firm in selling its products or services. It is one of the most important activities of the marketing MIS. Normally, the sales function deals with the management of the channels of sales, i.e., wholesalers, retailers, stockists, etc., to ensure that the product or service reaches the consumer. The marketing MIS, therefore, provides information about all such entities. Sales department is the department, which lies at the interface between the customer and the organization and hence it generates a lot of data. This data is used as input for the MIS. It lies at the boundary between the organization system and the environment of the customers. The sales subsystem, in addition, provides forecast to the sales department and indicates the future sales in both volume and revenue terms. It also provides information regarding product lifecycle by indicating the stage of the product or service, which in turn helps the department to organize and develop product strategies. Promotion, advertising and publicity subsystem gives information about the success of each medium of communication—like electronic or print medium—and helps the department to formulate communication strategies based on the information on return on investment for each medium of communication. The information system in such cases gives a detailed review on each Rupee spent on advertisement, promotion or publicity. Product management subsystem provides information about a product and the reception accorded to it in the market. Exception reports are generated if the product is not performing as per expectations. Customer relationship management subsystem fosters loyalty of the customer towards a brand or product or a company. It encompasses activities which result in a better understanding and knowledge of the customer. As an activity, it enables a company Self-Instructional Material 163 Application of Information Systems NOTES to have a long-term view of customers rather than a short-term view. The activity of a CRM subsystem is based on the understanding of the customer as a person who has a long-term relationship with the organization rather than at the time of sale only. This subsystem provides key information about the customers' likes and dislikes and also helps the department to organize customer-specific strategies. Pricing subsystem uses advanced analytics to help the marketing department take pricing decisions. Packaging subsystem gives information about packaging. This module will help the department by giving vital information about the likely impact of a particular packaging strategy on sales. Decisions on SKU, etc., are taken based on such information. 5.2.2 Financial MIS Managing finances is the most crucial function of an organization. It involves managing costs, budgets, accounts, receivables and payables and capital expenses. The value of the business can be gauged using various accounting tools. A financial MIS helps the finance department to take financial decisions in a better manner. The financial MIS is linked with several other departments and in some instances, the basic data may not be created by the finance department at all. The financial MIS has the following subsystems: Working capital management subsystem manages the working capital requirements of an organization. Working capital, as you know, is the capital required for an organization to run. It is used to pay for salaries and materials. It normally is in the form of a short- term debt. This subsystem provides information about the requirement of working capital and the ideal method of financing it. Receivables and payables management is that module of the financial MIS which manages the receivables and payables of a company. It results in the management of creditors and debtors and helps the management to take suitable decisions. This is a very important activity of finance and is done with diligence. This module manages debtors and creditors by maintaining such key information about them as their commercial terms and reference with the organization. Budgeting is a strategic function of finance. The financial MIS offers tools that help the finance department prepare a budget. The budgeting module also has tools that can project the future needs of resources so that budgets can be made accurately. The budgeting module helps the finance department take decisions on the quantum of money spent on each activity of the organization. This is a complex module and uses many analytical tools. Funds management module of the financial MIS helps the department to take decisions regarding capital expenditure better by providing relevant information. The module helps decision makers in the finance department by giving them information about fund utilization, cost of funds, the most suitable fund management options, etc. Interactive financial planning subsystem helps decision-makers in the finance department to plan for finances in the near future. It has interactive tools for scenario building and 'what if' analysis, which helps managers in planning financial matters. Financial control subsystem helps the finance department to exercise control over finance by giving control-related information to the department.

Self-Instructional 164 Material Application of Information Systems NOTES 5.2.3 Operations Management MIS All organizations pursue a goal or an objective and offer a service or a product. Operations management ensures the smooth running of all the activities related to the creation of a product or service. The operations (production) management MIS helps in taking operations-related decisions. It is connected to the financial MIS and marketing MIS so that some basic data can be interchanged between the departments. The system has the following subsystems: Production management subsystem provides information for managing the production process of a firm. It provides information about production in different periods, their planning of capacities and monitors the production process so that control can be exercised over the production process. Capacity planning and production scheduling-related information is also provided by this module so that the operations managers can use it for better decision-making. Maintenance management subsystem helps in managing the maintenance of machines in a firm. Different companies have different maintenance policies and the system must give the necessary information regarding such policies. The maintenance management subsystem will also have critical information regarding the performance of machines. Quality management subsystem helps the quality team take quality-related decisions in a better manner. Quality check data are analysed in this module and information is passed on to the department for decision-making. Project management subsystem provides information about projects. This module has the facility for PERT/CPM type analysis and crashing activities to fit the entire project within the cover cost and time schedules. The module on project management also has a lot of visualization and system of alerts to warn the manager of possible problem areas. This is a complex and advanced subsystem. Inventory management subsystem helps in taking decisions on ordering, optimum stock, inventory planning, vendor management and contracts management. This subsystem gives detailed information of all the above issues and helps the managers take decision on the same. It is a complex subsystem and uses mathematical models. 5.2.4 Human Resource MIS The most precious asset of any organization is its people. Managing them well leads to growth and prosperity and mismanagement results in losses. Human resource MIS helps managers to manage the HR of the organizations in a better manner. HR MIS, sometimes called HRIS, is an integrated system and has the following modules: •••• Recruitment subsystem: It has already been explained earlier that recruitment is a regular activity in an organization and involves the selection of suitable people for suitable jobs. Recruitment activity tends to increase with the expansion of the organization. It is an ongoing process because people leave an organization for various reasons. Therefore, as mentioned earlier in this book, recruitment neutralizes the effect of attrition and ensures that sufficient staff is always present to handle the growth activities of the organization. HRIS is connected to online job portals and through these job portals, HRIS downloads and shortlists candidates for likely suitable positions in the organization. The module also helps in manpower planning and in managing bench. The HRIS Check Your Progress 1. What is the primary role of a marketing MIS? 2. List the subsystems that make up a marketing MIS. 3. Briefly explain the financial control subsystem of a financial MIS.

Self-Instructional Material 165 Application of Information Systems NOTES gives detailed information about likely candidates and this aids the recruitment process. •••• Training and development subsystem: HRIS helps the ongoing training and development activities in an organization by giving detailed information about the training needs of employees, training modules and content, etc., to help the HR department take training and development-related decision. •••• Compensation and benefits management subsystem: Compensation management involves deciding employees' compensation and benefits to ensure that they are satisfied in terms of the remuneration they receive and the facilities and benefits they are provided with. Compensation-related decisions depend on issues such as performance, seniority, fairness, etc. HRIS provides information on current market rates for the types of skill and competence that an individual possesses to help managers take a decision on compensation. Other related information like pay parity, information of similar ranking people in the organization, the historical compensation structure of the organization, etc., are also available with the HRIS to help the HR department decide compensation packages. •••• Performance management subsystem: As discussed earlier, performance management is a controlling activity wherein weak performers are recommended for training and strong performers are appropriately rewarded. HRIS maintains important measures of performance for each employee to rate his/her performance. Based on the aforementioned the high performers are rewarded and the poor performer are relieved. This type of information is very important for deciding the employees' career plan. 5.2.5 Manufacturing MIS A manufacturing information system is a computer-based system that works in conjunction with other functional information systems to help the management solve problems. It is basically related to the manufacture of products by a firm and relies on production schedules. It works out the cost that a firm will incur while developing resource requirements from the production schedule. The main function of the manufacturing MIS is to monitor and control the flow of materials, and produced products and services through the organization. Virtually all manufacturing systems today can trace their concepts and structures back to Adam Smith's idea of specialization of labour and the consequent fragmentation of work. This concept rationalizes mass production of highly standardized products. Furthermore, Henry Ford's idea still convinces many manufacturers today that they can have either standardization at a low cost or flexibility at a high cost, but not both. This idea has been challenged by the success of Japanese automobile and electronics industries that are based on an integrated systems concept. An integrated systems concept is not a conglomerate built with vertical integration. Instead, the integrated manufacturing system consists of several independent components, with suppliers at one end and customers at the other. To make the system operate efficiently, the manufacturing system should be designed with greater functional integration, fewer layers of hierarchy and more external partnerships. Most of the current manufacturing information systems are just individual applications of computer and/or information systems and their efforts have focused on how to computerize advanced manufacturing technologies. It provides a shared database, database management capability, and a communications network to link marketing, product

Self-Instructional 166 Material Application of Information Systems NOTES development, design and engineering, procurement, manufacturing and quality control functions, etc. This integration provides enhanced business capabilities which cannot be fully attained by the individual system's objectives.

Customers, Suppliers Databases of valid transactions for each TPS

Figure 5.1 Manufacturing Information System Figure 5.1 shows the relation of a manufacturing MIS with application databases, quality control, computer-aided design output reports, business transaction reports and operational databases. Table 5.1 lists the inputs and outputs of the manufacturing information system: Table 5.1 Inputs and Outputs of a Manufacturing Information System Inputs to MIS Output of MIS Order Processing Master Production Scheduling Inventory Data Design and Engineering Receiving and Inspecting Data Inventory Control Personnel Data Just-in-Time Inventory and Process Control Production Process Computer-Assisted Manufacturing (CAM) and Computer-Integrated Manufacturing (CIM) Quality Control and Testing A crucial objective of a manufacturing MIS is to plan the requirement of materials as per the deadline of the finished products. It improves the network schedule between customer service and productivity. Its prime goal is to manage inventory and deliver materials on time. These responsibilities fall under different effective business management directions. Business Systems Plant Controls Operator Interfaces Plant Networking Plant operations Information services Application Integration Figure 5.2 Business System and MIS Tools

 Figure 5.2 shows that a manufacturing MIS provides a complete set of tools for as business system. Its important tools are the operator interfaces and plant controls associated with successful business systems. It manages manufacturing production data throughout the enterprise that incorporates information technology and involves operations personnel. The software the related to the manufacturing MIS manages the real-time flow of data to and from manufacturing control, operations personnel, enterprise applications and business systems, key decision makers and relational databases. The operations professionals provide supervision and security management as well as system designers for the industrial network and complete manufacturing system. Data is easily accessible from industrial automation devices and is easily distributed to a database for long-term storage, real-time monitoring displays, messaging services, reports and interactive operator displays. Visibility of work-in-process which is turned into business intelligence is essential for any competitive manufacturer. This system is used to maintain manufacturing and machine control, and is the best source of insight into work in progress. This means that data must flow to and from all sources and destinations within the plant. So, it is insisted that through a concerted team effort, accurate and timely data be maintained about the work in process. This will keep the production running and capable of generating profits. A manufacturing MIS bridges the gap between corporate management and production and automation. The application of manufacturing MIS at the intermediate level plays a key role in synthesizing business management and production. A manufacturing MIS performs and manages inventory control, revision control, integrated purchasing, work orders, custom manufacturing orders, Master Production Scheduling (MPS), bin tracking, Material Requirements Planning (MRP), serial tracking and lot tracking, and allots bar codes to manufactured products. 5.2.6 Application of Information Technology in Banking Information technology is crucial to the banking sector. It supports two types of business application clients. Its primary function is to take action and make recommendations on applications with respect to individual customers. The IT applications used in the banking sector are discussed in the following sections: Web Banking Applications Web banking applications enable customers to view their bank accounts on line. The consumer banking solution is also a comprehensive application which is related to the Web-based account and payment management system. Corporate Banking Solution is a Web-based cash management and global payments system that allows financial institutions and their business customers to manage cash positions and process payments. It also allows financial institutions to transfer funds electronically. The solutions are integrated with service providers such as ViewPointe, Fiserv, Swift and CheckFree to provide online banking solutions. It also integrates legacy systems by using interfaces. Web Bowser Banking Remote Application Web Tller Business Tller Database Figure 5.3 Banking Remote Application Database Check Your Progress 4. What is the role of operations-related MIS? 5. What is the importance of a human resource MIS? 6. What is the main objective of a manufacturing information system?

Self-Instructional 168 Material Application of Information Systems NOTES Electronic Fund Transfer (EFT) EFT provides a fast, efficient and successful transaction chain system that enables clients to collect, process, and deposit electronic and paper based transactions online. This system ensures that rotations over network move accurately, securely and quickly among several business communities and consumers. In the electronic era, every type of business, small or big exchanges its traditional paper-based payment and billing with electronic processes so that money can be transacted quickly. In EFT, the payment gateway is designed to combine services for a complete and quick money transaction by using either credit card, smart card or a third party, such as Paypal. Generally, businesses move rotational money from one account to another in the same or different financial corporations. These payments are offered in various ways to improve the time frame of the payment process by automated systems and communication networks. E- payments range from the traditional approaches such as account transfers from one region to another, direct credits, direct debits, domestic and international funds; to the more individualistic approach such as person-to-person and electronic bill payments. It has been surveyed that the payer (consumer) and beneficiaries (business communities) transact about 10-40 per cent of retail payment transaction through electronic fund transfer channels and tools. Receiver (Beneficiary) Funds Transfer Network Operator Sender Instructs Transfer Sending institution Debt DR CR Account-account transfers CR Receiving institution Credits account Settlement Bank * Account transfers * Direct debit transfers * Direct credit transfers * Standing orders * Automatic bill payments * Electronic payment orders * Domestic funds transfers * International funds transfers * Person-to-person payments * Bill presentment Advises Transfer Credit Payment order Fund Transfer Message Transfer order Fund Transfer Message Figure 5.4 Money Rotation Using EFT Technology Electronic payments over a network are divided into three main categories. They are: • Intra-bank fund transfers • Inter-bank electronic fund transfers • Internet-based payment systems Intra-bank fund transfer This mechanism allows account-to-account transfer of services for account holders. It thereby facilitates cash management and effective payment systems. This system rotates one-time or recurring money transactions among customers of the various organizations or institutions that support institutions which are in the same domain. Inter-bank fund transfer This mechanism consists of routine transfer of funds between accounts of different financial organizations. It involves repetitive payments at a high level, such as direct credits for the transfer of wages and recurring bill payments by electronic cheques or

Self-Instructional Material 169 Application of Information Systems NOTES cardless POS (Point Of Sale/Service) debits. POS allows users to scan barcodes, price codes and keys in item numbers. These are processed as mass transfers over automated clearing houses (ACH) over EFTPOS (Electronic Funds Transfer at Point of Sale) networks. This mechanism also allows those time-dependent transfers that are sent through domestic or international transfer networks. The networks provide banks and non-bank financial service firms with a platform to develop creative and new ways to process payments. EFT networks provide consulting, design, implementation, service and support to help businesses improve reconciliation processes, strengthen internal controls, mitigate risk and increase compliance. Personnel Department Account Department Loan Department Installment Loans Mortgage Loans Saving Accounts Checking Accounts Employees Figure 5.5 Internet-based Payment System via Banks This payment system leverages the public networks between payers and payees. Some secure channels or derivations of existing payment systems use virtual accounts or automatic EFT with real accounts in order to get regulatory constraints (rules framed by certain regulatory bodies) that provide security mechanism using encryption, PKI (Public Key Infrastructure), etc. Over the past few years, hundreds of new electronic payment systems have been introduced only to fail quickly. The main reason for their failure was a lack of enthusiasm on the part of the consumer. A new EFT product requires a network of payers and payees, who hold deposit accounts at licensed financial institutions and are willing to participate in the system. It also requires clear transactions between the participating institutions. A scheme that is predicated on both payers and payees maintaining account relationships with the same organization can not possibly succeed over time. Likewise, a payment product that involves significant amounts of money being held in unregulated non-bank accounts is also not sustainable. Paypal is an example of a successful electronic payment system. The users of Paypal work inside a single market, such as the eBay auction market. They use existing bank account relationships for the domicile of funds and which simply operate as a mechanism for moving instructions between the parties. EFT fraud traps the money transaction system and steals money by processing it incorrectly. Large amounts of money are transmitted over EFT networks during a single EFT file transmission. By fraudulently altering payment instructions, e.g., bank account details or currency amounts, the EFT process steals large sums of money. To avoid media attention and a potential decline in share price, most companies do not disclose their fraudulent activities to the public. Hackers thwart systems to infect computers with a dangerous virus that can destroy the complete system. In today's corporate world, mergers, acquisitions and streamlining are common occurrences which increase the risk of disgruntled employees and fraudulent activity. For example, an employee at the EFT controls can work against the company by releasing a fraudulent EFT payments to his/her own bank account.

Self-Instructional 170 Material Application of Information Systems NOTES Functional Flows of EFT There are several scenarios for functional flows of electronic fund transfer. They are as follows: Electronic Check Concept Payer Remittance Invoice Payee E-mail/HTTP Remittance Check Signature Certificate Certificate Accounts Receivable Workstation Signature Card Mail statement E-Check line item Signature Card Remittance Check Signature Certificate End or segment Certificate Certificate Certificate Payee's Bank Credit Account Payers Bank Debit Account ECP Clear check E-mail ACH Figure 5.6 Process of Electronic Cheque Flow Figure 5.6 depicts a typical electronic cheque flow. The payer receives an invoice from the payee, generates an electronic cheque and sends it to the payee via email. The payee then e-mails the payment received to his bank and settles the transaction with the payer's bank. Payer Payee 1, Pay 2, Cash 5, Report 3, Notify Debit Credit 4, EFT Payer Bank Payee Bank Figure 5.7 Cash and Transfer Scenario In Figure 5.7 the payer receives an invoice from the payee, issues an electronic cheque and sends it to the payee. The payee presents it directly to the payer's bank to be paid to the payee's account in his bank. 4, Statement 1, Pay Payer Payee Payer Bank Payee Bank Debit 2, Clear Endorse & Credit 3, Accounts Receivable Update Figure 5.8 The Lockbox Scenario

Self-Instructional Material 171 Application of Information Systems NOTES In Figure 5.8, the payer receives an invoice from the payee, issues an electronic cheque and sends it to the payee's bank, either directly or via a lockbox. The lockbox is a special postal address used for the purpose of collecting payments. The payee's bank then sends accounts receivable information to the payee and clears the payment with the payer's bank. Write Payer Payee Payer Bank Payee Bank 1, Pay 3, Accounts Receivable Update 2, EFT Figure 5.9 EFT Funds Transfer Scenario In the Figure 5.9, the payer receives an invoice from his bank, electronic bill presentment captures the payee's bills, issues an electronic cheque and sends it to his bank. The payer's bank, in turn, transfers funds to the payee's account in the payee's bank. Automatic Teller Machine (ATM) An ATM is another important application where customers use a bank card or debit card to carry out banking operations such as withdrawals, deposits, transfers and bill payments. It is called a plastic card holding current bank balance. It is a 24×7 service. Each bank has its own ATM system, but certain features are common to all: an account, an access card and an ATM. The standard cash machine looks like a panel inset into a wall. The panel usually contains a screen on which the ATM displays messages, a keyboard, and slots to insert the card, access withdrawals and deposits. The ATM acts as a computer terminal connected to the bank's main system. When the access card is inserted, the ATM initiates communication over a network of communication lines dedicated for this purpose. After the machine has provided an on-screen greeting and made sure you are who you say you are, it will display its menu listing of the transactions you may want to perform. By pressing one of the keys located alongside the various options, you can find out your balance, transfer funds from one account to another, make deposits or loan payments, or—and this is the feature that has endeared the machine to millions—request for and receive cash.

Self-Instructional 172 Material Application of Information Systems NOTES CARD DETECTED PRINT HEADER GET CARD DATA REQUEST PIN SELECT TRANSACTION ENTER AMOUNT TRANSMIT AUTHORIZATION REQUEST OBTAIN REPLY OBTAIN DEPOSIT DISPENSE CASH DELIVER CASH PRINT AUDIT RECORD SEND COMPLETION MESSAGE PRINT AMOUNT CUT AND DELIVER RECEIPT PRINT TRANSACTION DESCRIPTION RETURN OR CAPTURE CARD PRINT ACCOUNT NUMBER Figure 5.10 Transaction Process Through ATM Card Electronic Cheques Issuing electronic cheques is another important application of information systems in banking services. For this, banks register users with NetCheque accounting servers. Users who are registered with NetCheque are able to write electronic cheques to other users. These cheques may be sent through an e-mail or as payment for services provided through other network protocols. When deposited, the cheques authorizes the transfer of account balances from the account against which the cheques is drawn in the account in which the cheques is deposited. The NetCheque system is well suited for clearing micropayments. It enables such information technology techniques as popular Internet services that charge a small fee to access the information, processing queries and consumption of resources. 0120 01-23096799 NAME ADDRESS CITY STATE ZIP DATE Routing Number Account Number $ BANK NAME ADDRESS CITY STATE ZIP FOR Pay to the order of DOLLARS |:012345678 01234567890123- 0123 Figure 5.11 Electronic Cheque Showing Account Number and Routing Number Check Your Progress 7. List the three categories into which electronic payments over network are broadly divided.

Self-Instructional Material 173 Application of Information Systems NOTES 5.2.7 Application of Information Technology in other Areas We will now discuss the applications of information systems in other areas. Digital Web Marketing The World Wide Web (WWW) and business community have an online presence and provide their customers with security and stability about their products and payment mode. It is also known as digital web marketing. In the 1990s, a high level of expertise was reached in the field of Internet business that leveraged the Internet as a tool to achieve strategic business success. Business consulting includes such features, as e-business consulting, e-marketing consulting, website usability, Internet trends and traffic and Search Engine Optimization (SEO) on the Internet. Publicity, Marketing and Advertising In information technology, the Internet is a very effective medium to promote business. For this, the first step is to set up a site on the Internet so that people across the world can get an accurate idea about products and their costs. The site is an online field of publicity and advertising scheme. Business promotion schemes are announced on business websites so that consumers can become aware of the promotion schemes of various products and get a good rebate. Very effective effective fair not effective do not know 40 35 30 25 20 15 10 5 0 Pubilicity Advertising Online selling Customer support Figure 5.12 Effectiveness of Online Activities Online Setting Users and consumers can view the virtual world of shopping, just as one does window shopping. It gives a good idea of products and costs. They can visit all the products in virtual malls and virtual showrooms and also get a catalogue through the Web, for example, sites for online shopping of designer bags for ladies and toys for children are developed as multimedia presentations which give an overall idea about the products. The use of multimedia on a company's Web pages for instance text only, text and graphics, text and graphics and photographs, text and graphics or photographs with sound or video clips—make the websites more effective in promoting business growth. Research and Development Many companies are involved in research and development in business areas. The Internet facilitates the collecting of information in the concerned areas. One can post a query and join a discussion group and also receive the solution to a business problem. Millions of Web pages contain databases that have information on specific topics so that they can research and know the trends of business growth and possible solutions.

Self-Instructional 174 Material Application of Information Systems NOTES Communication E-mail is used to send and receive the messages. Millions of computers are linked over a network of networks that enable the exchange of millions of e-mail messages between users. Business Collaboration Once a link is formed between companies, it is easy to communicate via the Internet. A fruitful collaboration has been formed between two well established companies, IBM and Bellcore, by using Internet links to share a workstation. Due to its performance and importance, the Internet is considered a prime business tool. Data has been published on the Net (in 1995, Yahoo) which indicates that there are over 20,000 business corporations on web sites. From 1997 onwards Business-to-Consumer concept has been gaining popularity. A survey was conduct by The Economist, in 1996, which indicated the following: Great profit is not in consumer shopping but in business-to- business commerce, since most business transactions are already done at a distance, whether by fax, telephone, post or private electronic links. WWW has enhanced the popularity of business corporations through the following strategies: • It provides a global presence to consumers as well as to businesses. • It establishes and maintains a competitive edge • It allows a substantial transaction cost savings • It maintains supply chains among distributors and encourages new possibilities in the field of strategic marketing • It provides marketing research advantage Financial Forecasting Financial forecasting is one of the most important tasks in the firld of information technology. In commerce and industry, it is essential to forecast demand, stock levels and production figures. In the financial and telecommunications sectors, the competitiveness of a company depends on its ability to forecast future client decisions and expenditure for a particular group of products or services. This application is being used practically in almost all business centres, such as call centres. Predictive models are often used to forecast the number of calls that have been processed by the telephone network over the Internet. All these tasks involve the use of forecasting models based on time series data to optimize costs. Solutions are selected so that they guarantee accurate and reliable quantitative or qualitative forecasts appropriate to the subject of analysis and the scope of available data. 5.3 SUMMARY In this unit, you have learned about the various functional information systems. The marketing information system helps to effectively manage the marketing department in an organization. The primary role of the marketing information system is to provide relevant information to marketing managers so that the department can function efficiently

Self-Instructional Material 175 Application of Information Systems NOTES and effectively. A financial MIS helps the finance department to take financial decisions in a better manner. The financial MIS is linked with several other departments and, in some instances, the basic data may not be created at the finance department at all. The operations management MIS helps in taking operations-related decisions. The operations management MIS is connected to the financial MIS and marketing MIS so that some basic data can be interchanged between the departments. A human resource MIS helps managers to manage the HR of organizations in a better manner. All these information systems have subsystems to help them perform their jobs effectively. You have also learned about the application of information systems in bankings and other areas as well. Banking applications support two types of business application clients, and its primary function is to take action and make recommendations on applications by individual customers. 5.4 KEY TERMS • Marketing MIS: It is a kind of MIS that helps to effectively manage the marketing department in an organization. • Principal MIS: It is a kind of MIS that helps the finance department to take financial decisions in a better manner. • Operations management MIS: It is a kind of MIS that ensures the smooth running of all the activities related to the creation of a product or a service. • Human resource MIS: It is a kind of MIS that helps managers to manage the HR of the organizations in a better manner. 5.5 ANSWERS TO 'CHECK YOUR PROGRESS' 1. The primary role of marketing MIS is to provide relevant information to the marketing department managers so that the department can function efficiently and effectively. 2. The subsystems that make up a marketing MIS are as follows: • Marketing intelligence subsystem • Market research subsystem • Sales subsystem • Promotion, advertising and publicity subsystem • Product management subsystem • Customer relationship management subsystem • Pricing subsystem • Packaging subsystem 3. The financial control subsystem helps the finance department to exercise control over finance by giving control-related information to the department. 4. The operations (production) management MIS helps in taking operations-related decisions. It is connected to the financial MIS and marketing MIS so that some basic data can be interchanged between the departments. 5. The most precious asset of any organization is its people. Managing them well leads to growth and prosperity and mismanagement results in losses.

Self-Instructional 176 Material Application of Information Systems NOTES 6. The main objective of MIS is to plan the requirement of materials as per the deadline of the finished products. 7. Electronic payments over network are broadly divided into three main categories. They are as follows: • Intra-bank fund transfers • Inter-bank electronic fund transfers • Internet based payment system 5.6 QUESTIONS AND EXERCISES Short-Answer Questions 1. State the primary role of a marketing information system. 2. What is working capital? 3. Write a short note on the marketing intelligence subsystem. Long-Answer Questions 1. Explain financial MIS. 2. Explain operations MIS. 3. Explain the significance of human resource MIS. 4. Marketing MIS helps to manage the marketing department in an organization effectively. Explain. 5.7 FURTHER READING Pressman, R.S. Software Engineering: A Practitioner's Approach, International Edition. Singapore: McGraw-Hill, 2001. Page-Jones, M. The Practical Guide to Structured Systems Design, 2nd Edition. New Jersey: Prentice-Hall Inc., 1988. Madnic, S.E. (ed.). The Strategic use of Information Technology. New York: Oxford University Press, 1987

Self-Instructional Material 177 Networking NOTES UNIT 6 NETWORKING Structure 6.0 Introduction 6.1 Unit Objectives 6.2 Introduction to Networking 6.2.1 The Telecommunications Revolution 6.2.2 Components and Functions of a Telecommunications System 6.2.3 Networks 6.2.4 Types of Networks 6.2.5 Communication Networks 6.2.6 Structure of Communication Networks 6.3

In this unit, you will learn about the important role telecommunications has played in the development of information technology. Computers were invented in the 1940s and became an integral part of the commercial world in the1960s. Since then, the growth of this industry has been phenomenal. Initial computers were built using vacuum tubes that have now been replaced by microprocessors. Nowadays, computers and other computing devices are extremely user friendly and can be carried around. Computers are also networked through the use of different communication media. This unit will discuss the various components of communication systems. The computing power of computers has been growing at a faster rate than its usage. They can process multimedia data such as sound, voice, still images and video images. In this unit, you will learn about computer networks which are essential for the structure of an

Understand networking • Discuss the various types of networks • Describe the structure of communictions networks 6.2 INTRODUCTION TO NETWORKING Network in computing system refers to two or more computers connected with each other to form a network and networking means two or more computers connected with each other and sharing data and resources. Self-Instructional 178 Material Networking NOTES 6.2.1 The Telecommunications Revolution Most information systems used today require networks and communication technology. This revolution has been possible due to the Internet which is a network of networks. Each of the constituent network is owned by a different organization. Some networks are in the public domain. These constituent networks are spread over 200 different countries across the globe and more than 6 billion people (according to 2008 data) use the Internet. The Internet has transformed the shape and form of business enterprises. Information superhighway was a popular term used through the 1990s to refer to digital communication systems. It is associated with Al Gore, the then US senator and subsequently the Vice President, who had been involved with computers since the 1970s. Gore could perceive the role telecommunications was to play in commercial and educational systems. He provided the intellectual, political and financial support required for the growth of telecommunication systems. The Internet is extremely flexible; a network can join the Internet and leave without affecting the overall network. One just needs an IP address (explained later) from a service provider to join the Internet. The marriage of communication and computers has greatly improved the flexibility of computer systems. Consequently, managers have gained access to information on the latest development in manufacturing technology, management and the servicing industry. A manager can study all options and pick the most suitable option. Before the Internet, information was difficult, time consuming and expensive to access. In an academic environment, a Ph.D. student needs to read at least a hundred research papers in his area of research. This activity took about one and a half years, and the most time-consuming part was the collection of the relevant papers. With the Internet, one can sit at one's office/desk and read research papers online and print the ones one finds relevant. The amount of non-productive component, cost and time has reduced greatly. The Internet supports multimedia data. There are search engines such as Google, Yahoo, etc., that facilitate the search of information and documents. An individual, a group of individuals or an organization, decided to share information, can create a Web site, get an IP address from a service provider, an Internet connection and go public. The whole effort can be completed in a few days' time. 6.2.2 Components and Functions of a Telecommunications System Telecommunication is communication of information by electronic means, usually over some distance. Previously, telecommunication meant voice transmission over telephone lines. Today, a great deal of telecommunication transmission is digital data transmission, using computers to transmit data from one location to another. Telecommunications systems can transmit text, graphic images, voice or video information. Components A telecommunications system is a collection of compatible hardware and software arranged to communicate information from one location to another. A network system consists of hardware components as well as software components. The following are the essential components of a telecommunications system: • Server or Host Computer: Host is the computer that has data to transmit. It is at one end of the transmission system. • Client: This is the computer at the other end of the transmission system. It receives the data transmitted by the server.

Self-Instructional Material 179 Networking NOTES • Network Interface Card (NIC): NIC is the interface between the network cable or transmission system and the computer. Earlier, one had to buy an NIC separately and install it in the computer. Nowadays, the NIC has become a standard component of a computer system. • Circuit or Transmission System: The circuit is the pathway through which data travels between a client and a server. The circuit may be a copper wire or an optical fibre. The commonly used media are Unshielded Twisted-Pair (UTP) cables, Shielded Twisted-Pair (STP) cables and coaxial cables. A cable has little cable connectors at both ends. One connector is plugged into the computer and the other one is connected to the switch or hub. Each type of cable has restrictions on its maximum length. The distance between the computer and the hub or switch is limited by the type of cable used to connect the two. The cost of each of these cables is also different. As an example, a UTP-CAT5 wire can be 200 metres (maximum) long with RJ45 as the cable connectors. The cost of the cable is approximately Rs 20 per metre. Nowadays, fibre optic cables are being used in place of copper wires. Fibre optic cables can withstand higher temperatures and have much higher bandwidths. Communication takes place through a wireless medium. Microwaves are also used for data transmission. • Network Hubs and Switches: Hubs and switches are used to connect cables. A hub is a simple device that broadcasts an incoming message on all its ports. Hubs come in 4, 8 and 16 port sizes. An 8-port hub can connect 8 systems to the central cable. Earlier, computers were connected using hubs, which have now been replaced by switches. A switch has more intelligence (circuitry) and knows the ports of the computers that are connected to a LAN. An incoming message is transmitted only through the appropriate port. Hubs are inexpensive as compared to switches. Each computer is connected to a switch by a network cable. • Network Operating System (NOS): In addition to the hardware, there is always a special purpose network software that makes the hardware work. NOS is the software that controls the network. It has software for the server as well as the client. Novell NetWare is one of the oldest NOSs. Novell supports a wide variety of topologies, protocols and computers. Microsoft Windows NT and Linux are two other very popular NOSs and are growing rapidly . Cellular telephones work by using radio waves which communicate with radio antennae (towers) placed within adjacent geographic areas called cells. A telephone message is transmitted to the local cell by the cellular telephone and then passed on from antenna to antenna—cell to cell—until it reaches the destination cell where it is transmitted to the receiving telephone. Older cellular systems were analog in nature while the newer cellular systems are digital in nature. Newer models of digital cellular phones can handle voice mail, e-mail and faxes, save addresses, access a private corporate network and information from the Internet as well as provide wireless voice transmission. These smart phones are equipped with Web browser software that lets digital cellular phones or other wireless devices access Web pages formatted to send text or other information that is suitable for tiny screens. Some smart phone models offer larger screens and keypads to make Internet access easier. Data cannot be transmitted seamlessly between different wireless networks if they use incompatible standards, for example, digital cellular services may use Code Division Multiple Access (CDMA), Global System for Mobile Communications (GSM) or Time Division Multiple Access (TDMA) technology, which are not compatible with each other. Check Your Progress 1. How can a service provider be joined with the Internet? 2. What is tele-communication?
Self-Instructional 180 Material Networking NOTES 6.2.3 Networks

94% **MATCHING BLOCK 137/190** W

In the mainframe and minicomputer environment, each user is connected to the main system through a dumb terminal that is unable to perform any of its own processing tasks.

Processing and memory are centralized in this environment. However, although

93% **MATCHING BLOCK 138/190** W

this type of computerization has its merits, the major disadvantage is that the system can easily get overloaded as the number of users, and consequently, terminals increase. Second, most of the information is centralized to one group of people, the systems professionals, rather than the end-users. This type of centralized processing system differs from the distributed processing system used by LANs. In

a

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distributed processing system, most of the processing is done in the memory of the individual PCs or workstations. Besides they share expensive computer resources like software, disk files, printers and plotters, etc.

One may question why PCs are not be connected together in a

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point-to-point manner. The point-to-point scheme provides separate communication channels for each pair of computers. When more than two computers need to communicate with one another, the number of connections grow quickly as

the

83% **MATCHING BLOCK 141/190** W

number of computers increase. Figure 6.1 illustrates that two computers need only one connection, three computers need three connections and four computers need six connections. Figure 6.1 illustrates that the total number of connections grow more rapidly than the total number of computers. Mathematically, the number of connections needed for N computers is proportional to square

is:

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Point-to-point connections required = (N 2 –N)/2 Figure 6.1 (a), (b), (c) Number of Connections for 2, 3, 4 Computers, Respectively Adding the Nth computer requires N–1 new connections, which becomes a very expensive option. Moreover, many connections may follow the same physical path. Figure 6.2 shows a point-to-point connection for five computers located at two different locations, say,

the ground and the

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first floor of a building. Figure 6.2 Five PCs at Two Different Locations

Self-Instructional Material 181 Networking NOTES Components of a Network In general, a computer network is composed of one or more servers, workstations, network interface cards, active and passive hub, routers, bridges, gateways, modem, software components like network operating systems and other application software. The following components are widely used for the construction of networks: Server It is the most powerful computer of the network. Usually in a local area network, a powerful microcomputer or a super microcomputer with the power of a minicomputer is used as a server. Two types of servers are normally employed in a local area network: dedicated servers and non-dedicated servers. In a dedicated server, the server computer performs functions and services for the entire network. It helps to run efficiently, user applications and increases the overall of the system. Users cannot run their applications directly in a dedicated server. It provides e-mail service and faster response time. It also enables computers to share multiple hard disks and other such resources. Dedicated servers are usually employed for larger networks with a heavy load. In a non-dedicated server, apart from the role of a network controller, a server too acts as an individual workstation. The server is equipped with a large memory. Network operations demand only a portion of server memory. The remaining portion of the memory may be used for user applications. Under light load conditions, it is advisable to use a non-dedicated server. Some servers can operate on both modes according to the requirement of the user. File Server The primary goal of a computer network is to share data among several users. They also make their attached disk drives, printers, modems and unique communication links available to the various client stations. Providing one computer with one or more hard disks facilitates this. All client stations share these hard disks. Clients can make their requests to access any of the shared facility to the server. The file server is a powerful computer, which runs a special software. It provides files and other shared resources to different users in the network. It provides facilities like user authentication, security to various user programs and data. It can be accessed through the Network Operating System (NOS). Typical configurations of a server are Pentium 4 machine with 128 MB or a higher capacity RAM, 40 GB or a higher capacity hard disk, to serve upto 10 nodes or workstations. All activities of a file server can be monitored and controlled from a monitor called console. The network administrators are given special privileges. They are given supervisory passwords. They perform network administration operation for the entire network. If any user of the network needs to get a new network service, they have to contact the network administrator and make a request for the specific service they require. The file server has a large memory, which is used for caching directories, and files and hashing directories. Novell Netware and Windows NT are the two network operating systems that run on a server machine. Workstation Another important component of a network is the workstation or client. A workstation is an individual computer with capabilities to communicate with other machines. It must be equipped with the necessary hardware and software to connect to a LAN. Usually a Network Interface Card (NIC) or an Ethernet card or an Arcnet card is used for this

Self-Instructional 182 Material Networking NOTES purpose. Part of the network operating system is also available in the workstation. A workstation can communicate with other workstations or to a server. The hardware requirement for a workstation depends on the application and the size of the network. In a typical LAN of a university computer center, a Pentium III system with 64 MB RAM and 4 to 8 GB hard disk capacity, with necessary network interface card can be used for a typical workstation. In general, the memory and hard disk capacity of a workstation is much less than that of a server. Network Interface Unit Every computer on a network needs one add on card called Network Interface Card (NIC) or Ethernet Adapter or Network Interface Adapter. The role of NIC is to move the serial signals on the network cables, or media into parallel data stream inside the PC. In some cases, two or more such NICs are used in the server to split the load. These interface units also have the important job of controlling access to the media. This includes activities known as carrier sense (listen before transmit), sequential station number and token passing. Transmission Media A data signal travels through this medium. It has two general categories: bounded (guided) and unbounded (unguided) medium. Twisted pair, coaxial, and fibre optic cables are all bounded media. The data signals travel within the boundaries of the transmission media. On the other hand, microwave and satellite transmissions, travel through air, which has no boundaries, and hence are called un-bounded transmission. Hub A network hub is a centralized distribution point for all data transmission in a network. Hub may also be referred to as a concentrator. Data packet from an NIC arrives at the hub. The hub receives and rebroadcasts them to other computers connected to it. In general, the hub network is a passive device. It does not know the destination of a received data packet. Hence, it is required to send copies to all the hub connections. Hubs can be classified into the following three categories: • Stackable and non-stackable hubs • Active and passive hubs • Intelligent and non-intelligent hubs Stackable hubs are hubs that can be stacked or interconnected to make a single hub appearance. They are useful for venders to make hubs of size suitable to customer requirement. Non-stackable hubs cannot be interconnected. They always provide only a fixed number of connections. Hubs that connect to a network backbone are known as active hubs. Those hubs which connect only to active hubs are known as passive hubs. Intelligent hubs contain a special firmware that can be accessed by remote workstations. The firmware is known as Simple Network Management Protocol (SNMP). Network performance and network status data are read from SNMP. Repeater A repeater is a communication device that connects two segments of a network cable. It retimes, regenerates and strengthens the digital data and sends them on their way again. Repeaters are often used to extend the cable length to enlarge LANs. Wide area network contains many repeaters. Ethernet also frequently uses repeaters to extend the length of the bus.

Self-Instructional Material 183 Networking NOTES Bridge A bridge interconnects two networks using the same technology (such as Ethernet or Arcnet). A bridge is more sophisticated than a repeater. A modern bridge reads the destination address of the received packet and determines whether the address is on the same segment of the network cables of the originating station. If the destination is on the other side of the bridge, the bridge transmits the packet into the traffic on that cable segment. Local bridges are used to connect two segments of the same LAN. Remote bridges are used to link local LAN cables to thin long distance cables and thus links two physically separated networks. Network administrators often use bridges to split big networks into a number of small networks. Bridges are easy to install. They provide an easy way to perform network management functions. Router A router transfers data between networks. It is also possible for a router to transfer data between different compatible network technologies such as Ethernet and IBM token ring. Since the Internet consists of thousands of different network technologies, routers are an integral part of the Internet. A router has its address on the network. A bridge does not have an address. Hence, a router can act as an intermediate destination. In other words, a computer can send a data packet to the router of another network. A router will transfer the packet to the other networks. On the other hand, a bridge must examine all the packets to determine which packets to transmit between networks. As such, computers never send packets directly to a bridge. A router examines a packet only if it contains the router's address. A router also can act as a bridge. Such a router is known as a brouter. The brouter receives a packet and examines whether it supports the protocol used by the packet. If not, it simply drops the packet. A packet is bridged using the physical address information. Gateway Two dissimilar networks can be connected by means of a gateway. For example, a mainframe can be connected and made accessible to a PC network by means of a gateway. Unlike a router, a gateway converts the format of the data sent between two networks. A router adds only addressing information to the data packet. Routers never change the content of the message. But a gateway has to identify the protocols used in the networks, and recognize the data format and convert the message format into a suitable format which is acceptable by the other network. Wide area networks often use gateways because there is a large number of dissimilar networks present in a WAN. Gateways provide good connectivity to different kinds of networks on the Internet. Modem Another significant network component is the modem. The term modem is the shortened version of the name modulator–demodulator. Modem provides two-way communication facility between a computer network and a telephone network. As Wide Area Network uses the existing telephone network to connect to a distant network, it always uses a modem to dial-up the telephone network. Modem converts the digital data from the computer into useful analog signals that can be transmitted through a telephone network. Similarly, signals from the telephone channels are converted back into digital data suitable for a computer. Check Your Progress 3. What is the primary goal of a computer network? 4. Define what a workstation is.

Self-Instructional 184 Material Networking NOTES 6.2.4 Types of Networks Local Area Network Definition Networks that are privately owned offer consistent, fast paced communication channels which are optimized to connect information processing tools in a restricted geographical area. These are known as Local Area Networks (LANs). A shared, local (restricted-distance) packet network for computer communication is a form of LAN. A common medium is used by LAN to link peripherals and computers so that the user can share access to databases, files, host computers, peripherals and applications. In addition to linking the computer equipment available on a particular premise also, LANs provides

The main users of LANs include business organizations, research and development groups in science and engineering, and industry and educational institutions. The electronic or paperless office concept is possible with LANs. The

that offer reliable high speed communication channels optimized for connecting information processing equipment in a limited geographical area such as

LAN in an Organization A LAN or buildings which connects computers that are in the same building are a few kilometres apart. A LAN usually uses the bus or ring topology. Fibre Distributed Data Interface (FDDI) is also becoming popular. The transmission rate varies from 10 million bits per second to 1 gigabits per second. A LAN is usually under the control of a single
Self-Instructional Material 185 Networking NOTES organization. Almost 70 per cent of all LANs in the world use the Ethernet, which is a bus topology. Here, all the computers are connected to one circuit. IEEE 802.3 is the standard for Ethernet. A typical LAN in an organization consists of a file server, a database server, an application software server and a Web server. There may be about 100 desktop systems and a single printer server. Earlier, computers were connected using hubs, which have now been replaced by switches. The prime objective of a LAN is to facilitate information and resource sharing within an organization. Application software, for example, which is used by many people in an organization can be installed on one computer. This computer can be made accessible to other computers through a LAN and everybody can use the same software. The machine on which the software is installed is often called a server. In the absence of a LAN, the same software has to be installed on all the machines, which may be very expensive. In addition, an upgrade in the software requires re-installation/modification on all the computers. The server may be a file server, a printer server or a database server, depending on the service it provides to its users. Several LANs of an organization are connected with each other through a backbone network. A backbone network is usually much faster than the LANs it connects. Each LAN may be connected to the backbone network through a switch gateway. There are numerous other ways of connecting LANs together. Usually, the administration of each LAN is done by the department system administrator and the backbone is managed by the computer centre systems administrator. Broadband versus Baseband LAN There are two LAN transmission options, baseband and broadband. Baseband LAN, which is the most prevalent by far, is a single-channel system that supports a single transmission at any given time. Broadband LANs, which are most unusual, support multiple transmissions via multiple frequency channels. Baseband may use UTP, Coaxial or Fibre Broadband using coaxial cable Channel 1 2 3 Figure 6.4 Broadband versus Baseband

Self-Instructional 186 Material Networking NOTES Broadband LANs Broadband LANs are multichannel, analog LANs as shown in Figure 6.4. They typically use coaxial cables as the transmission medium, although fibre optic cables are also used. Individual channels offer bandwidths of 1 to 5 Mbps, with 20 to 30 channels typically supported. The aggregate bandwidth is as much as 500 MHz. Its characteristics are: • Stations connected via RF modems, i.e., radio modems accomplish the digital- to-analog conversion process, providing the transmitting device access to an analog channel. • Digital signal modulated onto RF carrier (analog). • Channel allocation based on FDM. • Head-end for bidirectional transmission. Advantages • Has greater bandwidth • Data, voice and video can be accommodated in a broadband channel • Covers greater distances Disadvantages • Incurs high cost, requires modems • Lacks well-developed standards • Can be supported only by a coaxial cable • Requires alignment and maintenance Some broadband LANs are referred to as 10Broadband36 where 10 stands for 10 Mbps, broadband for multichannel and 36 for 3600 metres maximum separation between devices. Baseband LANs Baseband LAN is a single channel, supporting a single communication at a time as shown in Figure 6.4. It is digital in nature. It provides a total bandwidth of 1 to 100 Mbps over a coaxial cable, UTP, STP, or fibre optic cable. Distance limitations depend on the medium employed and the specifics of the LAN protocol. Baseband LAN physical topologies include ring, bus, tree and star topologies. Baseband LANs are by far the most popular and the most highly standardized. Ethernet, Token Passing, Token Ring and FDDI LANs are all baseband LANs. They are intended only for data, as data communication is, after all, the primary reason for the existence of LANs. The characteristics of this system may be summarized as follows: • No need for modems – low cost installation • Bidirectional propagation of signal • Unmodulated digital signal • Single channel • Stations connected via T connectors Advantages • Simplicity • Low cost

Self-Instructional Material 187 Networking NOTES • Ease of installation and maintenance • High rates Disadvantages • Limited distances • Data and voice only Advantages of LAN LANs are used almost exclusively for data communication over relatively short distances such as within an office, office building or a campus environment. LANs allow multiple workstations to share access with multiple host computers, other workstations, printers and other peripherals, and connections to other networks. LANs are also being utilized for imaging applications. They are being used for video and voice communication as well, although currently on a very limited basis. LAN applications include communication between a workstation and host computers, other workstations and servers. The servers may allow the sharing of resources. Resources could be information, data files, e-mail, voice mail, software, hardware (hard disk, printer, fax, etc.) and other networks. The benefits of LAN include the fact that a high-speed transmission system can be shared among multiple devices in support of large number of active terminals and a large number of active applications in the form of a multi-user, multi-tasking computer network. LAN-connected workstations realize the benefit of decentralized access to very substantial centralized processors, perhaps in the form of mainframe host computer and storage capabilities (information repositories). Additionally, the current technology allows multiple LANs to be inter-networked through the use of LAN switches, routers, etc. Disadvantages of LANs include concern for security of files and accounts. Metropolitan Area Network A

70%	MATCHING BLOCK 148/190	W

Metropolitan Area Network (MAN) covers large geographic areas such as cities or districts. By interconnecting smaller networks within a large geographic area, information is easily disseminated throughout the network. Local libraries and government agencies often use a MAN to connect with citizens and private industries. It may also connect MANs together within

a larger area than

100%	MATCHING BLOCK 149/190	W

a LAN. The geographical limit of a MAN may span a city. Figure 6.5 depicts how a MAN may be available within a city.

Figure 6.5

91%	MATCHING BLOCK 150/190	W

Metropolitan Area Network (MAN) In MAN, different LANs are connected through a local telephone exchange. Some of the widely used protocols for MAN are RS-232, X.25, Frame Relay, Asynchronous Transfer Mode, ISDN, OC-3 lines (155 Mbps), Asymmetrical Digital

Self-Instructional 188 Material Networking NOTES Subscriber Line (ADSL),

100%	MATCHING BLOCK 151/190	W

etc. These protocols are quite different from those used for LANs. Wide Area Network

A Wide Area Network (WAN) connects networks in different cities or countries. Gateways are used to connect these networks. A network which can connect networks that are over a hundred kilometres apart is not built by any organization. Instead, the organization uses leased telephone lines, satellite links or other wireless media to provide this service. It is obvious that a WAN is not owned by a single organization. It is owned and managed collectively by many cooperating organizations. This technology connects sites that are in diverse locations. Wide area networks connect larger geographic areas, such as New Delhi, India or

layer, the data link layer and the network layer.
Figure 6.6 explains a

carrier. Telephone Exchanges Router Router Ring Network Ethernet Figure 6.6

Private Branch Exchanges Networks may be classified on the basis of their geographic scope into local networks and wide area networks. Wide area networks encompass a relatively wider geographic area, from several miles to thousands of miles, whereas local networks link local resources, such as computers and terminals in the same department or building of a firm. Local networks consist of private brand exchanges and local area networks. A private branch exchange (PBX) is a special-purpose computer designed for handling and switching office telephone calls at a company site. It can belong to a company or to a provider. Today's PBXs can carry voice and data to create local

networks. PBXs can store, transfer, hold and redial telephone calls and also switch digital information among computers and office devices. Using a PBX, you can write a letter on a PC in your office, send it to the printer, then dial up the local copying machine and have multiple copies of your letter created. The advantage of digital PBXs over other local networking options is that they do not require special wiring. A PC connected to a network by telephone can be plugged or unplugged anywhere in a building using the existing telephone lines. Many commercial vendors provide/maintain PBX services, so an organization does not require a special expertise to manage them. The geographic scope of PBXs is limited, usually to several hundred feet, although a PBX can be connected to other PBX networks or to packet-switched networks to encompass a larger geographic area. The primary disadvantages of PBXs are that they are limited to telephone lines and cannot easily handle very large volumes of data. Network Services and Broadband Technologies In addition to topology and geographic scope, networks can be classified on basis of the service they provide. Value-added network A value-added network (VANs) is a private, third-party-managed network that offers data transmission and network services to subscribing firms. Let us say, a business firm wants to communicate purchase orders to its vendor. One possibility is that both parties join hands and set up a communication system. Another possibility is to subscribe to a VAN service provider who will set up the system and the buyer and the vendor will be connected to each other through the VAN service provider. The VAN service provider will facilitate communications between both parties. The parties pay only for the amount of data they transmit along with a subscription fee. VANs are cost effective because of economies of scale. Other network services It is more expensive to talk on a phone than to chat on the Internet. The latter is cheaper because the packet switching protocol it uses enhances the use of communication channels. In the case of telephone lines, circuit switching is used wherein the circuits are switched to establish an end-to-end communication channel which is dedicated for the duration of the conversation. In packet switching, each message (voice, data, graphic) is broken down into multiple packets and each packet has information about the destination and the sequence. Each packet then travels on its own , from source to destination, using the available communication channels. The packets are assembled together into a message at the destination. Integrated Services Digital Network (ISDN) It is an international standard to access a dial-up network that integrates voice, data, image and video services in a single link. Organizations and individuals that require the ability to provide simultaneous voice or data transmission over one physical line might choose this service. Primary Rate ISDN offers transmission capacities in the megabit range and is designed for large users of telecommunications services. Like ISDN, digital subscriber line (DSL) technologies also operate over existing copper telephone lines to carry voice, data and video, but they have higher transmission capacities than ISDN.

Self-Instructional 190 Material Networking NOTES High-speed transmission technologies are sometimes referred to as broadband. The term broadband is also used to designate transmission media that can carry multiple channels simultaneously over a single communications medium. Broadband media is available in most big cities in India. Network convergence As mentioned earlier, the need today is to have a single setup to transmit voice, data and video in a single network infrastructure. These multi-service networks can potentially reduce networking costs by eliminating the need to provide support services and personnel for each type of network. Many devices are available nowadays that use ISDN to provide such facilities. 6.2.5 Communication Networks Topologies and Design Goals LANs are classified on their topology, access methods, signalling methods, transmission medium and transmission mode. The control of the network is of two types, viz., centralized and distributed. With centralized control, access to the network and allocation of channel is controlled by one node, such as a dedicated communications processor or switch. When control is distributed, nodes have the ability to establish connections and access the network channel independently, according to an accepted set of rules. Most LANs are based on simple structured topologies, like the ring, bus or star. Some of the basic characteristics of these topologies are outlined as follows: Hierarchical Topology A hierarchical topology connects multiple star networks to other star networks. This type of topology contains a central root node that is a top-level hierarchy which is connected to one level lower in the hierarchy. It maintains a point-to-point link at the end of the previous level node. The total number of point-to-point links in a network is based on the physical hierarchical topology. Figure 6.7 Node Setting in Hierarchical Topology Advantages • It supports point-to-point connections and wiring for individual segments. • Systems access immediate and larger networks. • It is supported by several hardware and software vendors.

Self-Instructional Material 191 Networking NOTES Disadvantages • The whole network depends on the type of cable. • It depends on the root trunk which is the backbone of the network. • If a root network fails, the entire network will fail. • It is difficult to configure. Features • This topology will have at least three hierarchies in the hierarchy network, all based on the root mode. • It supports two networks, the star and the linear topology, which connect the node. • Nodes can be added at any level of hierarchy. • The higher level in the hierarchy performs more functions than the lower level. Horizontal Topology (Bus) Bus topologies are multipoint electrical circuits that can be implemented using coaxial cable, UTP or STP. In a bus topology, data transmission is bidirectional, with the attached devices transmitting in both directions. While generally operating at a raw data rate of 10 Mbps, actual throughput is much less. It is employed frequently in the LANs with distributed control in all nodes, as shown in Figure 6.8, share the common bus. Messages placed on the bus are transmitted to all nodes. Nodes must be able to recognize their own address in order to receive messages. However, unlike nodes in a ring, they do not have to repeat and forward messages intended for other nodes. As a result, there is none of the delay and overhead which is ordinarily associated with retransmitting messages at each intervening node. Because of the passive role that a node plays in transmission on the bus, network operation will continue in the event of node failures. This makes distributed BUS networks inherently resistive to single point failures. Figure 6.8 Bus Topology Bus networks employ a decentralized method of media access control known as CSMA (Carrier Sense Multiple Access), that allows the attached devices to make independent decisions relative to media access and initiation of transmission. This approach results in data collisions and requires frequent retransmission. Bus networks are specified in the IEEE 802.3 standard, and generally have a maximum specified length of 1.5 miles (2.5 km). Ethernet is based on a bus topology. A tree topology is a variation of the bus topology, with multiple branches off the trunk of the central bus.

Self-Instructional 192 Material Networking NOTES Bus networks also suffer from the vulnerability of the bus, which is, that if, one node is down, all nodes in the bus will be down. Similarly, tree networks depend on the integrity of the root bus. Ethernet Ethernet is the best alternative to a high-speed and cost effective LAN. Data is transmitted and received at the rate of 10 million bits per second. Heavy coaxial (thick net) or fibre optic cables are used to transfer data between wiring closets. Thick net coaxial is made to use over medium-long distances where the level of reliability required is medium. A light duty coaxial cable known as thin net is normally used to connect workstations within the same room. Figure 6.9 shows the scheme of Ethernet where a sender transmits a modulated carrier wave that propagates from the sender toward both ends of the cable. Ethernet was first designed and installed by Xerox Corporation at its Palo Atto Research Center in the mid-1970. In 1980, DEC Intel and Xerox came out with a joint specification which has become the de facto standard. Ethernet was named DIX from this period onwards. It gained this name after its business sponsors Digital, Intel and Xerox. Figure 6.9 Signal Flow across an Ethernet Star Topology The distinguishing feature of the star topology is that all nodes are joined at a single point, as shown in Figure 6.10. This single point is called as a central node, hub, or switch, to which all other devices are attached directly, generally via UTP or STP. This topology is frequently used for networks in which control of the network is located in the central node. This method is optimal when the bulk of communication is between the central and outlying nodes. If traffic is high between outlying nodes, an undue switching burden is placed on the central node. Transmission rates vary with AT&T's Star LAN operating at 1 to 10 Mbps, and both 100 Base-T and 100VG-AnyLAN at 100 Mbps. The primary advantage of a star is that a disruptive or failed station can be isolated, thereby eliminating any negative effect it may have on LAN performance. Additionally, each node has access to the full bandwidth of the LAN, at least in a LAN switch environment. The primary disadvantage is that a hub failure is catastrophic. Since the entire connectivity is provided through the central hub, its failure affects the entire LAN.

Self-Instructional Material 193 Networking NOTES Figure 6.10 Star Topology Asynchronous Transmission Mode (ATM) Asynchronous Transfer Mode (ATM) is an International Telecommunication Union- Telecommunication Standardization Sector (ITU-T) and is a standard for cell relay. Here, information about video, data or voice and other service types is communicated in tiny, fixed-size cells. Networks of ATMs are connection-oriented. ATM has emerged as a standard in communication. It provides medium to high bandwidth and a virtual link between the delivery of real-time data, video and voice. Ring Topology The ring architecture is a distributed architecture with minimal connectivity and a topology of two links connected to every node as shown in Figure 6.11 and forms unbroken circular configuration. Figure 6.11 shows a network laid out in a physical ring, or closed loop, configuration. Transmitted messages travel from one node to another around the ring. Each node must be able to recognize its own address in order to accept messages. Information travels around the ring in only one direction, with each attached station or node serving as a repeater. Rings generally are coaxial cable or fibre in nature, operating at raw transmission rates of 4, 16, 20 or 100 Mbps or more. Rings are deterministic in nature, and employ token passing as the method of media access control to ensure the ability of all nodes to access the network within a predetermined time interval. Figure 6.11 Token Ring Topology

Self-Instructional 194 Material Networking NOTES Ring networks with centralized control are known as loops. When ring networks with distributed control are used, some form of control strategies must be used to avoid conflicting demands for the shared channel. The popular control strategies are token passing, circulating slot and register insertion techniques. Fibre Distributed Data Interface (FDDI) Figure 6.12 (a) FDDI Network with Counter Ring (b) The Same Network after a Station has Failed FDDI has developed as a reliable, high-speed network to handle voluminous traffic. It provides data speed at a rate of 100 Mbps and is capable of supporting 500 stations on a single network. FDDI operates on fibre cables by transmitting light pulses which convey information back and forth between nodes. In some cases, it may also operate on copper using electrical signals. A related technology, Copper Distributed Data Interface (CDDI) works like FDDI using copper cables instead of fibre cables. FDDI is able to maintain high reliability because of the provision of two counter- rotating rings as shown in Figure 6.12(a) in FDDI networks. These rings provide a backup for each other by providing an alternate way to get the data, if something goes wrong in the network. Figure 6.12(b) illustrates data flow when one station fails. When a node fails, the adjoining node uses a reverse path to form a closed ring. FDDI is reliable because it has the ability to fix its own problems. Mesh Topology In a mesh network, each pair of nodes is connected by means of an exclusive point-to- point link. Each node requires a separate interface to connect with the other device. Mesh networks are seldom constructed in practice. They are useful in situations, where one node or station frequently sends messages to all other nodes. Otherwise, a considerable amount of network bandwidth is wasted. The advantages are excessive amount of bandwidth and inherent fault tolerance. The structure of a mesh network is shown in Figure 6.13. Figure 6.13 Mesh Network

Self-Instructional Material 195 Networking NOTES Switched and Non-switched Network Options Switching includes the 'plug and play' element. It determines Ethernet addresses which are used on each segment and creates a table of signal packets. This feature connects different network types together just like Ethernet and fast Ethernet of the same types. The main advantage of switching is that there are no protocol issues with switching. Nowadays, a fibre optic switch is used in switching technology because it harnesses all the available bandwidth. Use of an optical switch allows users on a network to send more information. It also provides huge advantage as immunity to EMI (Electrical and Musical Industries) disturbance and lighting strike which assures network security. Switching provides gigabit speeds and several management options. Basic management includes: • General – Switching manages location, system name, reboot on error, statistics collection, Telnet login, etc. • LAN Port – Switching configures speed and flow control, link type and physical address, to change configuration on each port. • Console – Switching at this stage changes the flow control method , baud rate, modern control, set-up string, enable or disable SLIP (Serial Line Internet Protocol), configure SLIP, SLIP subnet masking. In switching, file transfer packets allow you to identify the port which is up and the port which is down. The bandwidth option is increased through the trunk technique. Basically, it is the process of hooking one switch to another in full duplex. Intertnet Hub Workstation TrafMeter Network Switch Hub Hub Access Router/ Gateway/Firewall 'promiscuous mode' is on Figure 6.14 Switch Network Figure 6.14 shows that in a switched network, a network switch which is also called Ethernet switching, is used in segmenting to reduce network loading. It blocks some data from branches of the network which basically do not require the data. Advanced switching includes many tasks for setting up networking design including the following: • L2 Switching Database • L3 IP Networking • Bridging • Static Filtering • Spanning Tree • SNMP(Simple Network Management Protocol) • Port Trunking • Port Mirroring

Self-Instructional 196 Material Networking NOTES Non-Switching Options The non-switching option is used by small organizations. The computer network consists of only one segment to which all workstation computers are connected by a network hub. Access Router/ Gateway/Firewall Intertnet Hub Workstation TrafMeter "promiscuous mode" is on Workstation Workstation Figure 6.15 Simple Network Configuration Figure 6.15 shows how a segment is connected over a network by non-switching options to access a router/gateway/firewall device. The TrafMeter is connected to a hub carrying all traffic to and from the next gateway for non-switching network configurations. Figure 6.16 Pluggable Thermal Circuit Breaker used in Non-Switching Set-up In a non-switched network environment, the network segment concept is followed. Segment is a network architecture in which router, bridge and hub are directly addressable from each node. The main advantage is that frames are handled in a broadcast manner. Each node examines the frame to see if it is addressed to them.

Self-Instructional Material 197 Networking NOTES Step 2 Hub Router Step 4 Step 1 Step 3 Step 4 Figure 6.17 Non-Switching Set-up Figure 6.17 shows how a non-switched network works. Here, Node B is designed as the host which is used as a sniffing agent. Nodes A and C represent the innocent who try to communicate with each other. The normal flow of traffic in a non-switched network is as follows: • Node A transmits a frame to node C. • The hub broadcasts the frame to each active port. • Node B receives the frame and examines the address in the frame after determining that it is not a host. So, it discards the frame. • Node C also receives the frames and examines the address. If it is the intended host, further frame process is done in the same way. • Then, network frames are passed to other hosts as well as higher network layers where it is processed step-by-step. 6.2.6 Structure of Communication Networks 1. Bounded Media Bounded media or wired transmission systems employ physical media which are tangible. Also known as conducted systems, wired media generally employ a metallic or glass conductor which serves to conduct a few types of electromagnetic energy. For example, a copper medium is employed to conduct electrical energy by a twisted pair and coaxial cable system. Fibre optic systems conduct light or optical energy, generally using a glass conductor. The term bounded or guided media refers to the fact that a signal is contained within an enclosed physical path. Finally, bounded media refers to the fact that some form of shield, cladding, and/or insulation is employed to bind the signal within the core medium. This improves the signal strength over a distance and in the process enhances the performance of the transmission system. Twisted pair, both unshielded and shielded, and coaxial and fibre optic cable systems, fall into this category. (a) Twisted Pair (Copper Conductors) Figure 6.18 shows a pair of copper wires which is twisted together and wrapped with a plastic coating as a twisted pair and which has a diameter of 0.4-0.8.The error rate of
Self-Instructional 198 Material Networking NOTES transmission and electrical noise is reduced by the twisting. Each conductor is separately insulated by some low-smoke and fires retardant substance. Polyethylene, polyvinyl chloride, flouropolymer resin and Teflon(r) are some of the substances that are used for insulation purposes. Figure 6.18 Two Wires Open Lines The twisting process serves to improve the performance of the medium by containing the electromagnetic field within the pair. Thereby, the radiation of electromagnetic energy is reduced and the strength of the signal within the wire is improved over a distance. This reduction of radiated energy also serves to minimize the impact on adjacent pairs in a multiple cable configuration. This is especially important in high-bandwidth applications as higher frequency signals tend to lose power more rapidly over distance. Additionally, the radiated electromagnetic field tends to be greater at higher frequencies, impacting adjacent pairs to a greater extent. Generally, the more the twists per foot, the better the performance of the wire. These are commonly used in telephone network. The energy flow is in guided media. Metallic wires were used almost exclusively in telecommunication networks for the last 80 years, until the development of microwave and satellite radio communications systems. Copper wire has developed into an established technology which is strong and cost effective. In certain applications, copper-covered steel, copper alloy, nickel- and/ (or) gold-plated copper and even aluminum metallic conductors are employed. The maximum transmission speed is limited in this case. The copper conductor that carries analog data can in association with a modem, be used to carry digital data as well. Modem is a device that changes analog signals into digital signals and vice versa. In this category, data rate is restricted to approximately 28 Kbps.The use of better modulation and coding schemes led to the introduction of Integrated Services Digital Network (ISDN) along with an increased data rate of 128 Kbps. Local Area Networks (LANs) also use twisted pairs. In Asymmetric Digital Subscriber Lines (ADSL) technology, there has been a new progress which intends to use two cooper loops at a data rate of 1.544 Mbps. This data rate is developed towards the user direction in the network and rates upto 600 Kbps from the user to network. The twisted pair cable can be of two types: with shielding and without shielding. Figure 6.19, shows an Unshielded Twisted Pair (UTP) which is increasingly being for data rates and horizontal wiring. A UTP cable contains 2–4200 twisted pairs. Flexibility, cost-effective medium and usability of both data communications and voice are the biggest advantages of UTP. On the other hand, the major disadvantage of UTP is the fact that its bandwidth is limited. This limits long-distance transmission with low error rates. Single pair
Self-Instructional Material 199 Networking NOTES Figure 6.19 Unshielded Twisted Pair (UTP) (b) Shielded Copper or STP The shielded twisted pair (STP) differs from UTP in the metallic shield or screen which surrounds the pairs, which may or may not be twisted. As illustrated in Figure 6.20, the pairs can be individually shielded. A single shield can surround a cable containing multiple pairs or both techniques can be employed in tandem. The shield itself is made of aluminium, steel or copper. The shield is in the form of a metallic foil or woven meshes and is electrically grounded. Although less effective, the shield is sometimes in the form of nickel and/(or) gold plating of the individual conductors. Figure 6.20 Shielded Twisted Pair (STP) Configuration Shielded copper offers the advantage of enhanced performance for reasons of reduced emissions and reduction of electromagnetic interference. Reduction of emissions offers the advantage of maintaining the strength of the signal through the confinement of the electromagnetic field within the conductor. In other words, signal loss is reduced. An additional benefit of this reduction of emissions is that high-frequency signals do not cause interference in adjacent pairs or cables. Immunity from interference is realized through the shielding process, which reflects electromagnetic noise from outside sources, such as electric motors, other cables and wires and radio systems. A shielded twisted pair, on the other hand, has several disadvantages. First, the raw cost of acquisition is greater as the medium is more expensive to produce. Second, the cost of deployment is greater as the additional weight of the shield makes it more difficult to deploy. Additionally, the electrical grounding of the shield requires more time and effort. Applications: UTP's low cost, including recently developed methods that have improved its performance, has increased its application in short-haul distribution systems or inside wire applications. Current and continuing applications include the local loop, inside wire and cable, and terminal-to-LAN. UTP no longer is deployed in long haul or outside the premises of transmission systems.

Self-Instructional 200 Material Networking NOTES The additional cost of shielded copper limits its application to internal wiring applications. Specifically, it is generally limited to application in high-noise environments. It is also deployed where high frequency signals are transmitted and there is concern about either distance performance or interference with adjacent pairs. Examples include LANs and image transmission. (c) Coaxial Cable The core factor that limits a twisted pair cable is its skin effect. The flow of current in the wires is likely to be only on the wire's outer surface. As the frequency of the transmitted signal rises, available cross-section is useless. The electrical resistance of the wires is increased for signals of higher frequency which leads to higher attenuation. Further, significant signal power is lost due to the effects of radiation at higher frequencies. Thus, another kind of transmission medium can be used for applications that require higher frequencies. Both these effects are minimized by coaxial cable. The coaxial cable shown in Figure 6.21 is a robust shielded copper wire two- conductor cable in which a solid center conductor runs concentrically (coaxial) inside a solid outer circular conductor. This forms an electromagnetic shield around the former that serves to greatly improve signal strength and integrity. The two conductors are separated by insulation. A layer of dielectric (nonconductive) material, such as PVC or Teflon, protects the entire cable. The coaxial cable comes under the category of a bounded media and is still an effective medium to use in data communication. For better performance, coaxial cable contains shields which make it costly. Cable television uses coaxial cables. LANs functions over coaxial cable to the 10BASE5, 10BASE2 and 10BASET specifications.Generally, coaxial cable allows longer distance transmission at a higher data rate than does a twisted pair cable. This is however, costly. There are two types of coaxial cables. Baseband: It transmits a single signal at a time at very high speed. The signal on baseband cable must be amplified at specified distances. It is used for local area networks. Broadband: It can transmit many simultaneous signals using different frequencies. Figure 6.21 Coaxial Cable Configuration Applications: The coaxial cable's superior performance features makes it the favoured medium in many short hauls, bandwidth-intensive data applications. Current and continuing applications include LAN backbone, host-to-host, host-to-peripheral and CATV.

Self-Instructional Material 201 Networking NOTES (d) Optical Fibre You already, know that the geometry of the coaxial cable significantly reduces the various limiting effects, the maximum signal frequency, and hence the rate at which information can be transmitted using a solid conductor. This is also the case for twisted lines. However, an optical fibre is different from transmission media. The transmitted information is carried through a beam of light which fluctuates in a glass fibre instead of a wire or an electrical signal. This type of transmission has become a strong support for digital network owing to its high capacity and other factors favourable for digital communication. Figure 6.22 Fibre Optic Cable — General View Fibre optic transmission systems are opto-electric in nature. In other words, a combination of optical and electrical electromagnetic energy is involved. The signal originates as an electrical signal, which is translated into an optical signal, the optical signal subsequently is reconverted into an electrical signal at the receiving end. Figure 6.22 shows a clean, thin glass fibre reflecting light internally as the transmission carries light with encoded data. Fibres can bend without breaking with the help of a plastic jacket. Receivers that are light sensitive translate light back into data at the other end. The optical fibre consists of a number of substructures as shown in Figure 6.23. In this case, the glass core carrying the light is encircled by a glass cladding which has lower refractive index. Thus, blending the light and confining it to the core. A substrate layer of glass encircles the core thus, adding to the diameter and the power of the fibre.This layer of glass, however, does not carry light. Mechanical protections cover the secondary buffer coating and primary buffer coating. Figure 6.23 Glass Fibre Optic Cable, Side View, and Cross-Section A light pulse travels down the centre core of the glass fibre. Surrounding the inner core is a layer of glass cladding, with a slightly different refractive index. The cladding serves to reflect the light waves back into the inner core. Surrounding the cladding is a layer of protective plastic coating that seals the cable and provides mechanical protection.

Self-Instructional 202 Material Networking NOTES The manner in which light is propagated along the optical fibre core depends on the type and width of core material used. Applications: Applications for fibre optic transmission systems are bandwidth intensive. Such applications include backbone carrier networks, international submarine cables, backbone LANs (FDDI), interoffice trunking, computer-to-computer distribution networks (CATV and Information Superhighway) and fibre to the desktop (Computer Aided Design). Bounded Media Comparison Chart The following table shows the comparison between various types of bounded media. Table 6.1 Bounded Media Comparison Chart Media Advantages Disadvantages Twisted pair cable Inexpensive, well established, easy to add nodes Sensitive to noise, short distances, limited bandwidth, security hazard because of easy interception Coaxial cable High bandwidth, long distances, noise immunity Physical dimensions, security is better in comparison to twisted pair cable Optical fibre cable Very high bandwidth, noise immunity, long distances, high security, small size Connections, cost 2. Unbounded Media Wireless transmission systems do not make use of a physical conductor or guide to bind a signal. In this case, data is transmitted using electromagnetic waves. Therefore, they are also known as unguided or unbounded systems. Energy travels through the air rather than through copper or glass. Hence, the term 'radiated' is often applied to wireless transmission. Finally, such systems employ electromagnetic energy in the form of radio or light waves that are transmitted and received across space, and are referred to as airwave systems. The transmission systems addressed under this category include microwave, satellite and infrared. There are different techniques to convert the data suitable for this mode of communication. Theoretically, radio waves can travel through buildings and walls – as in the case of a radio, cellular phone and TV. They commute longer distances through satellite communication and use wireless communication to travel shorter distances. This technology can be used to deliver applications like multimedia material. However, it has to be carefully treated since radio links are vulnerable to interference, fading and random delays. Non-real time usage of this technology performs as good as the present Ethernet LANs. (a) Radio TV, cellular phones and radio use radio transmission in some form or the other. Radio waves travel long or short distances, depending upon the frequency. An example of long distance communication is satellite relay. All frequency ranges are split into different bands, with specific ranges of frequencies in the radio frequency (RF) spectrum. The RF spectrum has many ranges, beginning from very high frequencies and going on to very low frequencies. All bands with defined lower and higher limits of frequency are shown in Figure 6.24.

Self-Instructional Material 203 Networking NOTES Figure 6.24 Radio Frequency Range and Types of Transmission Media An identical frequency band cannot be shared between two transmitters because it leads to mutual interference. That is why band usage is controlled. The International Telecommunication Union (ITU) controls the international usage of the radio spectrum. Wireless Planning and Coordination (WPC) controls the domestic use of radio spectrum in India. WPC assigns every transmission source a band of operation, a maximum transmitter power and a transmitter radiation pattern. Omni-directional or directional antennas are used to broadcast radio waves depending upon the band. The transceiver unit, which comprises the transmitter, receiver and antenna, determines the power of the RF signal. Other characteristics of radio waves is that in a vacuum all electromagnetic waves or radio waves travel at the same speed, i.e., at the speed of light which is equal to 3 × 10 8 metres per second. In any medium this speed gets reduced and also becomes frequency dependent. In the case of copper, the speed of light becomes approximately two-thirds of the speed of light. The basic features of radio waves are: • They are easy to generate. • They have the same velocity in vacuum. • They can traverse long distances. • They are omni-directional. • They can penetrate buildings easily so they find extensive use in indoor and outdoor communication. • They are frequency dependent. At a low frequency they can pass through obstacles well, but their power reduces sharply with distance from the source as power is inversely proportional to the cube of the distance from the source. At a high frequency they travel in straight lines and bounce off obstacles. (b) Very low frequency Also referred to as VLF, this method benefits from the electromagnetic radiation produced in low frequency band of 3-30 kHz by the dominant radio transmitters which are utilized in long-range communications and navigational systems. From the source, the electromagnetic field is planer and horizontal and the electric component E lies in a vertical plane perpendicular to the H component in the direction of propagation and Self-Instructional 204 Material Networking NOTES follows the ground. AM uses VLF band. This band of frequencies cannot be used for data transfer because they offer a relatively low bandwidth. (c) Microwave Transmission Microwave radio, a form of radio transmission that uses ultra-high frequencies, was developed out of experiments with radar (radio detecting and ranging) during the period preceding World War II. Several frequency ranges are assigned to microwave systems, all of which are in the giga hertz (GHz) range and wavelength in the millimetre range. This very short wavelength gives rise to the term microwave. Such high frequency signals are especially susceptible to attenuation and, therefore, must be amplified or repeated after a particular distance. In order to maximize the strength of such a high frequency signal and increase the distance of transmission to acceptable levels, radio beams are highly focused. The transmit antenna is centered in a concave, reflective metal dish which serves to focus the radio beam with maximum effect on the receiving antenna, as illustrated in Figure 6.25. The receiving antenna, similarly, is centred in a concave metal dish, which serves to collect the maximum amount of incoming signals. Figure 6.25 Point-to-Point Microwave It is a point-to-point, rather than a broadcast, transmission system. Additionally, each antenna must be within the line of sight of the next antenna. Given the curvature of the earth, and the obvious problems of transmitting through it, microwave hops generally are limited to 50 miles (80 km). If the frequencies are higher within the microwave band, this impact is more than that of the lower frequencies in the same band. Frequency Bands: Maximum Antenna Separation of Analog/Digital–4–6 GHz, 32–48 km Analog; 10–12 GHz, 16–24 km Digital; 18–23 GHz, 8–11 km Digital. Applications: Microwave was originally used for long-haul voice and data communication. Competing with long-distance carriers, microwave was found to be the most attractive alternative to cabled systems due to the speed and low cost of deployment where feasible. Contemporary applications include private networks, interconnection of cellular radio switches, and as an alternative to cabled systems in difficult terrains.

Self-Instructional Material 205 Networking NOTES (d) Satellite Communication Satellite radio, quite simply, is a non-terrestrial microwave transmission system utilizing a space relay station. Satellites have proved invaluable in extending the reach of voice, data, and video communications around the globe and into the most remote regions of the world. Exotic applications such as the Global Positioning System (GPS) would have been unthinkable without the benefit of satellites. Contemporary satellite communications systems involve a satellite relay station that is launched into a geostationary, geosynchronous or geostatic orbit. Such satellites are called geostationary satellites. Their orbit is approximately 36,000 km above the Equator, as shown in Figure 6.26. At that altitude and in an equatorial orbital slot, the satellite revolves around the earth with the same speed as that of the earth's revolution and maintains its relative position over the same spot of the earth's surface. Consequently, transmitting and receiving earth stations can be pointed reliably at the satellite for communications purposes. Figure 6.26 Satellites in Geostationary Earth Orbit The popularity of satellite communications has placed great demands on the international regulators to manage and allocate available frequencies. The limited number of orbital slots available for satellite positioning are managed at the national, regional and international levels. Generally speaking, geostationary satellites are positioned approximately 2º apart in order to minimize interference from adjacent satellites using overlapping frequencies. Such high frequency signals are especially susceptible to attenuation in the atmosphere. Therefore, in the case of satellite communication, two different frequencies are used as carrier frequencies to avoid interference between incoming and outgoing signals. These are as follows: • Uplink frequency: This frequency is used to transmit signals from an earth station to a satellite. The uplink signal can be made stronger to cope better with atmospheric distortion. The antenna at the transmitting side is centred in a concave, reflective dish that serves to focus the radio beam, with maximum effect, on the receiving satellite antenna. The receiving antenna, similarly, is centred in a concave metal dish, which serves to collect the maximum amount of incoming signal. • Downlink frequency: This frequency is used to transmit signals from satellite to an earth station. In other words, downlink transmission is focused on a particular

Self-Instructional 206 Material Networking NOTES footprint, or area of coverage. The lower frequency, used for the downlink, can better penetrate the earth's atmosphere and electromagnetic field, which can act to bend the incoming signal much as light bends when entering a pool of water. • Broadcast: The wide footprint of a satellite radio system allows a signal to broadcast over a wide area. Thereby, any number (theoretically an infinite number) of terrestrial antennae can receive the signal, more or less simultaneously. In this manner, satellites can serve a point-to-multipoint network requirement through a single uplink station and multiple downlink stations. Recently, satellites have been developed which can serve a mesh network requirement, whereby each terrestrial site can communicate directly with any other site. Previously, all such communications were required to travel through a centralized site, known as a head end. Such a mesh network, of course, imposes an additional level of difficulty on the network in terms of management of the flow and direction of traffic. Applications: There are many satellite applications and are also increasing rapidly as the traditional voice and data services have been augmented. Traditional international voice and data services have been supplanted to a considerable extent by submarine fibre optic cable system. Traditional applications include international voice and data, remote voice and data, television and radio broadcast, maritime navigation, videoconferencing, inventory management and control through VSATs, disaster recovery and paging. More recent and emerging applications include air navigation, Global Positioning Systems (GPS), mobile voice and data because of Low Earth Orbit Satellites (LEOs), Advanced Traffic Management Systems (ATMS), Direct Broadcast Satellite (DBS) TV, Integrated Digital Services Network (ISDN), interactive television, and interactive multimedia. (e) VSAT VSATs or Very Small Aperture Terminals are a category of satellite systems involving terrestrial dishes of very small diameter (aperture). Operating in the C-band and Ku-band, VSATs are digital and designed primarily to support data communication on a point-to-multipoint basis for large private networks in applications such as retail inventory management and credit verification and authorization. Some of the newer systems also support mesh networks and voice communication. Their bandwidth is in channel increments of 56/64 Kbps, generally up to an aggregate bandwidth of 1.544 Mbps. (f) Infrared Transmission The use of infrared light transmissions has been restricted to TV and wireless slide projector remote controls, in spite of having existed for many years. It has, of late, gained some prominence. Infrared systems use the infrared light spectrum to send a focussed light beam to a receiver, in a similar manner as a microwave system, although no reflective dish is used. Rather, a pair of lenses is used, with a focussing lens employed in the transmitting device and a collecting lens in the receiving device, as shown in Figure 6.27. Infrared is an air wave, and not a conducted transmission system. Although generally used in short-haul transmission, they do offer substantial bandwidth, but with risks of interference.

Self-Instructional Material 207 Networking NOTES Figure 6.27 Infrared Transmission System Its advantages include rapid deployment, especially as there are no licensing requirements as also is the case with microwave systems. Additionally, infrared offers fairly substantial bandwidth at a relatively low cost. However, infrared systems require line-of-sight and suffer from environmental interference, as do microwave systems. Its error performance is also satisfactory. Additionally, infrared is limited by distance. However, infrared is often an attractive alternative to leased lines or private cable systems for building-to-building connectivity in a campus environment. Infrared transmission is also used in certain wireless LAN systems and is incorporated into some PDAs (Personal Digital Assistants). (g) Cellular Phone The evolution of cellular phones is recent. Cellular or mobile phones are intended for users who need to make telephone calls from various places when they are on the move. Rapid development in hardware technology helped in designing such kind of portable telephone sets as shown in Figure 6.28. Radio frequencies are used in cellular phones to interact with nearby cell sites. Cellular telephones are suitable for larger geographical areas including remote sites. It saves the cost of copper wiring and efforts in laying the same in densely populated areas. Figure 6.28 Cellular Phone (h) Cell Site A geographical area that is circular in shape and caters to cellular phones inside its defined physical boundary is called a cell site. A cellular network as shown in Figure 6.29 consists of overlapping cells. This provides a larger area and the probability of a call being dropped is low. The overlapping in the structure ensures that the call remains uninterrupted when the user changes his position from one cell cite to the other. In such Self-Instructional 208 Material Networking NOTES a scenario, the call is passed to the closest cell site which is accountable for that geographical area. Cell sites act as access points for telephone calls; and a cell site on a regular basis corresponds with the closest cell site to notify the network it is connected to. Each cell site shown in Figure 6.29 is connected to a master site, which acts as an access point for a particular cellular network. Regular telephone networks are interconnected with the master site. Each cell site handles calls that are communicated back to the master site, which gets routed to the telephone network as shown in Figure 6.30. Figure 6.29 Cellular Network consisting of Individual Cells Figure 6.30 Cellular Network Connection to a Telephone Exchange The forward cell can reuse frequencies used in the previous cell. This helps in sharing the same frequency band. With digital phones, multiple calls can be tackled by a single frequency. (i) Satellite Cellular Telephone This works on the same principle as cellular phones but uses Low Earth Orbiting (LEO) satellites. The advantages of satellite cellular phone may be seen in its capability to cover a much wider geographical area. This is a particularly good technology in a mountainous terrain and at sea. Unlike cellular phones, satellite cellular phone requires a large number of cells and their accurate positioning to avoid blind spots. Blind spots are the spaces where cells do not overlap or cells are not present. Therefore calls can be made at such spots. (j) Pager Pagers are devices that allow only one-way communication. They are very small in size. A pager tells the user, by ringing or vibration that a message is waiting for him. In this technology, a ground-based radio transmitter is used to send out a constant stream of messages on a particular frequency. On the other hand, a pager acts as a receiver. The message sent by the transmitter is stored in the pager as a stream of messages that can be monitored by its user on indication. Each pager has a built-in address code and whenever a pager detects a message, the built-in address associated with the pager decodes the address to know whether this should be received or discarded.

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Analog and Digital Signals Data communications and networks deal with data or information transmission. Data can be represented in many ways such as a human voice, a group of numbers, images, text and sounds, etc. There are two ways to communicate, display, store or manipulate information. These are: • Analog • Digital

Analog: Analog is best explained by the transmission of a signal such as a sound or human speech, over an electrified copper wire. In its native form, human speech is an oscillatory disturbance in the air which varies in terms of its volume or power (amplitude) and its pitch or tone (frequency).

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Analogous variations in electrical or radio waves are created in order to transmit the

analog

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information signal for video or audio or both, over a network from a transmitter (TV station or CATV source) to a receiver (TV set, computer connected with antenna).

An approximation (analog) of the original information is presented at the receiving end.

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Information which is analog in its native form (audio and image) can vary continuously in terms of intensity (volume or brightness) and frequency (tone or colour). Those variations in the native information stream are translated in an analog electrical network into variations in the amplitude and frequency of the carrier signal. In other words, the carrier signal is modulated (varied) in order to create an analog of the original information stream. The electromagnetic sinusoidal (waveform) or sine wave can be varied in amplitude at a fixed frequency, using Amplitude Modulation (AM). Alternatively, the frequency of the sine wave can be varied at constant amplitude using Frequency Modulation (FM). Additionally, both

frequency and amplitude can be modulated simultaneously. Digital: Computers are digital in nature. Computers process, store and communicate

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information in binary form, i.e., in the combination of 1s and 0s, which has

a specific meaning in a

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computer language. A binary digit (bit) is an individual 1 or 0. Multiple bit streams are used in a computer network. Contemporary computer systems communicate in binary mode through variations in

the electrical voltage.

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Digital signalling, in an electrical network, involves a signal which varies in voltage to represent one of two discrete and well-defined states, such as either a positive (+) voltage and a nill or zero (0) voltage (unipolar) or a positive (+) or a negative (–) voltage (bipolar).

Although analog voice and video can be converted into digital data,

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and digital data can be converted to analog, each format has its own advantages. 6.3

SUMMARY The Internet assists a person in many ways, with the help of the Internet one can sit at one's office/desk and read research papers and newspapers online. The amount of non-productive component, cost and time has reduced greatly because of the Internet. It even supports multimedia data. The Internet has many search engines such as Google, Yahoo, etc., that facilitate the search of information and documents. Telecommunication is communication of information by electronic means, usually over considerable distance. A great deal of telecommunication transmission is done through digital data transmission, Check Your Progress 5. What is the prime objective of a local area network? 6. What is a private branch exchange?
Self-Instructional 210 Material Networking NOTES by using computers to transmit data from one location to another. It is a collection of compatible hardware and software arranged to communicate information from one location to another. It is a system that consists of hardware components as well as software components. Its essential components are server or host computer, client, network interface card, circuit or transmission system, network hubs and switches and network operating system. Smart phones of today are equipped with Web browser software that lets digital cellular phones or other wireless devices access Web pages formatted to send text or other information that is suitable for tiny screens.

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In the mainframe and minicomputer environment, each user is connected to the main system through a dumb terminal that is unable to perform any of its own processing tasks.

A computer network consists of servers, workstations, network interface cards, active and passive hub, routers, bridges, gateways and modem. A local area network employs two types of servers, namely, network dedicated servers and non-dedicated servers. The prime objective of a local area network is to facilitate information and resource sharing within an organization. A wide area network connects networks in different cities or countries. In a mesh network, each pair of nodes is connected by means of an exclusive point-to-point link. Bounded media or wired transmission systems employ physical media which are tangible. The twisting process serves to improve the performance of the medium by containing the electromagnetic field within the pair. Cellular telephones are suitable for larger geographical areas including remote sites while pagers are devices that allow only one- way communication. 6.4 KEY TERMS • Repeater: It is a communication device that connects two segments of a network cable. • Bridge: It is a bridge that interconnects two networks using the same technology. • Router: It is a router that transfers data between networks. • Gateway: It is a network node that is used to connect two dissimilar networks. 6.5 ANSWERS TO 'CHECK YOUR PROGRESS' 1. A service provider can be joined with the Internet with the help of an IP address. 2. Telecommunication is the communication of information by electronic means, usually over some distance. 3. The primary goal of a computer network is to share data among several users. 4. A workstation is an individual computer with capabilities to communicate with other machines. 5. The prime objective of a local area network is to facilitate information and resource sharing within an organization. 6. A private branch exchange is a special-purpose computer designed for handling and switching office telephone calls at a company site.
Self-Instructional Material 211 Networking NOTES 6.6 QUESTIONS AND EXERCISES Short-Answer Questions 1. Name and briefly describe each component of a telecommunications system. 2. Describe the technologies used for wireless transmission. 3. List the various types of network topologies. 4. What are the components of a typical LAN? Long-Answer Questions 1. Why has telecommunications technology become such an important issue for managers and organizations? Discuss. 2. Describe the principal functions and components of all telecommunications systems. 3. Why is a network required? Describe the components of a network. 4. Describe the various network services available nowadays. 6.7 FURTHER READING Curry, A., P. Flett and F. Hollingsworth. Managing Information and Systems: The Business Perspective. Oxford: Routledge, 2006. Ahituv, N. and S.Neumann. Principles of Information Systems for Management. Dubuque: Wm. C. Brown Publishers, 1990. Madnick, S.E., (Ed). The Strategic Use of Information Technology. New York: Oxford University Press, 1987. Orna, E. Information Strategy in Practice. Burlington: Gower Publishing Ltd., 2004. Haag, S., M. Cummings and D.J. McCubbrey. Management Information Systems for the Information Age, 4th edition. New Delhi: Tata McGraw-Hill, 2004. McLeod, R. Management Information Systems, 2nd edition. Chicago: Science Research Associates, 1983.
Self-Instructional Material 213 Internet and WWW NOTES UNIT 7 INTERNET AND WWW Structure 7.0 Introduction 7.1 Unit Objectives 7.2 Internet 7.3 World Wide Web 7.4

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Summary 7.5 Key Terms 7.6 Answers to 'Check Your Progress' 7.7 Questions and Exercises 7.8 Further Reading 7.0 INTRODUCTION

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The Internet is a global system of interconnected computer networks, which uses the standard protocol suite

so that it can serve millions of users across the world. It is a network of networks and it

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consists of millions of private, public, academic, business, and government networks, which are linked by a broad array of electronic, wireless and optical networking technologies.

WWW or the Web is a system of hyper linked documents, which can be assessed via the Internet. In this unit, you will study about both the

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Internet and the WWW. 7.1 UNIT OBJECTIVES After going through this unit, you will be able to: •

Understand the Internet • Assess the concept of the World Wide Web • Learn about Internet browsing and net surfing 7.2 INTERNET

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The role of the Internet can be seen in the areas of education, economic productivity, healthcare, quality of life, etc. There are several other areas where the the Internet can contribute largely. In the area of education, this can contribute by way of shared databases, organization of conferences, circulation of papers and discussion, collaborative research and writing undertaken, web-based registration, online digital library privileges, other online learning facilities like virtual classrooms and information regarding courses, and so on. Economic productivity may be increased as the Internet run over telephone infrastructure at relatively marginal cost,

and

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provides increased economic benefit. The Internet enables global communication with suppliers and customers, etc. This can help to open global markets to developing nations. In this manner, the Internet has facilitated the opening up of e-commerce. The Internet is being effectively utilized in

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the health sector. The rapid growth of the Internet and related areas like switched leased lines, terrestrial and satellite packet radio and videoconferencing, etc., has led to the development of telemedicine. One may expect the Internet to encourage democracy by providing

information and ideas to people living under dictatorships, thus enabling them

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to share ideas and coordinate political activity within their nations. The Internet may force transparency in administrations and therefore, may be considered a catalyst

in encouraging human rights in a wider sense. The following are the different options for setting up an Intranet, education or e-commerce portal, etc. • Leased line • Dial-up connection • VSAT • Radio Link IP Address An Internet Protocol (IP) is a unique address which provides a universal address across the network. It is addressed to the data packets which transmit over the network that works with the IP protocol. The IP address consists of four parts and each is separated by a dot. The format of an IP address is as follows: XXX.XXX.XXX.XXX Each XXX is a number between 0 and 255 stored in 8 bits and can have 2 8 (2 raise to the power 8) values. Some of the examples are 127.0.0.1 and 192.168.0.1. The 127.0.0.1 IP address is the default IP address which is assigned to any system and is not connected to any network. This is called the local host address. Each version of IP address is 32 bit long. A computer converts this decimal–dotted notation into the binary form. The 32 bits are considered as an entity. The entity contains two components: Network Identifier and Host Identifier. Network Identifier: It starts from the left-most bit which is used to identify the network. This process is called network prefix. The four numbers in an IP address are called octets because in binary form each has eight positions. An IP address consists of octets which are used to create classes of IP addresses. An octet contains two sections in which the network identifier recognizes the first octet to identify the network that a system unit belongs to. Host Identifier: Host identifier is the remainder of bits used to identify the host on the network. It is declared in the host program. The host identifier, sometimes known as node identifier identifies the real computer on the network. It always contains the last octets.

Self-Instructional Material 215 Internet and WWW NOTES Class A Class B Class C 24 network bits 16 network bits 8 network bits 24 host bits 16 host bits 8 host bits 10 104 0 19 172 16 12 1 192 168 16 1 1 1 0 0 01 Figure 7.1 IP Address Structure Figure 7.1 shows the class A, class B and class C network bits and host bits arrangement. An IP address is associated with network layers because it examines the IP address information from an interface of the IP address. The network layer is used for an IP address because it obtains a distinct address for a given hardware address too. In the following Figure 7.2, it is divided into two parts: 0 8 16 24 32 Binary Dotted Decimal IP Address: 227.82.157.177 Split Into 8-Bit Network ID and 24-Bit Host ID 227 82 157 177 11100011 01010010 10011101 10110001 Figure 7.2 IP Address Division made of Network ID and Host ID The right hand side shows the Host ID and the left-hand side shows Network ID. The LAN router's IP address is 10.15.1.1 and the machine's IP address is 10.15.1.9 so the network part is 10.15.1 and machine part is the last quadrant. Features of IP Address • It provides a unique address over a network. We cannot get the same IP address for two system units. In case an IP address is set as same for two systems, an IP conflict process takes place wherein the data packets do not know the destination.

Self-Instructional 216 Material Internet and WWW NOTES • An IP address contains a default network whose address is 0.0.0.0 which is used by the default network. • An IP address provides a loopback address except for class A, class B class C, class D and class E. The IP address 127.0.0.1 is called loopback address which helps the host computer to send a message back to itself. It is frequently used for troubleshooting and network testing. • IP performs the task of routing data packets over a network and provides an IP address which specifies the locations of source and destination nodes in the network topology of a routing system. Allocation of IP Addresses IP addresses are assigned by the International Company for the Assignment of Names and Numbers (ICANN). This organization provides unique IP addresses to systems over a network. Before 1990, InterNIC assigned IP addresses. When users type the address of a site on a browser such as www.google.com, the name is converted to its IP address at the Domain Name Server (DNS) and then the Domain Name Translation is associated with the IP address. 7.3 WORLD WIDE WEB The Web is a collection of thousands of information locations connected to each other. Each such location is called a website and comprises of multiple Web pages. A Web page is created using HTML and is like any other computer document. It consists of text, pictures, sound, video and hyperlinks. You can navigate from one Web page to another using hyperlinks. A website can be created by an individual or a company. Websites are hosted on the Web servers that are accessible on the Internet. A URL (Uniform Resource Locator) defines the address of a website and is used to point to the homepage of the website. A homepage is the first page that is displayed when you access a website. It serves as a reference point and contains links to additional HTML pages or links to other websites. The screen below displays the homepage of the website britannica.com that is displayed on typing the URL 'http://www.britannica.com'. hyperlink Uniform Resource Locator (URL) A URL defines the address of a site on the Internet. It defines the global addresses of documents and other resources on WWW. Check Your Progress 1. List the various options for setting up an Intranet. 2. Define what an Internet protocol is. 3. What is a host identifier?

Self-Instructional Material 217 Internet and WWW NOTES Typically, the first part of a URL indicates the protocol to be used, while the second part specifies the domain name or IP address where the resource is located. Some examples of URLs are shown below: URL Description http://mysite.com/index.html Fetch a web page (index.html) using the HTTP Protocol ftp://www.sharware/myzip.exe Fetch an executable file (myzip.exe) using FTP Protocol HyperText Markup Language (HTML) HTML is the language that is used to publish hypertext or HTML pages on WWW. It is in a non-proprietary format. You can use a large number of tools for creating HTML pages, ranging from simple editors to sophisticated authoring tools that work on the WYSIWYG (What You See Is What You Get) principle. HTML provides various tags to structure text in a HTML page. For example, you can use >p<>/p<, >li<>/li< and >a<>/a< tags to structure text into paragraphs, lists and hypertext links. The following is an HTML page showing various HTML tags: >HTML< >HEAD< >TITLE< Welcome Page>/TITLE< >/HEAD< >BODY< >p align='center'<>font color='black' face='Arial' size='6'<Welcome to Everybody's Site>/font< >p align='center'<>font color='red' face='Arial' size='5'<Thought for the day.>/font< >p align='center'<>font color='blue' face='Arial' size='5'<>b<Don't like working on your own?>/font< >p align='center'<>font color='blue' face='Arial' size='5'<Hate making decisions?>/font< >p align='center'<>font color='blue' face='Arial' size='5'<Then call a meeting !!>/font<>/b< >p align='center'<>img src='meeting.jpg' height='100' width='100' < >p align='center'<>a href='http://www.yahoo.com'< >font color='blue' face='Arial' size='3'<Check Mail>/font< >/a< >/BODY< >/HTML< The output of the HTML code is as follows: Internet Browsing Web Browser A Web browser, commonly known as a browser, is a computer application that creates requests for HTML pages or Web pages and displays the processed HTML page. Web browsers use HTTP (HyperText Transfer protocol) to request for information from Web servers. The two most commonly used Web browsers are: • Netscape Navigator • Microsoft Internet Explorer Other examples of Web browsers include Mosaic, Cello, and Lynx.

Self-Instructional 218 Material Internet and WWW NOTES Toolbar of the Internet Explorer The toolbar consists of various icons that can be used to execute functions. In fact, most of the options available through the menu bar are also available through the icons in the toolbar. Some commonly used icons are: • Back: The back button allows you to navigate to the Web page you viewed last. • Forward: The forward button on the toolbar navigates to the next Web page that was accessed previously. To view a list of the last few Web pages visited, you can click the down arrow button beside the Back and Forward buttons. • Stop: The stop button can be used to terminate the current Web page request. This is usually used when you type the wrong URL by mistake and want to stop the request for the Web page or if the Web page takes too long to download. • Refresh: The Refresh or the Reload button is used to load the current Web page again. In other words, it refreshes the contents of the current page by fetching a new copy of it. • Search: The Search button allows you to find information on the Web. You can find information by clicking on the Search button on the toolbar. This activates the search text box as shown. You can then type in a word or phrase and click the 'search' button to start the search. Search Text box Search Button • Favorites: The Favorites button is used to record the addresses of frequently visited websites. Once a website or a Web page is added to the favorites list, it can be revisited by simply clicking on the link in the list. This saves the effort of typing the URL each time the user wishes to visit the same site. • History: The History button is used to view the list of all the Web pages visited in the last few days, hours or minutes. To revisit any one of them, simply click on the address. Print: The Print button is used to print the contents of the current Web page. Net Surfing Net surfing, Internet browsing or exploring a network on the World Wide Web is associated with visiting different websites on the Internet. Typically, it is finding places of interest at the click of a mouse. It is analogous to surfing TV channels with a remote control.
Self-Instructional Material 219 Internet and WWW NOTES Searching Searching is one of the most common uses of the Internet. You can search for any topic or information on the Internet. This is possible by using websites that provide a search engine.

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Search Engines A search engine is a software system that enables users to search for information on the

Web using keywords. It is designed to help Internet users locate Internet resources such as Web pages, documents, programs and images using a keyword search mechanism. Search engines typically use databases that contain references to a host of resources. The users interact with a search engine using an interface. There are many search engines available with different appearances and search mechanisms. Some commonly used search engines are: Google, Yahoo, MSN, Altavista, AOL, Ask Jeeves, Lycos, Excite and HotBot. Google (http://www.google.com) Yahoo (http://www.yahoo.com) Information is collected by programs, called 'spiders' or 'robots', following which, the search engine index them. Similar services are provided by 'directories,' which maintain ordered lists of websites. It is a program which acts as a card catalogue for the Internet. Search engines attempt to index and locate desired information by searching for keywords which a user specifies. The method for finding this information is usually done by maintaining indices of web resources that can be queried for the keywords entered by the user. How Search Engines Work Search engines are the key to finding specific information on the vast expanse of the World Wide Web. Without sophisticated search engines, it would be virtually impossible to locate anything on the Web without knowing a specific URL. But do you know how search engines work? And do you know what makes some search engines more effective than others? When people use the term search engine in relation to the Web, they are usually referring to the actual search forms that search through databases of HTML documents, initially gathered by a robot. There are basically three types of search engines: those powered by robots (called crawlers, ants or spiders); those powered by human submissions; and those that are a hybrid of the two. Crawler-based search engines are those that use automated software agents (called crawlers) that visit a website, read the information on the actual site, read the
Self-Instructional 220 Material Internet and WWW NOTES site's meta tags and also follow the links that the site connects to perform indexing on all linked websites. The crawler then returns the information back to a central depository where the data is indexed. It also periodically returns to the sites to check for any updates or change in information. The frequency with which this happens is determined by the administrators of the search engine. Human-powered search engines rely on humans to submit information that is subsequently indexed and catalogued. Only information that is submitted is put into the index. Useful Tips for Searching – Select a search engine, directory or library in accordance with the kind of search you are doing and the kind of results you are seeking. – Consider: Are you looking for a website? Are you seeking information that might be contained within Usenet? Are you interested in academic articles that may only be retrievable with gopher? – Determine your aims: Do you want a specific hard-to-find document on an esoteric subject, or general information on a broader topic? Do you need to search the entire Web, or is what you are seeking likely to be found on a number of sites, or only the most popular sites? – In making your choice, determine whether the information you are looking for is likely to be in a page's title or first paragraph, or buried deeper within the document or site. – Use a search engine's advanced features, if available, and read the help files in case the searching procedure needs to be understood more specifically. – Type in the words such as Singapore in the search box to get the result pages – You could also use multiple search terms that will produce more appropriate results. For example, if you are planning a vacation in Singapore, you may need to type both the terms in the search box, as shown: 'Vacation Singapore' This will result in pages containing both the terms and will therefore be more specific to your search. You should therefore, choose your search terms carefully. – To restrict a search further, include more terms in your search criteria. – You could also search using phrases when you need the results to contain the exact phrases. If this is desired, include the search phrase in quotation marks as shown: 'Five star hotels in Singapore' – Searches are usually not case sensitive. Boolean Searching The advanced search of AltaVista differs from the basic search page primarily because it allows you to make Boolean searches. In the regular search form, which is on top of the advanced page, you must be sure to use a + (plus) before search terms which must appear and a - (minus) before terms which must NOT appear, and to put quotation marks around works which must appear together. If you choose to use the Boolean search option, you will instead type AND, OR, NOT (or AND NOT) and NEAR (for words which must occur within ten words of each other, or a parentheses for those which must occur together).

Self-Instructional Material 221 Internet and WWW NOTES You will also want to list your most important keyword or keywords in the relevance ranking field within AltaVista's advanced form, in order to make sure that the results are listed in the order that is most relevant to you. Popular Search Engines www.google.com www.yahoosearch.com www.altavista.com www.hotbot.com www.webcrawler.com www.savvysearch.com www.metacrawler.com www.infoseek.com Google Search Using a Search Engine Type E-Governance in the search field as shown in the figure below: A The search engine will show the following result: A
Self-Instructional 222 Material Internet and WWW NOTES Type 'E-Governance' + India in the search field. B The search engine will show the following result: B Type 'E-Governance in India' in the search field. C The search engine will show the desired result. C
Self-Instructional Material 223 Internet and WWW NOTES Advanced search features are as shown on the screens here.
Self-Instructional 224 Material Internet and WWW NOTES Meta Search Engines Since different search engines use different search algorithms, you may often get different results for the same search criterion when using different search engines. The user must therefore know which search engine is best suited for his/her specific query. Meta-search engines make the search task easier by providing a central location to type the keyword or phrase and then obtaining results from multiple search engines. They enable the user to use different search engines simultaneously to search without having to worry about which search engine to use for a specific query. Meta search engines do not have any databases to search from and only provide services to route a single query to multiple search engines. Examples of meta-search engines include MetaCrawler, Mamma, DogPile and One Search. Electronic Mail E-mail, short for electronic mail, enables you to send your correspondence instantaneously anywhere in the world via the Internet. E-mail has made the world a 'smaller place'. The popularity of e-mails is because of its capability to send and receive messages anytime, anywhere without any cost. An e-mail allows you to send and receive a variety of file types such as text, image, video, sound and graphics to a single recipient or multiple recipients using broadcasting. To use the e-mail feature, you just need to create an e-mail account for yourself using a website that offers such services. Various sites provide e-mail facility. Some of them such as Yahoo.com, Rediff.com, hotmail.com and lycos.com, provide it free of cost while others charge for it. Since by now you would be quite keen to use the e-mail facility, let us run through the process of creating and using an e-mail account on Yahoo.com.
Self-Instructional Material 225 Internet and WWW NOTES Creating a User ID Type the URL 'http://www.yahoo.com' in the address bar of a Web browser such as Internet Explorer to visit the Yahoo homepage: Mail The page that is now displayed is the 'Sign in' page. If you are an existing user, you need to type in your user id and password to log on to your account. If you are a first time user, you need to first create an account for yourself. New User Existing User Click 'Sign Up' to create a new user id. The page that is displayed is a registration form that requires you to fill in your details along with the user Id and password for your new e-mail account. User Id and Password
Self-Instructional 226 Material Internet and WWW NOTES Once you have registered yourself on a website, you become a member and can simply log on to your mail account to start sending and receiving e-mails. For all future access, you would be required to remember your user id and password because that is the key to your login. Checking Your E-mail You can access your e-mail anytime by logging on to your mail. To do so, carry out the following steps: – Type the URL 'http://www.yahoo.com' in the address bar of a Web browser. – Enter your user Id and password. User Id and Password Sign In Once you have signed in successfully, you can access your e-mail account. You can access your 'Inbox' to view any incoming mail, or write a new mail through the Compose Mail option. Clicking the Inbox button displays all the received messages or mails. Clicking the e-mail subject displays the contents of the e-mail that can be read to take necessary action. Compose Inbox Changing the Password An e-mail password is used for security reasons. A password is the personal code of a user and should not be disclosed to anyone. Hence, never give your password to anyone and do not write it down where someone else may find it. You can change your password in the following manner: Click on Options on the top menu bar. Click on Password under Your Information.
Self-Instructional Material 227 Internet and WWW NOTES The Change Mail Password window should appear: In the Old Password box, type in your current password. In both the New Password and Re-enter New Password boxes, enter what you want your new password to be. Click on the Save Options button. A password should be at least eight characters in length. This will only change your e-mail account password, not the password you use to log on to the computer. Composing and Sending E-mails The Compose option on the left corner of your screen allows you to write an e-mail message. You can also attach documents to your mail. When you select the Compose option, the following screen appears: You can use the following option while composing or writing an e-mail message. – To: Specifies the e-mail address of a recipient such as recipient@domain.com and user@abcdomain.com. This should be a valid email id for the delivery of your message. You can specify multiple recipients' addresses separated by commas. – Cc: Specifies the address of the recipient to whom you want to send the carbon copy (cc) of your message. You can specify multiple recipients' addresses separated by commas. – Subject: Refers to the subject of the e-mail message. It provides a fair idea to the recipient about what the mail contains. – Message Box: Provides a text area for composing e-mail content. Send Attachments Message Box E-Mailing with Google • Open the web browser and type in the name of the e-mail site on which you would like to create an account. For example, gmail.com. • Type in the following URL: http://mail.google.com/mail/signup in the address bar. • Follow the steps mentioned in the web page in order to successfully create your e-mail account. The following page would be displayed.
Self-Instructional 228 Material Internet and WWW NOTES Click on Compose Mail to create a new message. You can select addresses from your Contacts list or type the address in the To:, Cc:, or Bcc: fields. When you begin to type an address in these fields, a complete address will be suggested from your Contacts list. Select the Attach a file link in order to attach any file with the e-mail message. (figure should show Attach a file. Attach another file is displayed only after the first file has been attached).
Self-Instructional Material 229 Internet and WWW NOTES Select the file you want to attach. Then click on Open. Your file will now be attached to your e-mail message. Now click on the Send button in order to send the e-mail.
Self-Instructional 230 Material Internet and WWW NOTES You can now see that the message has been sent. You can check the received mails by clicking on the Inbox tab. Popular e-mail Websites Given below are names of some popular free e-mail websites. 1. www.gmail.com 2. www.mail.yahoo.com 3. www.hotmail.com 4. www.rediffmail.com 5. www.indiatimes.com Popular Networking Sites The following are some popular networking and community websites are: 1. www.orkut.com 2. www.fropper.com

Self-Instructional Material 231 Internet and WWW NOTES Travel Sites The following are some travel-related websites are: 1. www.makemytrip.com 2. www.travelguru.com 3. www.cleartrip.com Job Sites Some popular job-related websites are as follows: 1. www.naukri.com 2. www.jobstreet.com 3. www.timesjobs.com
Self-Instructional 232 Material Internet and WWW NOTES Auction Sites The following are names of some common auction-related websites: 1. www.ebay.com 2. www.amazon.com Internet Phone Skype is a software that lets you talk over the Internet to anyone, anywhere in the world for free. Features • Make free Skype-to-Skype calls to anyone, anywhere in the world. • Make calls to ordinary phones and mobiles at cheaper rates per minute than normal landline or mobile costs. • See who you are talking to by using video calls. • Send SMS (short message service) to friends on the move and set up call- forwarding so they can contact you. • Group-chat with up to 100 people or make conference calls with up to nine others. • Search the Web with the Google Toolbar (optional install). • Free to download.
Self-Instructional Material 233 Internet and WWW NOTES System Requirements • PC running Windows 2000 or XP (Windows 2000 users require DirectX 9.0 for making video calls). • Internet connection (broadband is considered the best; GPRS is not supported for voice calls, and results may vary on a satellite connection). • Speakers and microphone, built-in or separate. • To make video calls, you need a computer with at least 1GHz processor, 256 MB RAM and of course a webcam. • At least a 400 MHz processor, 128 MB RAM and 50 MB free disk space on the hard drive. Steps for Opening a New Skype ID • Click to say that you don't already have a Skype Name. • Create a memorable Skype Name that you wish to use as your User Name. • Think of a password. This should contain at least 4 characters and be difficult for other people to guess. • You're legally required to read and agree to the License Agreement, the Terms of Service and the Privacy Statement. Click on each to view them. • Your alternate e-mail ID, if provided here, will be kept a secret. However, if people already know it, they can find you in the directory. • Click on Sign In to start using Skype. • You'll now be signed in and the Getting Started guide will open up. (You might require permission for this guide to open.) Steps for Chatting on Skype • Click on the name of the person you want to chat with. Select the Send message icon. • You can set a topic for your chat by opening Chat Options and a click on Set Topic. (You can skip this and just start chatting, if you prefer.) • Your messages and your contact's replies will appear in the main window. • To chat with more than one person, click Add more people to this chat. • Type your message in the chat box and press enter on your keyboard. • Select the name of the person you want to chat with and click Add. A Skype chat can include up to 100 participants. • When you add a contact, they'll appear in the Chat participants list. • Click OK once all the contacts have been added. You will now automaically return to the chat window. • All of the chat participants are now visible to each other and can send messages (and files) to the group. • To bookmark a chat so you can return to it easily later, click on the Book on the top of the chat window and select Bookmark Chat. This chat will now appear in your Bookmarked Chats. • To leave a chat room without getting alerts of new messages, click Leave.
Self-Instructional 234 Material Internet and WWW NOTES System Requirements for Google Earth To use Google Earth on a Windows PC, you must have at least the following: • Operating system: Windows 2000 or Windows XP or Windows Vista • CPU: 500Mhz, Pentium 3 • System memory (RAM): 128MB RAM • Hard disk: 400MB free space • Network speed: 128 Kbits/sec • Graphics card: 3D-capable with 16MB of VRAM • Screen: 1024×768, '16-bit high color' screen Navigating in Google Earth In Google Earth, you see the Earth and its terrain in the 3D viewer. You can navigate through this 3D view of the globe in several ways. To start navigating with your mouse, simply position the cursor in the middle of the 3D viewer (image of the earth), click one of the buttons (right or left), move the mouse and note what happens in the viewer. Depending upon which mouse button you press, the cursor changes its shape to indicate a change in behaviour. By moving the mouse while pressing one of the buttons, you can: • Drag the view in any direction • Zoom in or out • Tilt the view (requires middle button or scroll wheel) • Rotate the view (requires a scroll wheel or a middle button) 7.4 SUMMARY The Internet plays very important roles in the areas of education, economic productivity, health care and quality of life. Nowadays,
the Internet is being effectively utilized in the health sector.

in encouraging human rights in a wider sense. An IP address consists of four parts and each is separated by a dot. Each version of an IP address is 32 bit long. An IP address consists of octets, which are used to create classes of IP addresses. A Web is a collection of thousands of information locations connected to each other. Each such location is called a Website and comprises of multiple Web pages. A Website can be created by an individual or a company. A URL defines the address of a Website and is used to point to the homepage of the Website. Web browsers use hypertext transfer protocol to request for information from Web servers. They even have search engines that are software systems that enables the users to search for information on the Web using keywords. On the Internet, Skype is software that lets you talk over the Internet to anyone, anywhere in the world for free. Check Your Progress 4. What is the Web? 5. What does a URL define? 6. Define what a Web browser is. 7. Define what Skype is.

Self-Instructional Material 235 Internet and WWW NOTES 7.5 KEY TERMS • Host Identifier: It is the remainder of bits used to identify the host on the network. • Web: It is a collection of thousands of information locations connected to each other through the Internet. • Web browser: It is a browser, which is a computer application that creates requests for HTML pages or Web pages and displays the processed HTML page. • Search engine: It is a software system that enables the users to search for information on the Web using keywords. 7.6 ANSWERS TO 'CHECK YOUR PROGRESS' 1. The various options for setting up an Intranet are as follows: • Leased line • Dial-up connection • Radio link 2. An Internet protocol is a unique address, which provides a universal address across the network. 3. A host identifier is the remainder of bits used to identify the host on the network. 4. The Web is a collection of thousands of information locations connected to each other. 5. A URL defines the address of a site on the Internet. 6. A Web browser, commonly known as a browser, is a computer application that creates requests for HTML pages or Web pages and displays the processed HTML page. 7. A Skype is a software that lets you talk over the Internet to anyone, anywhere in the world for free. 7.7 QUESTIONS AND EXERCISES Short-Answer Questions 1. What do you mean by network identifier? 2. What is HTML used for? 3. How can you check your e-mail? 4. List the features of Skype. Long-Answer Questions 1. Describe the various features of an IP address. 2. Explain the various tools in a toolbar of the Internet Explorer.
Self-Instructional 236 Material Internet and WWW NOTES 3. How do search engines work? 4. Describe the steps that are required for opening a new Skype ID. 7.8 FURTHER READING Curry, A., P. Flett and F. Hollingsworth. Managing Information and Systems: The Business Perspective. Oxford: Routledge, 2006. Ahituv, N. and S.Neumann. Principles of Information Systems for Management. Dubuque: Wm. C. Brown Publishers, 1990. Madnick, S.E., (Ed). The Strategic Use of Information Technology. New York: Oxford University Press, 1987. Orna, E. Information Strategy in Practice. Burlington: Gower Publishing Ltd., 2004. Haag, S., M. Cummings and D.J. McCubbrey. Management Information Systems for the Information Age, 4th edition. New Delhi: Tata McGraw-Hill, 2004. McLeod, R. Management Information Systems, 2nd edition. Chicago: Science Research Associates, 1983.
Self-Instructional Material 237 Decision Support Systems NOTES UNIT 8 DECISION SUPPORT SYSTEMS Structure 8.0 Introduction 8.1 Unit Objectives 8.2 Decision Support Systems 8.2.1 Overview 8.2.2 Components of DSS 8.2.3 Characteristics of DSS 8.2.4 Framework for DSS 8.2.5 Benefits of DSS 8.3 Expert Systems: Concepts of ERP, SCM and CRM 8.4 E-Business and Knowledge Management 8.5 Security Aspects of Information Systems 8.5.1 Information Security and Control 8.5.2 Vulnerability and Abuse of Systems 8.5.3

63% **MATCHING BLOCK 173/190** **W**

Creating a Control Environment 8.5.4 Ensuring System Quality 8.5.5 Software Quality 8.6 Summary 8.7 Key Terms 8.8 Answers to 'Check Your Progress' 8.9 Questions and Exercises 8.10 Further Reading 8.0

INTRODUCTION
A

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decision support system is a computer-based information system that supports business or organizational decision-making activities. DSS serve the management, operations and planning levels of an organization and help to make decisions, which may be rapidly changing and not easily specified in advance.

In this unit, you will study about expert systems, e-business and knowledge management and about the security aspects of the nformation systems. 8.1

100% **MATCHING BLOCK 175/190** **W**

UNIT OBJECTIVES After going through this unit, you will be able to: •

Understand decision support systems • Explain the expert systems • Describe e-business and knowledge management • Discuss the security aspects of information systems 8.2

62% **MATCHING BLOCK 176/190** **W**

DECISION SUPPORT SYSTEMS A decision support system is an information system, which assists in decision-making

activities

Self-Instructional 238 Material Decision Support Systems NOTES 8.2.1 Overview The use of computers to solve complex analytical problems can be traced to the early days of computing in the 1960s. It became an established field of work for helping in management decision-making (Michael S. Scott Morton, 1971). This class of systems, loosely clubbed as decision support systems, changed the way in which MIS was conceived in those days (Gordon Davis, 1974) and together with the work of Little (1970), who observed that the biggest obstacle with management science/ operations research based models was that people at the decision-making stage rarely used them and thus incorporated models inherently in such systems, laid the foundation of today's DSS. The framework for decision support was however laid much earlier by Gorry and Scott Morton (1971), and also in the seminal works of both Simon (1977) and Anthony (1965). Decision Support Systems, or DSS, are required when one has to take decisions on unstructured and semi-structured problems. This means that the problem itself is not clear and a lot of ambiguity is present in the problem and in its possible decision path outcomes. Such decisions are more often required to be taken by the top management. In such cases, a lot of judgement, experience, intuition and expert knowledge is required to take decisions as one is treading a path no one has taken before. No precedent is normally available for such decisions. A DSS is required in such a case. It is an information system class which works with a human to assist him to take decisions in the situation as described above. The system is robust and allows the user to create a host of alternative decision paths by analysing its data (internal data of the organization stored in a transaction processing system as well as external data), and then suggests the 'best fit' solution for the problem at hand. It only prompts the decision-maker to take the best solution, but does not decide on the decision-maker's behalf. All the while, the DSS helps the decision-maker by providing him with supporting information about each decision path. It is also very interactive. The easy-to-use user interface hides the layers of model housed in the system and the user stays oblivious to the complexities of the system. It must be pointed out that the decision-maker has control over the process of decision-making and makes choices at each stage of decision-making like choosing the database, etc. The interactive nature of the systems helps the decision-maker maintain control over the decision-making process. The system only works on data and provides alternatives to the user (and also hints at the best possible solution). According to Gory Scott Morton (1989) decision support systems 'Couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. [They comprise] a computer-based support system for management decision-makers who deal with semi-structured problems.' 8.2.2

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Components of DSS Even though DSS can be of several types, fundamentally each DSS will have the following components: • Interactive User–System Dialog Management Subsystem: DSS requires continuous user interaction. Sometimes, the system should prompt the user to give an input at other times the user should be able to control the process. A typical user-system dialog management subsystem will have the following elements:

Self-Instructional Material 239 Decision Support Systems NOTES o

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User Interface: The user interface of a DSS has to be dynamic and GUI- based. It has to be an easy-to-use user interface as most of the people who will be using it are not technical experts but management experts (top management) and hence the interface should be minimalist in design. Also, the system should be able to interact with the user in an interactive mode and hence, the user interface has to be dynamic. o Request Constructor: Since DSS works on an interactive dynamic mode, it needs a request constructor (incorporating aspects of Language Query Interface) which can convert the user's instructions into

a model understandable form, and send

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the model's data request to the database, and the model's instructions/requests to the user. • Data Management Subsystem: Data is the most important component of a DSS. Without data a DSS cannot function. The data management subsystem manages data for a DSS. Data is accessed in a DSS in many ways like ad hoc basis, structured query basis, heuristic search basis, etc. Hence, a strong data management subsystem is required to service the varied data requests from a DSS. The subsystem has the following elements: o Database Management System: It is the data store for the DSS. It manages the data and performs all the functions that a typical DBMS package does. In fact, in most DSS, a commercial DBMS or RDBMS package is used to perform this task. o Query Control: This is an element tailored to handle the query requirements of DSS. It may connect the database, directly to the user interface or to the model base or both. o Meta Data: This contains data/

information

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about the data that is stored in the database. This helps the DSS in understanding the data in the database properly and helps in creating ad hoc queries. • Model Management Subsystem: This is a unique feature of a DSS

and

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makes the system special. However, this also makes the system very specific. There are very few examples of a generalized DSS as generalized models are not available. Those that exist, work on half-baked solutions. The model management subsystem may use different classes of models

such as: o Optimization Models o

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Simulation Models o Heuristic Models o Deterministic Models o Predictive Models Each class of model is

used to solve a specific class of problems like (say)

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a routing problem or a scheduling problem or a combinatorial search problem, etc. Model and model management has several connotations in DSS literature and there have been wide-ranging definitions of these terms. The common strain that evolves from

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plethora of definitions is that a model is conceived to consist of a solver

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a model for solving a problem and data (Ramirez, 1993), where model represents relationships between variables, data represents the values of the variables under consideration and the solver is the tool that enables the computation of the variable values and their relationships. It has been also conceptualized in some literature as a procedure which works on the data to give an output after analysis.

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The model management subsystem has the following elements: o The Model Base Management System: A model base or rather a model base management system is a software (is conceptually like what the DBMS is to data) which has the capabilitiy to manage a model so that it is useful for the decision-maker. It is the core of a DSS. It supports

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generation of models and works with data on one hand and user-supplied instructions on the other.

o The Model Command Processor: It

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is the entity that processes the commands coming from the dialog management subsystem. o The Model Executor or Solver: It is the heart of the system. It is the process through which the model is solved (using some algorithm). It works with the model generated by the model base (with instructions from the user), the request constructor (dialog management subsystem in general) to get the parameters of the model from the user, and data from the data management subsystem. It then solves the problem and displays the results and some variations of the best fit solution through the dialog management subsystem. The alternative solutions, as provided, help the user in decision-making. 8.2.3

Characteristics of DSS The characteristics of DSS are as follows: • DSS works in semi and unstructured environments rather than in a structured environment. In structured environments, DSS is not required as the problem (and environment) and information related to it is structured and available. In most cases, structured decisions have precedence and thus have a reference point. DSS is required in unstructured and semi-structured environments. • DSS plays a decision-support role: It does not replace the decision-maker but only helps the decision-maker to take a better decision by: o Making more analysed data available to him o Processing the analysed data through a model and making available possible decision paths o Enabling him to conduct 'what if' analysis in a simulated environment o Helping him put up a realistic picture of outcomes • DSS can support individual users or a group of users: DSS can work in an individual as well as a group mode as per the needs of the organization. In case of group- based decisions, DSS can be tailored to work in groups. • It supports all phases of the decision-making process. • It focusses on effectiveness. • It remains under the control of the DSS user. This is unlike an expert system, which can take action on its own. It also functions as per the users requirements. • It uses underlying data and models: DSSs are useless without the underlying data as these work on an empirical platform rather than a theoretical platform. • It can provide support for multiple independent or interdependent decisions. • It has a model as its core which helps it to solve complex decision problems. This model is the heart of the DSS. It gives the DSS the capability to solve unstructured and semi- structured problems.

Self-Instructional Material 241 Decision Support Systems NOTES 8.2.4 Framework for DSS Simon laid out the most popular framework for decision support which consists of three linear phases—intelligence, design and choice. Van Grundy, Mintzberg and others have later on modified this framework to suggest that decision-making, as an activity, is too complex to find sufficient description in a linear model. They have gone on to give more comprehensive frameworks. These works led to models on the framework of problem solving. Sprague (1980) gives us a framework for DSS itself in which DSS has three components—database, model base and a dialogue management system. A DSS works normally in a client-server or 3-tier architecture environment where the client houses the model and interface and the server houses the data. Many variations of this are possible. A schematic diagram of a DSS in a client-server environment is shown in Figure 8.1. The Client User The Model Management Subsystem The Dialog Management Subsystem The Server The Data Management Subsystem Figure 8.1 Decision Support System within a Client-Server Framework 8.2.5 Benefits of DSS DSS helps management take complex and difficult decisions. It improves the quality of decision-making by helping the decision-maker to make an informed choice. It thereby improves efficiency and performance. By expediting problem-solving (mostly at higher levels), it frees the managers and helps them to concentrate on other tasks. Therefore, it helps managers become effective. It enhances the quality of decision-making and thereby helps the organization gain a competitive edge. 8.3 EXPERT SYSTEMS: CONCEPTS OF ERP, SCM AND CRM Expert systems are classified as a subset of the field of artificial intelligence (AI). Expert systems employ a codification of human expertise to solve problems. The goal of expert system is to emulate the problem solving process of experts whose knowledge was used in the development of the system. Thus, the system's performance is highly dependent on the quality of the expert. Typically, expert systems are narrowly limited in their domain of operation. An expert system comprises of three component areas. First is the knowledge base. The knowledge base contains a representation of the expert's Check Your Progress 1. List the elements of user-system dialog management subsystem. 2. Name the most important component of a DSS. 3. What are the elements of the model management subsystem?

Self-Instructional 242 Material Decision Support Systems NOTES knowledge in the problem domain. Next is the database that contains specific facts about the problem situation under study. Finally, the inference engine is a program that applies the expertise of the knowledge base to the facts in the database to solve the problem at hand. It is basically associated with various mechanisms, such as ERP, SCM and CRM. 1. Enterprise Resource Planning Enterprise resource planning (ERP) is a popular expert system supported by multi- module application software. It manages the business, strategic planning of controlling inventories, maintaining relationships with suppliers as well as customer services. It also provides a strategy to the finance and human resources fields. Basically, it is a software infrastructure that manages RDBMS to follow the '5Ms' technique, known as Money, Machines, Man, Material and Market. The fundamental purpose behind ERP's successful implementation is the integration of multiple software products and development of an external interface for stand-alone systems. It maintains a series of specialized applications that handles business requirements, such as warehouse management, staff rostering and logistics. ERP delivers a single database containing all the accumulated data for the software modules. The different types of management are shown in Table 8.1. Table 8.1 Management Functions Supported by ERP Management Areas Fields with Reference to MIS Manufacturing Management Engineering, Bills of Material, Capacity, Workflow Management, Quality Control, Cost Management, Manufacturing Process, Manufacturing Projects and Manufacturing Flow Supply Chain Management Inventory, Order Entry, Product Configurator, Supply Chain Planning, Supplier Scheduling, Inspection of Goods, Claim Processing, Commission Calculation Financial Management General Ledger, Cash Management, Accounts Payable, Accounts Receivable, Fixed Assets, Costing and Billing, Activity Management Human Resources Management Human Resources, Payroll, Training, Time and Attendance, Benefits Customer Relationships Management Sales and Marketing, Commissions, Services, Customer Contact and Call Centre Support Data Warehouse Management Self-Service Interfaces for Customers, Suppliers and Employees The term ERP is derived from Manufacturing Resource Planning (MRP II). MRP II followed Material Requirement Planning (MRP). MRP involves ERP if software architecture and a company's capacity is chained with a routing setup. An ERP system boosted sales and marketing at a time when companies were facing the Y2K problem in their legacy systems. Many companies replaced their legacy information systems with ERP systems therefore it is called back office systems, whereas Customer Relationship Management Systems (CRMS) manages directly with the customers, e- Business, e-Finance, e-Commerce, e-Government, etc., and are hence called front office systems.

Self-Instructional Material 243 Decision Support Systems NOTES Figure 8.2 ERP Mechanism Figure 8.2 shows that ERPs are cross-functional and enterprise wide. All functional departments that are involved in operations or production are integrated in one system. In addition to manufacturing, warehousing, logistics, and information technology, this would include accounting, human resources, marketing and strategic management. ERP II facilitates open ERP architecture of components, whereas the older ERP system was component-oriented. Enterprise Application Suite (EAS) is a new name for formerly developed ERP systems which include all segments of business, using ordinary Internet browsers known as 'thin clients.' Advantages of ERP Large manufacturers often believe that many software applications do not communicate with each other without ERP. So, they use ERP to enhance their complete business system. The advantages of ERP are as follows: • It supports design engineering to make the best product. • It orders tracking from acceptance through fulfillment. • It maintains revenue cycle from invoice through cash recipient. • It tracks the three-way match between purchase orders (what materials were ordered), inventory recipients (what materials arrived) and costing (what vendors were invoiced). • It manages interdependencies of complex bills of materials. • It maintains the accounts for all of the above tasks, tracks the revenue and checks the cost and profit on a granular level. • It also maintains computer security within an ERP to protect against both external crime, such as espionage and internal crime, for example, embezzlement. ERP security prevents data abuses that involve disgruntled employees modifying prices in order to attempt to take down the company or manufacturer. Disadvantages of ERP The main disadvantage of ERP is that many organizations that have the ERP system face a slowdown due to inadequate investment to train personnel. This is simply because of a lack of a corporate policy that will protect the integrity of the data in the ERP systems.
Self-Instructional 244 Material Decision Support Systems NOTES Limitations of ERP Systems The limitations of ERP depend on the skill and experience of the workforce. Many companies cut costs by cutting down training budgets. The limitations of ERP are as follows: • Companies employ new mangers to mange turnover personnel due to lack of education regarding the company's ERP system. • The ERP software is customized in a very limited manner. If any company changes the ERP software structure, it is often not allowed to change as per requirement. • ERP system leads to a loss of competitive advantage if the business requires to be re-engineered to fit the industry standard. • ERP systems are difficult to use. They are too restrictive and do not allow much flexibility in implementation and usage. The system can suffer from the 'weakest link' problem and inefficiency in one department or one of the partners may affect other participants. • Once a system is established, switching costs are very high even if one of the partners is caused to reduce flexibility and strategic control at the corporate level. • There are many problems with various types of legacy systems in the business partners. 2. Supply Chain Management (SCM) Supply chain management facilitates a network of facilities and distribution options. It creates a process whereby an organization can deliver its products to the market in a more cost competitive and efficient way. SCM is divided into two broad categories: strategic category and operational category. The strategic category is closely linked to corporate strategy. It is developed from a design perspective. The operational category focuses on the activities and trends of an organization on a day-to-day basis. These types of efforts are made effectively and efficiently to manage the product flow in a strategically planned supply chain. Figure 8.3 shows the four prime decision areas in SCM. Location ↓ Production ↓ Inventory ↓ Transportation (Distribution) Figure 8.3 Four Prime Decision Areas in SCM
Self-Instructional Material 245 Decision Support Systems NOTES Figure 8.4 Supply Chain Management Mechanism Figure 8.4 shows that once the size, number and location of the requirements are decided, the possible path is required to follow the product flow through to the final customer by using SCM tools such as warehouse and distribution, manufacturing, supply management, demand management, planning inventory and management. It impacts revenue, cost and level of service that is determined by costs, taxes, duty drawbacks, tariffs, local content, distribution content, distribution costs, production limitations, etc. Supply Chain Management and e-Business Standards Framework Supply Chain Management and e-Business Standards Framework e-Business Applications • Supply Chain Management • Marketing Customer Support • Channel Management Collaboration Business Service Infrastructure • Security • Payments • Catalogs Messaging Infrastructure • eXtensible Markup Language (XML) • Electronic Data Interchnage (EDI) • e-mail • Hypertext Transfer Protocol (HTTP) Content and Publishing Infrastructure • XML • Standard Generalized Markup Language (SGML) • Hyper Text Markup Language (HTML) • Java • WWW (World Wide Web) Network Infrastructure • Telecom • Cable • Wireless • Ethernet • Routing • Internet Protocol (IP) Address Public Policy • Legal • Crypto • Privacy • Tax Control • Economics Computing Infrastructure • Servers • Clients • Operations Technical Standards • Privacy • Documents • Security • Network • Computing

Self-Instructional 246 Material Decision Support Systems NOTES The various types of decisions and approaches implemented in a successful supply chain are shown in Table 8.2. Table 8.2 SCM Decisions and Approaches Decisions Taken by SCM Process Functions Production Decision It includes the contribution of master production schedule Inventory Decision It manages supply chain of raw materials, semi- finished or finished goods. It provides a buffer against any uncertainty that might exist in the entire supply chain process. Transportation Decision It checks the shipment sizes, logistics costs, fast and reliable transportation facilities and consolidated bulk shipment. Supply Chain Modelling Approaches It takes operational decision and addresses the day-to-day operation of the supply chain. Network Design Method Decision Its objective function is to minimize a combination of cost and time elements. Challenges of SCM The major challenges of SCM are the following: • How to better deal with different languages, laws and customs • How to get better support models • How to optimize beyond the corporate and supply chain spheres of influence Customer Relationship Management (CRM) CRM increases the effectiveness of a company's its service to customers. It mainly encompasses the marketing and sales process (as per a customer's order) and post- sales customer support. The CRM software application is also sometimes referred to as a front-office system. Good CRM applications help companies to identify individual customer values at each step of the customer-supplier relationship. Table 8.3 shows the critical CRM functions. Table 8.3 Strategies and Functions of CRM Strategy Functions Marketing Automation The main function behind this strategy is to follow the track lead-generation activities that help to manage promotional campaigns and provide automated market analysis tools. Technology-Assisted Selling The main function behind this strategy is to help sales persons manage their contact lists. It is also known as Sales Force Automation (SFA). It can also include capabilities for configuring products, with some of them allowing salespersons to help customers create custom configurations on the spot. Customer Support The main function behind this strategy is to run call centres staffed by telemarketing or technical support personnel. CRM provides better customer service by giving businesses many strategic advantages. It is used as a repository to maintain customer profiles by treating each client as an individual and not as a group. CRM helps an organization to easily adjust the
Self-Instructional Material 247 Decision Support Systems NOTES level of service that reflects the customer's importance and status. Better customer service builds customer loyalty and decreases customer agitation. It helps the company to get feedback at regular intervals from the customer about the product She has bought. It introduces higher customer retention by introducing various loyalty programmes. It helps to improve communication channels for customers. PLAN IMPROVE OPERATE Process Improvement Solution Optimization Analysis CRM Strategy Reporting Data management System Administration Figure 8.5 Pyramid Level of CRM Strategy CRM was initially used as a strategic weapon. Since the improvement of manufacturing processes in the late 1980s and 1990s, manufacturing companies began to use customer service as a means to differentiate themselves. Peggy Menconi, a research director with Boston-based AMR research, says: 'Providing good customer service became the manufacturer's best means of retaining customers. E-business is simply changing the way these companies interact with their customers.' Figure 8.6 Integrated CRM and ERP The realization that stand alone CRM applications can only provide true strategic benefits when they are linked with back-office systems has prompted an assault on the CRM market by suppliers of enterprise applications; most notably, by vendors of what is widely known as enterprise resource planning (ERP) systems. These suppliers generally take one of two approaches to enter the CRM market. One approach involves forming a strategic alliance with a CRM vendor and then linking the CRM application with the enterprise system product suite. The other approach is to simply build a CRM application that can be embedded in the existing enterprise applications suite. The approach to CRM mirrors a company's overall business philosophy, which holds that systems providing
Self-Instructional 248 Material Decision Support Systems NOTES various functions must be completely integrated in order to provide full benefits to their users. The global approach to CRM allows users with certain security rights to access the entire interface that is structured like the Microsoft Windows Explorer file manager program. Users can click on the various file folders to get to the applications or data they need. They also can create 'favourites' screens for quick access to information which they need to access on a regular basis, or to launch applications that they use frequently. The functional approach involves the use of tabs within the various application modules of both the front-office and back-office portions of the whole system. If someone is working in a sales force automation application and receives a call from a customer regarding inventory availability, the user does not have to exit the current application to access the customer's profile. He can simply click on the tab folder to go to to an inventory or distribution screen and get the background information to answer the customer's question. CRM Sales Automation Order Processing RMA CRM Portals API & Web Services Knowledge Management Marketing Automation Customer Support Employee Support Defect Tracking Figure 8.7 Customer Relationship Management Mechanism Figure 8.7 shows the mechanism of CRM that provides enterprise-wide access to vital customer information anytime and anywhere so that businesses can be managed with such an integrated approach. 8.4 E-BUSINESS AND KNOWLEDGE MANAGEMENT E-business and e-commerce refer to all business transactions that depend on information technology and where electronic communication takes place between the different parties involved. Data may be communicated using electronic mail (e-mail) and may contain data, pictures, video or voice. A group may use a groupware technology such as teleconferencing, dataconferencing and videoconferencing to share data among the team. All these technologies reduce communication cost, effort and time. Electronic Mail, Voice Mail, Fax and Groupware Electronic mail is one of the oldest applications of the Internet and has become the most common way of communication. For a detailed discussion on e-mails, see Section 6.4 World Wide Web. Check Your Progress 4. What is an enterprise resource planning? 5. What is the main disadvantage of ERP?

Self-Instructional Material 249 Decision Support Systems NOTES Facsimile (fax) machines can transmit documents containing both text and graphics over ordinary telephone lines. A fax machine scans and digitizes the document image, and then transmits it over a network and is reproduced in a hard copy form by the receiving fax machine. The process results in a duplicate, or facsimile, of the original. A groupware facilitates collaboration through document sharing and information sharing like work allocated to each member, etc. Lotus notes, Open Text's Livelink and Microsoft Project are some popular groupware. Nowadays, one can create a Web site and give appropriate access rights to various users. For instance, collaboration in Microsoft Project happens through a Web site, e-mail or by using a central database server. Teleconferencing, Dataconferencing and Videoconferencing People can meet electronically, even though they are hundreds or thousands of miles apart, by using teleconferencing, dataconferencing or videoconferencing. Teleconferencing allows a group of people to confer simultaneously via telephone or via an e-mail group communication software. Teleconferencing that includes the ability of two or more people at distant locations to work on the same document or data simultaneously is called dataconferencing. With dataconferencing, users at distant locations are able to edit and modify data (text, such as word process-ing documents; numeric, such as spreadsheets; and graphic) files. Teleconferencing in which the participants can see each other on video screens is termed video teleconferencing or videoconferencing. Digital Information Services, Distance Learning and E-learning Powerful and far-reaching digital electronic services enable networked PC and workstation users to obtain information from outside the firm instantly, without leaving their desks. Stock prices, periodicals, competitor data, industrial supplies catalogues, legal research, news articles, reference work and weather forecasts are some of the types of information that can be accessed online. Many of these services provide capabilities for e-mail, electronic bulletin boards, online discussion groups, shopping and travel reservations and Internet access. Organizations can also use communications technology to run distance learning programmes where they can train employees in remote locations without the employees having to be physically present in a classroom. Distance learning education or training delivers services over a distance, to individuals in one or more locations. Although distance learning can be accomplished with print-based materials, the distance learning experience is increasingly based on IT, including videoconferencing, satellite or cable television or interactive multimedia, including the Web. The term e-learning is being increasingly used to describe instructions that use purely digital technology such as CD- ROMs, the Internet or private networks. Some distance learning programmes use synchronous communication. Teacher and students are present at the same time even if they are in different places. Other programmes use asynchronous communication in which the teacher and students do not have person-to-person interaction at the same time or place; for example, students might access a Web site to obtain their course materials and communicate with their instructors via e-mail. Electronic Data Interchange Electronic Data Interchange (EDI) integrates business processes across companies by exchanging business documents such as purchase orders, invoices, shipment notices,
Self-Instructional 250 Material Decision Support Systems NOTES etc., in an electronic form using a standard format over a communication network. EDI is supported by the electronic library, Electronic Data Exchange (EDX). The benefits of EDI include reduction in data entry errors, cycle time, cost and paperwork. Once the data is in an electronic form, it stays that way; it does not get converted into a paper form that will require re-entry at the receiver's site. If the communicating parties are a customer and a supplier, both can benefit by following the same standards and plan in a better manner. This results in a reduced inventory and competitive advantage. There are many protocols for EDI such as ANSI X.12 and EDIFACT. Applications such as ATMs, airlines reservations systems and stock exchange transactions use this technology. EDI differs from e-mail in that it transmits an actual structured transaction (with distinct fields such as the transaction date, transaction amount, sender's name and recipient's name) as opposed to an unstructured text message such as a letter. 8.5 SECURITY ASPECTS OF INFORMATION SYSTEMS Security aspects of information refers to protecting information and information systems from unauthorized usage. 8.5.1 Information Security and Control IT and computers have indeed heralded in the 'Information Age'. 'Information' itself has emerged as one of the most valuable and sought after 'resources' conferring a competitive advantage on those organizations which have it. Those organizations which missed the bus, did try to regain their position by sometimes poaching, or trying to encroach upon the information resource base of their competitors. This was done by cracking or breaking into the information/computer systems of their leading counterparts. The spread of Internet and the relative ease of access made this task of 'information breach' relatively easier. Cracking or breaking into the computer system by way of malicious and unauthorized access can be in any one of the following ways: (a) Unauthorized reading of data (theft of information) (b) Unauthorized modification of data (c) Unauthorized destruction of data Why Breach IT System Security? There could be a number of reasons as to why people/organizations would want to crack or break into their competitors computer systems. Some of the most popular reasons could be as follows: (a) Revenge (b) Money (c) A shot at notoriety (d) The challenge of doing 'IT' Regardless of the reasons, it cannot be denied that there have been a number of attempts – some successful, some failed – to crack the computer/IT system's security. It became apparent that organizational 'information resources' had to be jealously guarded, protected and controlled against such unauthorized and undesired access, as Check Your Progress 6. What does e-business refers to? 7. What is tele-conferencing used for?

Self-Instructional Material 251 Decision Support Systems NOTES otherwise, not only the data, the networks and the information infrastructure, but ultimately, the organization itself could be at risk. The future cannot be secure if information is not secure. Security Threats When it comes to information system security and control, it must be realized that, broadly, there are two different types of threats/problems: • External threats • Internal threats Of course, with the prevalence of remote access, the World Wide Web, intranets and extranets, the distinction/difference between external threats and internal threats has become more blurred and hazy. It would not be out of place to say that the difference is a more logical than a physical one. Security threats and the managerial responses to them have been discussed in detail in the following pages. External security/control threats External threats are those that emanate from outside the organization. To provide security against these threats, the following issues need to be addressed: • The organization's connections to the Internet • Remote dial-in capabilities Internet connections Normally, in every organization, there are only a few identifiable Internet connections. It is, therefore, relatively easy to focus on them and exercise control. The Internet connection should be protected by a 'Firewall'. Firewalls are hardware and software combinations that guard the border between the corporate Inter/Intranet (Private Access) and the Internet (Public Access), as illustrated in Figure 8.8. Firewall Internet Corp orate Network Pr ivate access/side Public Access/side Figure 8.8 Firewalls Firewalls can control who, if anyone, can surf the Web, download files, etc. Firewalls can also hide the organizational network's identity from the rest of the world on the Internet, as corporate internal IP address/es is/are never used. It should be remembered that if the organization's Internet connections are not protected by firewalls, it would be like going away on a vacation leaving the door of your house unlocked. It would be an invitation for disaster, as, while there may not be any visible indication that you are vulnerable, the first person who comes knocking on

Self-Instructional 252 Material Decision Support Systems NOTES the door is going to find out that the door is open and not locked, and he may not exactly be your best and trusted friend! Remote dial-in capabilities While Internet connections are few and easy to watch/control, threats from dial-in capabilities are real. There might be hundreds of dial-in threats, most of which might be unknown to the security administrator. Any user in the organization with a phone line and a modem attached to his PC can be a potential source of external access. While controlling remote dial-in capabilities, the following aspects need to be given due weightage/considerations: (a) Remote access (b) Remote Access Servers (RAS) (c) Server ID (d) The weak points of the system environment Internal security threats It is generally thought that the employees of a company are trustworthy and that the real threat to security comes from outside. Nothing can be more ironic than that. More often than not, the greatest security threats come from within! It is therefore imperative that formal security policies/measures be carefully designed and scrupulously followed to ensure the best protection and prevent security breaches. The policies/measures need to address the following aspects: (1) Passwords (2) User termination (3) Special privilege IDs (4) Access reviews (5) Authorization levels (6) User information (7) Routine maintenance (8) Software updates (9) Virus checking/checks (10) Physical considerations (11) Audit trails Passwords The password should be at least five characters in length. It should be neither the same as the user's ID – nor a common word. It should expire/change regularly and reuse of the older passwords should not be permitted. Some software, with the ability to disable an ID if too many or a specified number of failed attempts are made within a specified period of time, should be installed. User termination When the user ceases to be an employee, intern, temporary associate or consultant/ contractor, the user security administrator must be informed forthwith, so that the user ID can be terminated.

Self-Instructional Material 253 Decision Support Systems NOTES Special privilege IDs Certain functionaries (like network/system managers) are allotted special IDs and passwords called root, supervisor or administrator ID/passwords) providing a carte blanche access to the system. These passwords too should be changed regularly. They should be changed immediately when someone who knows them leaves the organization. Access reviews There are generally a number of users and hundreds of thousands, if not millions, of files on computer networks. Some type of user administrator review must be undertaken twice or thrice a year to ensure that unauthorized users are not given access. Authorization levels Who has authority over what must be made absolutely clear. It must also be ensured that requests for authorization – permitting access to relative database files – are received and issued in writing, usually via e-mail. Further, the user could be assigned several forms of authorization for access to parts of the database. The authorization could be: read authorization, insert authorization, update authorization, delete authorization, index authorization, resource authorization, actuation authorization, drop authorization. User information The users should be made aware of the security issues. Routine maintenance Routine maintenance should mainly cover such activities as: (a) IDs that have not been used for predefined period of time should be disabled. (b) Logs giving details about unsuccessful log-in attempts should be reviewed and investigated. (c) Files that have not been accessed for quite some time should be purged to create free space. Software updates Security administrators should regularly check with software vendors to obtain and apply the latest software updates or patches that help close security gaps/holes. Virus checking Viruses are programming codes that intentionally cause a system disruption, shut down or loss of data. The disruption might be harmless or even amusing – like displaying the message, 'Feel like banana?' on the computer screen. The disruption could also be hostile and destructive; files/data on hard drives can get erased without any intimation. There are many types of viruses including those known as 'Trojan Horses' and 'Worms.' Some other major viruses are 'Melissa,' 'Chernobyl', 'Explorer Zip.Worms,' 'I Love You,' 'Code Red' and 'WBL SQL Slammer,' among others. Viruses therefore, are occupational annoyances/hazards to IT professionals. However, as viruses pose a very real threat to security, special attention has to be paid to virus protection programmes, policies and procedures. Installation of anti-virus software is, hence, a must. Pattern files, which contain all the information that the actual anti- virus program uses to look for viruses, must be updated regularly. Further, as e-mails

Self-Instructional 254 Material Decision Support Systems NOTES have become the most prevalent form of propagating viruses, anti-virus software should be installed on mail servers to scan message attachments. Some of the anti-virus software products currently in use include Symantec's Norton Antivirus, Network Associates, Total Virus Defence Product Suit Intel's LANDesk etc. Physical considerations Physical access to the IT area needs to be controlled. Access to the computer room or data centre should be limited to a need only basis. Other IT areas such as auxiliary storages and wiring should be locked. Even printed report distribution should be controlled, and apart from door-locks and access cards, shredders should be made available to dispose abundant output. Visitors should be personally escorted within the premises. Audit trails Audit trails can and should be made mandatory. An audit trail is a log of all the changes (inserts/deletes/updates) made to the database, along with information such as who performed the change and when it was performed. Audit trails help 'security' and 'control' in a number of ways. To illustrate, audit trails help in: (a) Tracing all the updates performed (b) Finding incorrect/fraudulent updates (c) Finding the person who carried out the updates Audit trails can be created by defining appropriate triggers on relation updates. They can also be based on built-in mechanisms. 8.5.2 Vulnerability and Abuse of Systems Why Systems are Vulnerable When an organization has functional units that create and maintain their own data, the data is spread across the organization. If data is maintained in paper files, these are categorized and secured appropriately. If data is maintained in computer systems, multiple software and computers are used. But since data is integrated across the organization, a single uniform access method is used. In such a case, one successful illegal attempt to access data can compromise the data of the entire organization. A single database server failure can make the entire data inaccessible if there are no backup servers. A network failure or website failure can cause inconvenience, financial loss and embarrassment to the organization. Computer systems can fail or not perform their designated functions due to many other possible reasons such as hardware failure, software failure or telecommunication problems. A human error, theft, natural disaster or a break in electrical supply can threaten the functionality of an information system. Sometimes, a policy change by a regulatory authority can render existing systems useless; for example when the VAT system was modified. One major source of security threat is communication technology. The objective of communication technology is to enhance accessibility. Data stored at any location can be accessed from virtually anywhere on the globe. This provides potential points to an intruder. An attack from an intruder may corrupt data or prevent it from reaching the intended user. Such attacks are active attacks. A hacker

Self-Instructional Material 255 Decision Support Systems NOTES can easily gain access to any data. Such attacks are performed by computer viruses that are software programs. Viruses travel from one computer to another through e- mails. There are viruses that attack mobile devices. There are programmers who write virus generating programs, and there are programmers who write anti-virus programs. But somehow, virus creators always stay ahead of these anti-virus programmes or vaccines. Concerns for System Builders and Users Software companies that create software systems and organizations that use them and depend on them, make efforts to protect their systems from natural and technical failures. A natural disaster such as an earthquake or fire can destroy an entire system and precious data beyond repair. Most organizations therefore keep one or two backup servers in different seismic zones. These servers are updated in real time and kept in sync with the primary server. Data Quality Problems Another problem is the poor quality of data. Data is generally stored in a relational database management system (RDBMS), which has very little capability to check data integrity. One can enter an invalid address and the system has no way of checking and stopping it from entering the system. Sometimes, data entry staff can make a mistake; at other times the data made available to them may itself not be correct. 8.5.3 Creating a Control Environment Information systems are expensive and time consuming to build, and organizations depend heavily on these systems for data and services. It is therefore important to protect systems and data from all the threats and abuses mentioned in the previous section. A control structure has to be put in place to ensure the safety of information systems. A control structure or environment includes safety measures built into the software. It also includes access methods, and policies and procedures enforced by the organization. There was a time when few people had access to and interest in computers. Only small volumes of data were stored in each insolated computer. A paper system operated in parallel, and data was frequently printed and filed. The security and availability of data was not a major concern. The scenario has changed with the growing dependence on information systems and the integration of data and computers through networks. Various measures exist that constitute the control structure in an organization. There are application-specific controls that apply to particular software and there are general controls that apply to all information systems. General Controls and Application Controls General controls include access control to application software and data. All operating systems now provide password protection that limits access to a system. An administrator who has full rights can provide limited or full access rights to different users. Most systems maintain a log which the administrator can examine. Hardware has to be protected from accidents such as fire. The required temperature, humidity level, voltage and frequency for power supply should be carefully and continuously monitored. Air conditioners, humidifiers or de-humidifiers, voltage stabilizers, etc., may be required to maintain the required conditions. Physical theft can

Self-Instructional 256 Material Decision Support Systems NOTES be avoided by employing guards on the premises. Earlier, people were allowed to bring in bags. Any malicious user could open a system, remove any component(s) from inside the computer and take it away. In order to prevent such a situation, bags should not be allowed inside. Resources for backup activities are essential. There are backup systems that include high storage capacity devices and robotic arms that automatically rotate storage media and take backups. There are companies that provide backup services. The management or administration of an organization should formalize a control policy and allocate resources to execute the policy. As far as application-specific controls are concerned, the controls vary from application to application; for example, if someone is entering data into a database, only correct and complete data should be entered. During the development of an information system, proper software development methodology has to be followed to ensure high quality software. Application-specific controls govern the input, processing and output of systems. Protecting the Digital Firm A digital firm that depends heavily on IT needs fault-tolerant and high-availability computing facilities. A fault-tolerant system contains redundant hardware and smart software to detect a fault and automatically switch to a redundant device. The administration can replace or repair the faulty component without disrupting the services. For instance, a computer may have redundant CPUs and disks to make it fault-tolerant. High-availability computing A high-availability computing environment helps a system recover quickly from a crash. A backup server in a different seismic zone constitutes a part of such an environment. If the primary server fails, all accesses are re-directed to the backup server. Sometimes a server may get overloaded and some users may not receive service. Techniques called mirroring and load-balancing are used to provide the same service from multiple servers. Internet Security Challenges An organization that provides data access to its customers, suppliers and employees over the Internet needs a Firewall.

is installed between an organization's internal network and any external network. Every message packet (a message is divided into packets) is first examined by the Firewall to check unauthorized access. Intrusion detection systems monitor network traffic to detect attacks. These systems use data mining techniques to analyse malicious and suspicious patterns in the network traffic. Encryption is the process of coding of messages before they are transmitted to the network. Public key encryption is a popular encryption algorithm. It uses a public key and a private key. Public key is used for encryption and private key decrypt is used to the encrypted message. The algorithms for encryption and decryption are identical; only the keys change. One can encrypt someone's signature using his private key and

Self-Instructional Material 257 Decision Support Systems NOTES the message using the public key. The receiver can verify the identity of the sender because he has used a private key, and the sender has ensured that only the intended receiver will be able to decrypt the key. 8.5.4 Ensuring System Quality Organizations can improve the quality of a system by using software quality assurance techniques and by improving the quality of their data. This section deals with measures that are taken by system builders to ensure quality. Software Quality Assurance Methodologies and Tools Many software development life cycle methodologies are available. One such methodology is known as the Waterfall methodology. This methodology is process oriented and linear in nature. The conclusion of one process triggers the next one. This section will discuss data-oriented methodologies. These methodologies focus on the flow of data and functions that process the data. One such methodology is Data Flow Diagram (DFD). A DFD consists of functions that are represented as circles/bubbles, data stores that are represented as two horizontal lines, and data sources and risk that are represented by rectangles. This is illustrated in Figure 8.9. Customer Verify login Display & Log Login Information Password Login Accepted Login Information Login Welcome Message Figure 8.9 A Data Flow Diagram The bubbles can be further clarified in another DFD. One can do away with the data components and create a hierarchy of DFD till every process and data store is clear. Such a methodology is known as structured analysis. One can do away with the data components and create a hierarchy of processes only. At the top level, high-level processes are written that are broken down into sub processes. Such a design methodology is referred to as structured design. One can then pick processes at the lowest level and write corresponding modules in a computer. This discipline introduces a structure to the programs and is referred to as structured programming. An object oriented development methodology combines data and the functions (referred to as methods) that process the data into an object. A system is modelled as a collection of objects and their relationships. It turns out that no single methodology is suitable for all types of systems. Unified modelling language (UML) has created a list of modelling techniques appropriate for capturing different aspects of a system. Table 8.4 lists the diagrams and their capabilities.

Self-Instructional 258 Material Decision Support Systems NOTES Table 8.4 Diagrams used in Unified Modelling Language Diagram What it captures Use Case Diagram Displays the relationships among actors and methods Class Diagram Captures objects in the system, their data components, Activity Diagram Captures the flow of data and actions Object Diagram Captures the structure of the modelled system methods and the inter-relationships among objects There are other types of diagrams also in UML. These diagrams can be used to capture other aspects of the system such as states of objects, collaboration among various objects, and so on. These diagrams can be categorized as structural diagrams and behavioural diagrams. Structural diagrams capture the relationships between classes. A class diagram is a structural diagram. Behavioural diagrams are used for describing the interaction between objects. Use case diagrams and activity diagrams are behavioural diagrams. There are many tools that facilitate the designing phase of a system. These tools are known as CASE (Computer-aided software) tools. Most CASE tools provide graphical user interface (GUI) for producing diagrams and for collaboration. A CASE tool has to be used properly to obtain its full benefits. Let us say, the requirements are well understood, documented and have become part of a CASE tool. Now, any change in this document must be controlled. If a team is allowed to make changes at will, then the whole point of using a CASE tool is lost. A change in requirements specification has to be evaluated by the team and approved by the client and the project manager. The impact of the change on the project's time and cost has to be assessed before it can be allowed. It is the responsibility of the management to allocate time and resources for project management activities and documentation. The time spent on the requirements specification phase alone is about 20 per cent of the total project effort. Fifty per cent of the effort is spent on design, programming and testing. About 25 per cent effort is spent on the deployment and installation of the system. The software quality assurance activity takes place in every phase and includes documentation, verification and validation, test plan creation testing, etc. Some data is collected during the development process to assess the quality of the SDLC process and the product. To take an example, the number of changes made to the software requirements specification (SRS) document should decrease as the project progresses. The number of bugs found in the code should decrease with every new project. The difference between the estimated cost and the actual cost should also decrease with every new project. These matrices are used for assessing the quality of the software development methodology. The quality of a system being built is governed by the SDLC methodology. If SDLC enforces the creation of SRS and if changes to the SRS are controlled, then the entire team refers to the same version of the SRS. In other words, the entire team and the client know what to expect from the final product. The Waterfall model requires the creation of a test plan for each module, for system integration and for user acceptance. These plans create the input and expected output, performance requirement, etc., as well as a walkthrough, a review of each document and generate the code. This is done

Self-Instructional Material 259 Decision Support Systems NOTES by a small team and is the least expensive mechanism to catch errors. Walkthroughs have been found to be very effective, while performance testing is sometimes tricky; for example, wireless applications or e-commerce transactions are difficult to test for their performance, security and capacity to handle anticipated concurrent users. 8.5.5 Software Quality Historically speaking, the application of information technology was initially confined to scientific and research-related activities, where time was not considered a constraint. However, as the IT capabilities and their impact on organizational functioning became apparent, IT emerged as a new, powerful tool to out-perform business rivals and gain competitive advantage by improving product quality, facilitating product delivery and changing the very processes in an organization. IT applications and, of course, IT software then became a 'HOT' thing, the end- user, surprisingly, being at the 'receiving end' and the software developer in the 'driver's seat'. No wonder, then, that the development of software was used to put an over- emphasis on schedule and cost, to the detriment of quality. It is now being realized that the development of information systems requires a constant trade-off between schedule and cost and quality. With operational snags emerging after the installation of the systems and with soaring maintenance costs, it is also being realized that there is an urgent need for software products, like any other product in the market, to be evaluated carefully before they are delivered and implemented. There is yet another dimension to software quality assurance. Software is ubiquitous and people often behave as if they had complete confidence in it. For example, ATMs or computerized railway bookings or the telephone network. People do not expect them to fail! Software failures can now impact many areas of people's lives and are much less likely to be tolerated than they were in the past when software was used only by a small number of people who understood that they were using an inherently unreliable system. Software failures can now affect people who are unaware of the fact that they are using software. It is, therefore, the responsibility of the software developer and provider to develop and provide a 'fail-safe' software which justifies this level of public confidence. Hence, the expectation and demand for the most stringent software quality assurance progamme to provide the required degree of confidence must be met. The Need for Software Quality Assurance Apart from the factors discussed earlier, software quality assurance is also required for the following reasons: (a) Avoiding legal liability if the software fails (b) Proving, with due documentation, that the software was developed using best practices techniques embodied in various standards (c) Convincing users or prospective clients that the developer has a satisfactory software quality assurance programme in place (d) Being able to develop/deliver a good quality product which, in turn, may enable the developer to offer guarantees as part of the marketing strategy

Self-Instructional 260 Material Decision Support Systems NOTES (e) Making software development more cost-effective (f) Taking advantage of a rigorous quality assurance programme as a marketing USP (g) Taking the user/client from 'customer satisfaction' to 'customer delight' to 'customer LUV' and ensure 'customer loyalty' What is Software Quality? Before discussing software quality, it is important to discuss the two terms separately. Software Generally, software is defined as a set of instructions. In the context of software quality assurance, software is viewed as 'all instructions and data which are input into a computer to cause it to function in any code.' It includes 'operating systems, supervisory systems, compilers and test routines as well as application programmes. It also includes the documents used to define and describe the programme, including flow charts, network diagrams and programme listings, as well as specifications, test plans, test data, test results and user instructions.' Quality 'Quality indicates the degree of excellence of a product or service.' According to DoD 1985, quality means the degree to which the attributes of the software enable it to perform its specified end use. According to ISO 1986, quality means the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs. As can be observed, the ISO definition clearly reflects the desire to define quality in a way which captures the current concept of quality as customer satisfaction in the broadest possible context. Software quality • Software quality is the inherent ability of a software to be used for a specified purpose as the software possesses certain features and characteristics and which enable it to be used for that purpose. • Software quality meausre the suitability and capability of a software to ensure that: (a) It will be reliable (b) It will what it is supposed to do (c) It will perform according to its specifications (d) It will work efficiently (e) It will work efficiently for the time for which it is predicted to work • Software quality could also imply: (a) The quality of conformance, reflecting the extent to which the developer has succeeded in producing a software which implements the design (b) The quality of design, which reflects the extent to which a given software product meets a customer's expectations

Self-Instructional Material 261 Decision Support Systems NOTES The following is a broad summary of the attributes of quality known as Quality Factors. • Aesthetics • Conformance • Correctness • Durability • Efficiency • Extendability • Integrity • Inter-operability • Maintainability • Openness • Perception/Perceived quality • Portability • Reliability • Reusability • Security • Serviceability • Survivability • Testability • Understandability (comprehensibility) • Usability • User-friendliness Quality assurance Quality assurance is defined as 'A planned and systematic pattern of all actions necessary to provide confidence that the item or project conforms to established technical requirements.' Software quality assurance Software quality assurance, accordingly, lays considerable stress on obtaining a design prior to coding. However, an increasing use of prototyping in systems development is producing differences between the production stages of hardware and software. Software quality assurance must also: (a) Provide for exhaustive testing (b) Obtain a mathematical proof of correctness (c) Convince one that the output from each phase of the development process, which will be a different representation of the software, is functionally equivalent to its predecessor Management Role in Software Quality Assurance The failure of management to properly plan and control the software development process is now felt to have been responsible for much of the poor quality software developed/ produced in the past. In fact, one of the major roadblocks in software quality is the belief/attitude that problems can be sorted out at the end of the development process.

Self-Instructional 262 Material Decision Support Systems NOTES It is now generally recognized that management has a key role to play in the production/ development of quality software, as software quality assurance, like any other form of quality assurance, is highly dependent upon management attitudes. While organizational structures can be created and put in place any time, the real change required is in managerial attitudes. The management must manifest and transmit a greater desire to produce high quality products. It must also commit 'commensurate resources' to ensure this. In turn, software developers must plan and implement software development projects with the objective of 'building in' good quality. Towards this end, they must: (a) Establish and maintain the requirement specifications (b) Establish and implement a process for developing the software (c) Establish and maintain an evaluation process Further, the 'Discipline Triangle' must be applied to produce quality software successfully. The 'Discipline Triangle' would contain management, software development and product assurance discipline. 'Management Discipline' would include both project management and general management. 'Software development discipline' would involve activities such as analysis, design and testing. 'Product assurance discipline' would include quality assurance, test and evaluation and configuration management. Formal Quality Assurance Measures/Structure The formal quality assurance structure will need to be woven around the ISO 9000 Standard. ISO 9001 defines a minimum set of requirements for quality management. It includes quality assurance, quality control, process control, change management and formal review. ISO 9001 is acknowledged as requiring additional features for software development. It is required that the ISO 9001 Standard, IEEE 1298 Standards and the ISO 9000-3 Guidelines be considered for software quality assurance. Additional Considerations In addition to the standards mentioned earlier, due attention should also be given to the following: Quality profile model To ensure quality assurance, it is imperative to keep in view the quality profile of a software. The Quality Profile Model, proposed by Kaposi and Kitchenham as a way of structuring the analysis of the quality of a piece of software, is presented in Figure 8.10.

Self-Instructional Material 263 Decision Support Systems NOTES Quality Profile Quality factors (Objectively measurable) Transcendental properties (Not quantifiable) Quality metrics (Quantifiable) Quality attributes (Indicates presence or absence of a property) Quality ratings (Quantifications of value judgement) Merit indices (Subjectively measurable) Figure 8.10 Quality Profile Model Constructive quality model Kitchenham also discussed the development of a Constructive Quality Model, known as COQUAMO. The model attempts to make explicit, the dependence of the achievement of a quality factor upon activities undertaken throughout the life cycle. In each stage of the life cycle, checklists can be used to monitor progress towards the achievement of the quality factor. The model involves measuring the following three types of values: (a) Quality factor metrics (b) Quality indicators (c) Measures of quality drivers The COQUAMO model is illustrated in Figure 8.11. QUALITY FACTOR Requirements Checklist Design Checklist Coding Checklist Testing Checklist Metircs Procedures Standards Metrics Procedures Standards Metrics Procedures Standards Procedures Standards Metrics Figure 8.11 Constructive Quality Model 'TickIT' initiative TickIT focusses on software development, as this is the component that gives an information system its power and flexibility. Yet, unfortunately, it is also the source of problems. The fundamental

Self-Instructional 264 Material Decision Support Systems NOTES objective of the TickIT initiative is to ensure that developers deliver quality. The TickIT guide contains structured guidance for the application of ISO 9001. It also includes the ISO 9000-3 document which explains how ISO 9001 can be applied to software. The TickIT initiative has two components: (a) A quality management certification scheme for the software and IT industries. (b) An awareness programme to raise the level of understanding of what quality is and how it may be achieved among the professionals within the industry. TickIT is about the certification of a quality management system within the context of an organizational commitment to total quality management. Certification should result from delivering quality. (c) The TickIT certification scheme is a sector scheme. (d) TickIT promotes certification within the context of Total Quality Management (TQM). The TickIT TQM model continuous the improvement of the quality management system. It results from three long term driving components which work on the quality management system. The three driving components are as follows: (1) Management commitment improvement (2) Motivation for improvement (3) Measurement for improvement 8.6 SUMMARY Decision support systems (DSS) are required when one has to take decisions on unstructured and semi-structured problems. It requires continuous user interaction. A model management subsystem has many elements, which are model base management system, model command processor and model executor or solver. A DSS works in semi and unstructured environments rather than in a structured environment. It works normally in a client-server or 3-tier architecture environment where the client houses the model and interface and the server houses the data. Expert systems are classified as a subset of the field of artificial intelligence (AI). Enterprise resource planning (ERP) is a popular expert system supported by multimodule application software. The limitations of ERP depend on the skill and experience of the workforce. Many companies cut costs by cutting down training budgets. Nowadays, the term e-learning is being increasingly used to describe the instructions that use purely digital technology such as CD-ROMs, the Internet or private networks. Viruses are the programming codes that intentionally cause a system disruption, shut down or loss of data. In today's world, one major source of security threat is communication technology. 8.7 KEY TERMS • E-business: It refers to the application of information and communication technologies in support of all the activities of business. • E-mail: It is a method of exchanging digital messages from an author to one or more recipients. Check Your Progress 8. What are external threats? 9. What is the major characteristic of a password? 10. What is software?

Self-Instructional Material 265 Decision Support Systems NOTES • Teleconference: It is the live exchange and mass articulation of information among several persons from one another but linked by a telecommunications system. • Software: It is a collection of computer programs and related data that provide the instructions telling a computer what to do and how to do it 8.8 ANSWERS TO 'CHECK YOUR PROGRESS' 1. The elements of user-system dialog management subsystem are as follows: • User interface • Request constructor 2. Data is the most important component of a DSS. 3. The elements of the model management subsystem are as follows: • The model base management system • The model command processor • The model executor or solver 4. Enterprise resource planning is a popular expert system supported by multi-module application software. 5. The main disadvantage of ERP is that many organizations that have the ERP system face a slowdown due to inadequate investment to train personnel. 6. E-business and e-commerce refers to all business transactions that depend on information technology and where electronic communication takes place between the different parties involved. 7. Teleconferencing allows a group of people to confer simultaneously via telephone or via an e-mail group communication software. 8. External threats are those that emanate from outside the organization. 9. The major characteristic of a password is that it should be at least five characters in length. 10. A software is defined as a set of instructions. 8.9 QUESTIONS AND EXERCISES Short-Answer Questions 1. List the various classes of models used in model management subsystems. 2. What are the limitations of ERP? 3. What are the major activities that are covered under routine maintenance? 4. Name the driving components of TickIT TQM model. Long-Answer Questions 1. Describe the various characteristics of a DSS. 2. Discuss the similarities and differences in teleconferencing, data conferencing and videoconferencing.

Self-Instructional 266 Material Decision Support Systems NOTES 3. Explain how a control environment is created. 4. Why is software quality assurance required? Explain. 8.10 FURTHER READING Madnick, S.E., (Ed). The Strategic Use of Information Technology. New York: Oxford University Press, 1987. Orna, E. Information Strategy in Practice. Burlington: Gower Publishing Ltd., 2004. Haag, S., M. Cummings and D.J. McCubbrey. Management Information Systems for the Information Age, 4th edition. New Delhi: Tata McGraw-Hill, 2004. McLeod, R. Management Information Systems, 2nd edition. Chicago: Science Research Associates, 1983.

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Summary 5.8 Key Terms 5.9 Answers to 'Check Your Progress' 5.10 Exercises and Questions 5.11 Further Reading Introduction NOTES Self-Instructional Material 1 INTRODUCTION Rapid globalization coupled with the growth of the Internet and information technology has led to a complete transformation in the way businesses or organizations function today.

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also led to increased competition in terms of market and resources. E-business is gaining popularity because businesses have become more customer-driven.

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traditional means of correspondence have given way to online dealings, e-mails and chats. This paradigmatic shift in business approach

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Summary 2.7 Key Terms 2.8 Answers to 'Check Your Progress' 2.9 Questions and Exercises 2.10 Further Reading UNIT 3 MANAGEMENT INFORMATION SYSTEM AND DBMS 75–124 3.0 Introduction 3.1 Unit Objectives 3.2

Summary 2.8 Key Terms 2.9 Answers to 'Check Your Progress' 2.10 Exercises and Questions 2.11 Further Reading UNIT-3 INFORMATION SYSTEM IN BUSINESS 65-90 3.0 Introduction 3.1 Unit Objectives 3.2

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12/190	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

to handle the various departments and functions in an organization.

to handle the various departments and functions in an organization.

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13/190	SUBMITTED TEXT	30 WORDS	59%	MATCHING TEXT	30 WORDS

Management Information System or MIS can be called an organized and well-structured system that is introduced in an organization to collect, store, process and disseminate data in the form of information.

Management Information System or MIS can be called an organized and well- structured system put in place in an organization for the collection, storage, processing and dissemination of data in the form of information

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

14/190	SUBMITTED TEXT	14 WORDS	78%	MATCHING TEXT	14 WORDS

Summary 1.6 Key Terms 1.7 Answers to 'Check Your Progress' 1.8 Questions and Exercises 1.9 Further Reading 1.0 INTRODUCTION

Summary 5.8 Key Terms 5.9 Answers to 'Check Your Progress' 5.10 Exercises and Questions 5.11 Further Reading Introduction

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15/190	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

UNIT OBJECTIVES After going through this unit, you will be able to: • Define

UNIT OBJECTIVES After going through this unit, you will be able to: ?Define

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16/190	SUBMITTED TEXT	31 WORDS	92%	MATCHING TEXT	31 WORDS

basic facts and entities such as names and numbers. Examples of data are dates, weights, prices, costs, numbers of items sold, employee names, product names, addresses, tax codes, registration marks, etc. Data is

basic facts and entities such as names and numbers. The main examples of data are weights, prices, costs, numbers of items sold, employee names, product names, addresses, tax codes, registration marks etc. Data is

W https://ecomputernotes.com/fundamental/information-technology/what-do-you-mean-by-data-and-inform ...

17/190	SUBMITTED TEXT	23 WORDS	78%	MATCHING TEXT	23 WORDS

Other forms of information are pay-slips, schedules, reports, work sheet, bar charts, invoices and account-returns. Information may further be processed and/or manipulated to form knowledge.

Other forms of information are pay-slips, schedules, reports, worksheet, bar charts, invoices and account returns etc. It may be noted that information may further be processed and/or manipulated to form knowledge.

W https://ecomputernotes.com/fundamental/information-technology/what-do-you-mean-by-data-and-inform ...

18/190	SUBMITTED TEXT	27 WORDS	75%	MATCHING TEXT	27 WORDS

time tables, merit lists, report cards, headed tables, printed documents, pay slips, receipts, reports, etc. It is obtained by assembling items of data into a meaningful form.

Time Table, Merit List, Report card, Headed tables, printed documents, pay slips, receipts, reports etc. The information is obtained by assembling items of data into a meaningful form.

W https://ecomputernotes.com/fundamental/information-technology/what-do-you-mean-by-data-and-inform ...

19/190	SUBMITTED TEXT	22 WORDS	72%	MATCHING TEXT	22 WORDS

data that has been put into a meaningful and useful context and communicated to a receiver who uses it to make decisions.

data that have been put into a meaningful and useful content and communicated to a recipient who uses it to made decisions".

W https://fliphtml5.com/pyiue/sfgj/basic

20/190	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

the right information to the right people at the right time.

SA Ready Reckoner.pdf (D143237822)

21/190	SUBMITTED TEXT	41 WORDS	80%	MATCHING TEXT	41 WORDS

and model management have several connotations in DSS literature and there have been wide-ranging definitions of these terms. The common feature that emerges from these definitions is that a model consists of a solver, a model for solving a problem and data (Ramirez,

and Model Management has several connotations in DSS literature and there have been wide ranging definitions of these terms. The common strain that evolves from these plethora of definitions is that a model is conceived to consist of a solver, a model for solving a problem and data (Ramirez, 1993)

W https://ecomputernotes.com/structure-and-classification

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22/190	SUBMITTED TEXT	48 WORDS	72%	MATCHING TEXT	48 WORDS

a type of data processing systems, which collect the data from different sources, process that data and generate information from the data to be used for different applications within the organization. For example, in a business context, an information system collects data from various systems such as finance and sales systems

a type of data processing systems which collects the data from different sources, processes that data and generates information from the data to use them for different applications within the organization. For example, in business context, the information system collects data from various systems such as finance and sales systems

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

23/190	SUBMITTED TEXT	45 WORDS	88%	MATCHING TEXT	45 WORDS

supplier side. The information system processes the data and generates information for the customer. Customers provide feedback to the supplier depending on the information processed by the information system. Figure 1.6 shows the information system in a business context. Figure 1.6 Information System in a Business Context Information

supplier side. The information system processes the data and generates information for the customer. Customers provide feedback to the supplier depending on the information processed by the information system. Figure 1.1 shows the information system in business context. Fig. 1.1 The Information System in Business Context The information

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

24/190	SUBMITTED TEXT	27 WORDS	98%	MATCHING TEXT	27 WORDS

information system helps to manage and store information to perform various functions such as decision-making, documentation of business activities and generation of reports for analysis of organizational operations.

information system helps to manage and store information to perform various functions such as decision-making, documentation of business activities and generation of reports for the analysis of organizational operations.

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25/190	SUBMITTED TEXT	24 WORDS	89%	MATCHING TEXT	24 WORDS

raw material that can be a number, a fact, a sound, a picture or a statement gathered from different sources. In the real world

raw material that can be a number, a fact, a sound, a picture or a statement gathered from different sources. Data represent something that exists in the real world

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

26/190	SUBMITTED TEXT	55 WORDS	89%	MATCHING TEXT	55 WORDS

business processes and employee details. • Information is a meaningful data or a processed data. It defines the relation between different data. • System is a collection of components that helps in achieving a common objective. For example, in a human–machine system, the machine element consists of hardware and software to perform computation, and people make decisions based on this computation.

business processes and employee details. ?Information: It is a meaningful data or a processed data. It defines the relation between different types of data. ?System: It is a collection of components that help in achieving a common objective. For example, in a human-machine system, the machine element consists of hardware and software to perform computation and human makes decisions based on this computation. 1.2.1

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

27/190	SUBMITTED TEXT	78 WORDS	90%	MATCHING TEXT	78 WORDS

system consists of two types of components, abstract system components and physical system components. Abstract system components perform such operations as collecting input data, processing the data and generating information from that data. Physical system components consist of various elements such as hardware, software and human resources. There are a few more components of an information system, such as: • Data: Input that the system takes to produce information. • Hardware: A computer and its peripheral equipment such as input, output and storage devices. •

system consists of two types of components—abstract system components and physical system components. Abstract system components perform the operations such as collecting input data, processing the data and generating information from that data. Physical system components consist of various elements such as hardware, software and human resources. There are a few more components of the information system which are as follows: ?Data : These are the input that the system takes to produce information. ?Hardware : A computer and its peripheral equipment such as input, output and storage devices

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

28/190	SUBMITTED TEXT	83 WORDS	77%	MATCHING TEXT	83 WORDS

model represents relationships between variables, data represents the values of the variables under consideration and the solver is the tool that enables the computation of the variable values and their relationships. It has also been conceptualized in some literature as a procedure that works on data to provide an output after analysis. Model base A model base or a model base management system (MBMS) is a software that has the capabilities to manage a model for it to be useful to the decision-maker. It is the core of a DSS.

model represents relationships between variables, data represents the values of the variables under consideration and the solver is the tool that enables the computation of the variable values and their relationships. It has been also conceptualized in some literature as a procedure which works on the data to give an output after analysis. The model management subsystem has the following elements: • The Model Base Management System-A model base or rather a model base management system is software is conceptually like what the DBMS is to data which has the capabilities to manage a model for it to be useful to the decision maker. It is the core of a DSS.

W https://ecomputernotes.com/structure-and-classification

29/190	SUBMITTED TEXT	80 WORDS	73%	MATCHING TEXT	80 WORDS

set of instructions that process the input data using computers, generate information and store information for future use. • Network: A collection of computer systems connected to each other for communication to share the information. • Manpower: Information system professionals and users who perform various organizational operations such as analysis of information, designing and construction of the information system, and maintenance of the information system. The workforce could comprise IT experts, managers and workers. • Graphical User Interface (GUI): This is an interface for the users of

set of instructions that process the input data using computers, generate information and store information for future use. ? Network : It is a collection of computer systems connecting to each other for communication to share the information. ? Manpower : Information system professionals and users who perform various organizational operations such as analysis of information, designing and constructing information system and maintenance of information system. They may be IT experts, managers and workers. ?Graphical User Interface (GUI) : This is an interface for the users of

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30/190	SUBMITTED TEXT	87 WORDS	67%	MATCHING TEXT	87 WORDS

information system to work with information on the computer system. A user can operate, process and retrieve information from the computer storage using GUI. The components of an information system describe the functioning of the system. An information system takes input data from the users of the system to perform business operations. The users interact with the computer to process data using GUI. After the data has been processed, information is retrieved at the users' end. Figure 1.7 shows the basic information system to perform business operations. Figure 1.7 Basic Information System Self-Instructional Material 31

information system to work with information on the computer system. A user can operate, process and retrieve information from the computer storage using GUI. The components of information system describe the functioning of the system. An information system takes the input data from the users of the information system to perform the business operations. The users interact with the computer to process the data using GUI. After processing of data, the information is retrieved at the user's end. Figure 1.2 shows the basic information system to perform the business operations. Fig. 1.2 The Basic Information System 6 Self-Instructional Material

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31/190	SUBMITTED TEXT	14 WORDS	78%	MATCHING TEXT	14 WORDS

Summary 2.7 Key Terms 2.8 Answers to 'Check Your Progress' 2.9 Questions and Exercises 2.10 Further Reading 2.0 INTRODUCTION

Summary 5.8 Key Terms 5.9 Answers to 'Check Your Progress' 5.10 Exercises and Questions 5.11 Further Reading Introduction

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32/190	SUBMITTED TEXT	27 WORDS	95%	MATCHING TEXT	27 WORDS

information systems to create products and services that are custom-tailored to fit the precise specifications of individual customers. Dell Computer Corporation sells directly to customers using assemble-to- order manufacturing.

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33/190	SUBMITTED TEXT	9 WORDS	100%	MATCHING TEXT	9 WORDS

directly using a toll-free telephone number or Dell's

SA 346E2320-Managment Information System_178E1220-349E2330.pdf (D165442840)

34/190	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

UNIT OBJECTIVES After going through this unit, you will be able to: •

UNIT OBJECTIVES After going through this unit, you will be able to: ?

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

35/190 **SUBMITTED TEXT** 11 WORDS **100%** **MATCHING TEXT** 11 WORDS

the computer based on the configuration specified by the customer

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36/190 **SUBMITTED TEXT** 40 WORDS **85%** **MATCHING TEXT** 40 WORDS

An information system can have a strategic impact if it helps the firm provide products or services at a lower cost than its competitors, or if it provides products and services at the same cost as competitors but offers greater value.

SA 346E2320-Managment Information System_178E1220-349E2330.pdf (D165442840)

37/190 **SUBMITTED TEXT** 13 WORDS **91%** **MATCHING TEXT** 13 WORDS

Administration and Management: Electronic scheduling and messaging systems Human Resources: Workforce planning

SA 346E2320-Managment Information System_178E1220-349E2330.pdf (D165442840)

38/190 **SUBMITTED TEXT** 16 WORDS **MATCHING TEXT** 16 WORDS

support activities. Primary activities are most directly related to the production and distribution of a firm's products **83%**

SA 346E2320-Managment Information System_178E1220-349E2330.pdf (D165442840)

39/190 **SUBMITTED TEXT** 10 WORDS **100%** **MATCHING TEXT** 10 WORDS

margin of value to the firm's products or services.

SA 346E2320-Managment Information System_178E1220-349E2330.pdf (D165442840)

40/190 **SUBMITTED TEXT** 57 WORDS **82%** **MATCHING TEXT** 57 WORDS

An information system can have a strategic impact if it helps the firm provide products or services at a lower cost than its competitors or if it provides products and services at the same cost as its competitors but offers greater value. The activities that add most value to products and services depend on the features of each individual firm.

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41/190	SUBMITTED TEXT	23 WORDS	87%	MATCHING TEXT	23 WORDS

Businesses should try to develop strategic information systems for both internal and external value activities that add the most value. A strategic analysis

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42/190	SUBMITTED TEXT	24 WORDS	94%	MATCHING TEXT	24 WORDS

analysis might recommend a system to reduce marketing costs by targeting marketing campaigns more efficiently or by providing information for developing products more finely attuned to

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43/190	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

pool markets and expertise. Such relationships can lower costs and generate profits.

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44/190	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

to tie together the operations of disparate business units so that they can act as a whole.

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45/190	SUBMITTED TEXT	25 WORDS	82%	MATCHING TEXT	25 WORDS

Firms together comprise an industry, such as the automotive industry, telephone, television broadcasting and forest products industries. The key strategic question at this level of analysis

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46/190	SUBMITTED TEXT	21 WORDS	67%	MATCHING TEXT	21 WORDS

The three principal concepts of analysing strategy at the industry level are (i) information partnership, (ii) the Competitive Forces Model and (

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47/190	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

even link their information systems to achieve unique synergies. In

SA 346E2320-Managment Information System_178E1220-349E2330.pdf (D165442840)

48/190 **SUBMITTED TEXT** 29 WORDS **100%** **MATCHING TEXT** 29 WORDS

Such partnerships help firms gain access to new customers, creating new opportunities for cross-selling and targeting products. Companies that have been traditional competitors may find such alliances to be mutually advantageous.

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49/190 **SUBMITTED TEXT** 29 WORDS **100%** **MATCHING TEXT** 29 WORDS

a firm faces a number of external threats and opportunities: the threat of new entrants into its market, the pressure from substitute products or services, the bargaining power of customers

SA PAPER XIII - MANAGEMENT INFORMATION SYSTEM.pdf (D142213696)

50/190 **SUBMITTED TEXT** 26 WORDS **55%** **MATCHING TEXT** 26 WORDS

Such efforts increase efficiency at the industry level as well as the business level. It makes product substitution less likely and raises entry costs. Thus new entrants

SA 346E2320-Managment Information System_178E1220-349E2330.pdf (D165442840)

51/190 **SUBMITTED TEXT** 22 WORDS **93%** **MATCHING TEXT** 22 WORDS

Although the Internet can provide benefits such as new channels to customers and new operating efficiencies, firms cannot achieve competitive advantage unless they

SA 346E2320-Managment Information System_178E1220-349E2330.pdf (D165442840)

52/190 **SUBMITTED TEXT** 14 WORDS **100%** **MATCHING TEXT** 14 WORDS

Network Economics A third strategic concept useful at the industry level is network economics.

SA 346E2320-Managment Information System_178E1220-349E2330.pdf (D165442840)

53/190 **SUBMITTED TEXT** 11 WORDS **100%** **MATCHING TEXT** 11 WORDS

the more any given resource is applied to production the lower

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54/190 **SUBMITTED TEXT** 18 WORDS **100%** **MATCHING TEXT** 18 WORDS

the marginal gain in output, until a point is reached where the additional inputs produce no additional outputs.

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55/190 **SUBMITTED TEXT** 33 WORDS **98%** **MATCHING TEXT** 33 WORDS

according to Davis and Olson, is 'data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or prospective actions or decisions.'

According to Davis and Olson, ' Information data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or prospective actions or decisions.'

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56/190 **SUBMITTED TEXT** 35 WORDS **68%** **MATCHING TEXT** 35 WORDS

network economics, IT can be strategically useful. Internet sites can be used by firms to build communities of like-minded customers who want to share their experiences. This can promote loyalty, enjoyment and unique ties among customers. 2.3 INFORMATION

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57/190 **SUBMITTED TEXT** 14 WORDS **78%** **MATCHING TEXT** 14 WORDS

Summary 3.10 Key Terms 3.11 Answers to 'Check Your Progress' 3.12 Questions and Exercises 3.13 Further Reading 3.0 INTRODUCTION

Summary 5.8 Key Terms 5.9 Answers to 'Check Your Progress' 5.10 Exercises and Questions 5.11 Further Reading Introduction

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58/190 **SUBMITTED TEXT** 16 WORDS **81%** **MATCHING TEXT** 16 WORDS

UNIT OBJECTIVES After going through this unit, you will be able to: • Understand the features of

UNIT OBJECTIVES After going through this unit, you will be able to: ?Define the concept of

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

59/190 **SUBMITTED TEXT** 14 WORDS **75%** **MATCHING TEXT** 14 WORDS

is the smallest unit of data that has meaning for its users. Record is

is the smallest unit of the data that has meaning to its users and is

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60/190	SUBMITTED TEXT	21 WORDS	67%	MATCHING TEXT	21 WORDS

The three principal concepts of analysing strategy at the industry level are (i) information partnership, (ii) the Competitive Forces Model and (

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61/190	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

most directly related to the production and distribution of the firm's products

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62/190	SUBMITTED TEXT	10 WORDS	91%	MATCHING TEXT	10 WORDS

warehouse is a subject-oriented, integrated and non-volatile collection of data.

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63/190	SUBMITTED TEXT	15 WORDS	87%	MATCHING TEXT	15 WORDS

constraints in the system by adding appropriate codes in the application programs. However, when new constraints

constraints in the system by adding appropriate code in the various application programs. However, when new constraints

W https://mrcet.com/downloads/digital_notes/ECE/III%20Year/DATABASE%20MANAGEMENT%20SYSTEMS.pdf

64/190	SUBMITTED TEXT	12 WORDS	83%	MATCHING TEXT	12 WORDS

Definition of data is embedded in application programs rather than stored separately.

Definition of data was embedded in application programs, rather than being stored separately

W https://lechaamwe.weebly.com/uploads/2/6/6/5/26654545/gbs789nmodule_2015.pdf

65/190	SUBMITTED TEXT	17 WORDS	73%	MATCHING TEXT	17 WORDS

Database management system (DBMS) It is a software system that allows users to define, create and maintain

Database Management System(DBMS) o A software system that enables users to define, create, and maintain

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66/190	SUBMITTED TEXT	18 WORDS	58%	MATCHING TEXT	18 WORDS

If data is required to be shared among many users, the system must ensure that possible anomalous results

If data are to be shared among several users, the system must avoid possible anomalous results.

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67/190 **SUBMITTED TEXT** 20 WORDS **57%** **MATCHING TEXT** 20 WORDS

structured organization on data. A DBMS provides simple mechanisms for processing huge volumes of data because it is optimized for operations

SA MBA-Sem-I-IT Application for Managers.pdf (D143653178)

68/190 **SUBMITTED TEXT** 16 WORDS **68%** **MATCHING TEXT** 16 WORDS

to be stored in the database and the appropriate structure to represent and store that data.

SA lessons 1.docx (D130576007)

69/190 **SUBMITTED TEXT** 21 WORDS **61%** **MATCHING TEXT** 21 WORDS

users are users who interact with the system by invoking one of the permanent application programs that had been written previously

users are unsophisticated users who interact with the system by invoking one of the application programs that have been written previously.

W https://mrcet.com/downloads/digital_notes/ECE/III%20Year/DATABASE%20MANAGEMENT%20SYSTEMS.pdf

70/190 **SUBMITTED TEXT** 9 WORDS **95%** **MATCHING TEXT** 9 WORDS

American National Standards Institute/Standards Planning and Requirements Committee (ANSI/SPARC). The

American National Standards Institute/ Standards Planning and Requirements Committee (ANSI/SPARC) The

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71/190 **SUBMITTED TEXT** 10 WORDS **100%** **MATCHING TEXT** 10 WORDS

before the database is actually implemented and populated with data.

SA lessons 1.docx (D130576007)

72/190 **SUBMITTED TEXT** 12 WORDS **83%** **MATCHING TEXT** 12 WORDS

the lowest level of abstraction. It describes how data is actually stored

SA sree lekha project document.docx (D19942921)

73/190 **SUBMITTED TEXT** 28 WORDS **100%** **MATCHING TEXT** 28 WORDS

The internal view is expressed by the internal schema, which contains the definition of the stored record, the method of representing the data fields and the access aids used.

SA Practical approach to db system module 1.pptx (D110954076)

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74/190 **SUBMITTED TEXT** 15 WORDS **100%** **MATCHING TEXT** 15 WORDS

Each external view is described by means of a schema called an external schema or

SA Practical approach to db system module 1.pptx (D110954076)

75/190 **SUBMITTED TEXT** 11 WORDS **88%** **MATCHING TEXT** 11 WORDS

Query evaluation engine: It executes low-level instructions generated by the DML compiler.

Query evaluation engine, which executes low-level instructions generated by the DML compiler.

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76/190 **SUBMITTED TEXT** 12 WORDS **87%** **MATCHING TEXT** 12 WORDS

DML) statements embedded in an application program to normal procedure calls in

SA Practical approach to db system module 1.pptx (D110954076)

77/190 **SUBMITTED TEXT** 15 WORDS **90%** **MATCHING TEXT** 15 WORDS

The precompiler must interact with the query processor in order to generate an appropriate code.

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78/190 **SUBMITTED TEXT** 25 WORDS **76%** **MATCHING TEXT** 25 WORDS

is a program module that provides an interface between low-level data (stored in the database) and the application programs and queries which are submitted to the system.

SA Practical approach to db system module 1.pptx (D110954076)

79/190 **SUBMITTED TEXT** 16 WORDS **90%** **MATCHING TEXT** 16 WORDS

can be defined as the immunity of applications to change in the physical representation and access

can also be defined as the immunity of the application programs to change in the physical representation and access

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80/190 **SUBMITTED TEXT** 14 WORDS **78%** **MATCHING TEXT** 14 WORDS

a set of tables that are stored in a special file called data dictionary,

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81/190	SUBMITTED TEXT	33 WORDS	39%	MATCHING TEXT	33 WORDS

The values are atomic • Each row is unique • Column values are of similar type • Sequencing of columns is not significant • Sequencing of rows is not significant • Each column is given a unique name

The column Values are Atomic In Each Row is independent and unique. Column Values are of the same kind. The Sequence of Columns is Insignificant. Odisha State Open University Page 35 38 Sequence of Rows is Insignificant. Each Column Has a Unique Name

W https://docplayer.net/49707273-Diploma-in-computer-application-database-system-concepts.html

82/190	SUBMITTED TEXT	16 WORDS	90%	MATCHING TEXT	16 WORDS

in the database at a particular moment of time is called an instance, state or a

in the database at a particular moment of time is called an instance or a

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83/190	SUBMITTED TEXT	23 WORDS	46%	MATCHING TEXT	23 WORDS

always consistent with the current structure and definition, maintained automatically by the system itself. •••• Passive (Non-integrated): It is used only for documentation purposes and

always consistent with the current structure and definition of the database. Most of the RDBMS's maintain active data dictionaries. 2. Passive Data Dictionary : It is used only for documentation purposes and

W https://fliphtml5.com/pyiue/sfgj/basic

84/190	SUBMITTED TEXT	16 WORDS	65%	MATCHING TEXT	16 WORDS

is managed by users of the system. It also modifies whenever the structure of the database

is generally managed by the users of the system and is modified whenever the structure of the database

W https://fliphtml5.com/pyiue/sfgj/basic

85/190	SUBMITTED TEXT	20 WORDS	87%	MATCHING TEXT	20 WORDS

description of a database is called database schema, which is specified during database design and is expected not to change

SA lessons 1.docx (D130576007)

86/190	SUBMITTED TEXT	29 WORDS	75%	MATCHING TEXT	29 WORDS

A database schema includes such information as follows: • Characteristics of data items • Logical structure and relationship among those data items • Format for storage representation • Integrity parameters, authorization and backup

SA Practical approach to db system module 1.pptx (D110954076)

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87/190 **SUBMITTED TEXT** 23 WORDS **85%** **MATCHING TEXT** 23 WORDS

Data definition language A database scheme is specified by a set of definitions, which are expressed by a special language called Data Definition Language (

SA sree lekha project document.docx (D19942921)

88/190 **SUBMITTED TEXT** 17 WORDS **97%** **MATCHING TEXT** 17 WORDS

In most DBMSs, DDL also defines user views and sometimes, storage structures. In other DBMSs, separate languages

SA lessons 1.docx (D130576007)

89/190 **SUBMITTED TEXT** 12 WORDS **92%** **MATCHING TEXT** 12 WORDS

View Definition Language (VDL), is used to specify user views and their mappings.

View Definition Language (VDL) It is used to specify user's views and their mappings

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90/190 **SUBMITTED TEXT** 23 WORDS **62%** **MATCHING TEXT** 23 WORDS

the conceptual and internal schemas are seperated DDL is used to specify the conceptual schema, and SDL is used to specify the internal schema.

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91/190 **SUBMITTED TEXT** 18 WORDS **80%** **MATCHING TEXT** 18 WORDS

Once the schemas are compiled and the database is populated with data, users need to manipulate the database.

SA lessons 1.docx (D130576007)

92/190 **SUBMITTED TEXT** 27 WORDS **46%** **MATCHING TEXT** 27 WORDS

DML) is a language that allows users to access as well as manipulate data. Retrieving data from the database, inserting new data into the database and deleting or

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93/190 **SUBMITTED TEXT** 21 WORDS **85%** **MATCHING TEXT** 21 WORDS

could be used in an interactive mode or embedded in conventional programming languages such as Assembler, COBOL, C, C++ Pascal or

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94/190	SUBMITTED TEXT	27 WORDS	74%	MATCHING TEXT	27 WORDS

a combination of two technologies: (i) database technology and network and (ii) data communication technology. It provides the advantages of distributed computing to the field of database management.

a combination of two technologies: one is the database technology and other is network and data communication technology. DDBs provide the advantages of distributed computing to the field of database management.

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

95/190	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

components are interconnected by a computer network and work together to perform the

components are interconnected by a computer network and work together to perform the

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96/190	SUBMITTED TEXT	14 WORDS	84%	MATCHING TEXT	14 WORDS

are used for several reasons such as organizational decentralisation and cost-effective processing. The advantages of

are used for several reasons such as organizational decentralization and cost- effective processing. Some of the advantages of

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97/190	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

Increased reliability and availability Reliability is a measure of the possibility that

Increased reliability and availability : Reliability is a measure of the possibility that

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98/190	SUBMITTED TEXT	35 WORDS	98%	MATCHING TEXT	35 WORDS

time. On the other hand, availability is a measure of the possibility that the system is continuously serving the queries made to it during a time interval. When you use DDBs, which are spread over several

time point. On the other hand, availability is a measure of the possibility that the system is continuously serving the queries made to it during a time interval. When you use DDBs, which are spread over several

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

99/190	SUBMITTED TEXT	40 WORDS	67%	MATCHING TEXT	40 WORDS

continue to function normally. But the data and software that resides in the site which has failed cannot be accessed, without affecting the performance of the other sites in the distributed database. This quality improves reliability and availability. A distributed DBMS fragments the

continue to function normally. Only the data and software that resides on the failed site cannot be accessed without affecting the performance of other sites in the distributed database. This improves both reliability and availability. ? Improved performance : A distributed DBMS fragments the

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100/190 **SUBMITTED TEXT** 27 WORDS **67%** **MATCHING TEXT** 27 WORDS

The queries and transactions that access data from smaller databases perform better. In addition, when the database is fragmented into smaller databases, each site requires less overhead transaction

The queries and transactions accessing data at smaller databases have a better performance. In addition, when the database is fragmented into smaller databases, each site has less overhead of transaction

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

101/190 **SUBMITTED TEXT** 24 WORDS **80%** **MATCHING TEXT** 24 WORDS

is defined outside the application program or interactive session. Data is manipulated by procedure calls to subroutines provided by a DBMS or through preprocessor statements.

SA Practical approach to db system module 1.pptx (D110954076)

102/190 **SUBMITTED TEXT** 12 WORDS **100%** **MATCHING TEXT** 12 WORDS

the details of where each file is physically stored within the system.

SA V3_Data Base Technology_MCA ODL_Course Material_25.10.2021.doc (D116380835)

103/190 **SUBMITTED TEXT** 11 WORDS **100%** **MATCHING TEXT** 11 WORDS

warehouse is a subject-oriented, integrated, time-variant and non-volatile collection of data

SA 346E2320-Managment Information System_178E1220-349E2330.pdf (D165442840)

104/190 **SUBMITTED TEXT** 28 WORDS **64%** **MATCHING TEXT** 28 WORDS

database schema includes the following information: • Characteristics of data items • Logical structure and relationship among data items • Format for storage representation • Integrity parameters, authorization and backup policies 9.

database schema includes information as Characteristics of data items such as entities & attributes. Logical structure and relationship among data items. Format for storage representations. Integrity parameters such as physically authorization and backup policies.

W https://docplayer.net/49707273-Diploma-in-computer-application-database-system-concepts.html

105/190 **SUBMITTED TEXT** 14 WORDS **78%** **MATCHING TEXT** 14 WORDS

Summary 4.9 Key Terms 4.10 Answers to 'Check Your Progress' 4.11 Questions and Exercises 4.12 Further Reading 4.0 INTRODUCTION

Summary 5.8 Key Terms 5.9 Answers to 'Check Your Progress' 5.10 Exercises and Questions 5.11 Further Reading Introduction

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106/190 **SUBMITTED TEXT** 12 WORDS **100%** **MATCHING TEXT** 12 WORDS

UNIT OBJECTIVES After going through this unit, you will be able to: •

UNIT OBJECTIVES After going through this unit, you will be able to: ?

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107/190 **SUBMITTED TEXT** 12 WORDS **76%** **MATCHING TEXT** 12 WORDS

data in the data warehouse is identified by a specific time period.
Non-

SA 346E2320-Managment Information System_178E1220-349E2330.pdf (D165442840)

108/190 **SUBMITTED TEXT** 20 WORDS **67%** **MATCHING TEXT** 20 WORDS

Organizing the MIS personnel: The MIS department will be the
custodian of the system and hence it has to be

SA Sambalpur_MBA_SEM_1_Computer Application in Management_Merged.pdf (D156214882)

109/190 **SUBMITTED TEXT** 12 WORDS **100%** **MATCHING TEXT** 12 WORDS

The participation constraint specifies whether the existence of
an entity depends on

SA lessons 1.docx (D130576007)

110/190 **SUBMITTED TEXT** 13 WORDS **100%** **MATCHING TEXT** 13 WORDS

It represents the flow of data from one stage to another stage. It represents the flow of data from one stage to another stage

W https://vou.ac.in/slm/mba/MBA-203-Mgnt%20Info.System.pdf

111/190 **SUBMITTED TEXT** 12 WORDS **83%** **MATCHING TEXT** 12 WORDS

the existence of an entity depends on its relation to another
entity. •

SA lessons 1.docx (D130576007)

112/190	SUBMITTED TEXT	30 WORDS	27%	MATCHING TEXT	30 WORDS

a > b? Let a = b + c YES NO Is b > c? Let a = a + c Is a > b? NO YES Let a = a + c Let a = b + c YES NO Is b > c? Let a = a + c (a)

A 9 56 B " 9 55 % ? +C 9 58 ! ! - 3 1 ! 5 ",. ""/ : 6 : 5 &$7 : 8 ' : 9 ' : 9 5 ! : : !)- : ; % , : > %) < ? : = : @ B " : A % ? +C : 56 ! ! . ! 5 1 3 7 ""* ")" ; 6 ; 5 &$7 ; 8 - 4 4 * 4 * 4 & 4 ; 8 5 + % ; 9 + , - 4 !) ; : %) < ? ; ; ; > B " ; = % ? +C ; @ ! ! / 3 1 3 7 ")& "-) > 6 > 5 &$7 > 8 - !) > 9 + > 9 5 > : %) < ? > ; > > B " > = % ? +C > @ ! ! * 7 ! 3 1 3 "-- ".* = 6 = 5 &$7 = 8 - = 8 5 = 8 8 = 9 . / +) = : %) < ? = ; = > B " = = % ? +C = @ ! # ! 3 3 5 2 ! 5 ! + ! 3 7 34 ".+ "*" @ 6 @ 5 &$7 @ 8 ' 0 # @ 8 5 @ 8 8 % @ 9 @ : 1 @ ; %) < ? @ > @ = B " @ @ % ? +C @ A ! ! 0 !1 !3 7 ! 5 "*& "+/ A 6 A 5 &$7 A 8 A 8 5 % $ + A 9 A : & 0 A ; %) < ? A > A = B " A @ % ? +C A A ! ! ", ! 5 7 4 3 "+* &"- 56 6 56 5 &$7 56 8 - & , ! 56 8 5 ! 56 8 8 56 8 9 56 9 " 56 : " 56 ; 56 ; 5 56 ; 8 56 ; 9 56 ; : # 56 > & 0 56 = %) < ? 56 @ 56 A B " 56 56 % ? +C 56 55 ! # 3 !3 2 3 ! "" 3 !3 &". &&+ 55 6 55 5 &$7 55 8 ' 0 + 2 % 55 9 2 55 9 5 2 % $ 55 : ' 2 1) 55 ; %) < ? 55 > 55 = B " 55 @ % ? +C 55 A ! ! "& ! 3 3 5 &&0 &)+ 58 6 58 5 &$7 58 8 % & 58 9 # 58 9 5 58 9 8 + + 58 : %) < ? 58 ; 58 > B " 58 = % ? +C 58 @ ! 4# ! 5 2 1! !3 1 ! ") 3 ! 5 &)0 &-0 59 6 59 5 &$7 59 8 - % & 59 8 5 ! 59 8 8 # 2) 59 8 9 $ 2 59 8 : $ 59 8 ; 59 8 > + $ 59 9 2 59 9 5 3# 3 $ 3 % 59 : %) < ? 59 ; 59 > B " 59 = % ? +C 59 @ ! 5: 6 5: 5 &$7 5: 8 ! 5: 9 5: : 5: ; ! 5: > - % 5: > 5 1 $ - & % 5: > 8 &2 &2% 5: > 9 - % % 5: > : 5: > ;) 5: > > 5: > = ? 2 . ?2/ 5: > @ 5: > A % 5: = %) < 5: @ 5: A B 5: 56 % ? +C 5: 55 ! !" # ! # ! $! % & ! ' (#) # ! ' (# # ! $ # # & *) #) ! %) ! ! &# # ! & + $ # ! & ! $! ,!" + + & - . / (0 +0 1 2% 3 4 % ! ! " # $! % & ' & ( ) * + , - & . / $$ 0 1 2 * $. #3 4 5 & ! & $ 6 !7 $ $ & $ 8 +9 9 8 & $ & $ 6 7 2 $ $ & 8 $ & $ & & #3 $ $ & & $: $ $ $ & $ & $ $ $ & $ & : 8 $ $ & ; 8 $ 9; (& 8 & & & $ 8 $ $ $ + $ & & $ $ + * & & & 8 > = #3 = (& $ & $ = ($! = #3 $ $! = 5 & : & ! 0%/8 < 4 & & $ $ $ $? $ 2 & & + & @ > ! & $ & $ + & & $ $ 8 $ 8 $ 8 $; $ $ + $ & $ & 8 8 & : $ $ $ & $ 4 $ + $ $ 8 $ 8 $ 8 $ $ $ & & $ $ 8 4 $ $ $ $ 2 $ & & & $ 8 & 8 & + 8 $ & & A $ 8 & 9 & & $ 8 $ $ + & $ 8 & 8 & & $ & + # & &

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113/190	SUBMITTED TEXT	34 WORDS	84%	MATCHING TEXT	34 WORDS

Implementation as an activity has to be carefully managed. It requires client interaction at every stage. The implementers need the cooperation of the client and their developers to successfully execute the implementation of information systems.

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114/190 **SUBMITTED TEXT** 13 WORDS **100%** **MATCHING TEXT** 13 WORDS

Setting timelines for critical and non-critical activities • Identifying major bottlenecks and their solutions

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115/190 **SUBMITTED TEXT** 39 WORDS **75%** **MATCHING TEXT** 39 WORDS

to understand the time frame for installing the new system. Communication plays a vital role in implementation, and without proper communication from senior management on the installation and implementation of the new system, management of change is difficult. Resistance to change-related issues

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116/190 **SUBMITTED TEXT** 26 WORDS **66%** **MATCHING TEXT** 26 WORDS

them mentally for change. The communication should be formal so that rumours cannot be spread about the system. The communication process can take place in several phases.

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117/190 **SUBMITTED TEXT** 52 WORDS **61%** **MATCHING TEXT** 52 WORDS

the new system will tackle, and leave detailed briefings to division heads. The communication process also indirectly indicates the role each employee is required to play in the implementation process. 3. Organizing the MIS Department The MIS department is the custodian of the new system. Hence, it has to get organized to support the new system.

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118/190 **SUBMITTED TEXT** 21 WORDS **84%** **MATCHING TEXT** 21 WORDS

department is therefore necessary before the new system becomes operational. The roles of MIS department members have to be clearly laid out.

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119/190	SUBMITTED TEXT	25 WORDS	68%	MATCHING TEXT	25 WORDS

so that they can help others. This process begins much before the actual implementation process, as it entails some hiring and training. Thus lead time

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120/190	SUBMITTED TEXT	23 WORDS	62%	MATCHING TEXT	23 WORDS

when the implementation process starts. It also enables the MIS staff to understand the new system as they get hands-on experience in its implementation. 4.

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121/190	SUBMITTED TEXT	57 WORDS	32%	MATCHING TEXT	57 WORDS

that the organization gets the best deal. This process of selection and procurement varies greatly with each firm, depending on its size, the industry in which it operates and its management. However, typically, the following procedure is followed: • Preparing a vendor list: A list of reliable vendors is prepared after analysing the organization's experience with various vendors or based on

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122/190 **SUBMITTED TEXT** 176 WORDS **70%** **MATCHING TEXT** 176 WORDS

list of vendors prepared by an organization of repute or a regulatory body. The selected vendors are chosen after a careful check of their credentials and goodwill in the market. This is essential, as the vendor relationship is based on trust and compromise and not only on the basis of strict commercial terms. • Preparing the request for proposal: The implementation team prepares the request for proposal (RFP) document based on its understanding of the hardware required to run the new system. The RFP must contain technical details about the required hardware systems, including specifications, make, performance expectations, warranty and service quality requirements. This document is prepared by the implementers in consultation with the development team, the management of the organization and the MIS team, so that the need for each specification is well established and there is no scope for dissent. The consultative process results in the RFP technical document. The RFP also includes commercial details, which the implementation team prepares in consultation with the management of the organization. The RFP is a quasi-legal document in some countries, and legal opinion is normally sought before sending it to the enlisted vendors.

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123/190 **SUBMITTED TEXT** 46 WORDS **50%** **MATCHING TEXT** 46 WORDS

to vendors: After the RFP is prepared, it is sent to the selected set of vendors. The mode of communication could be an advertisement in print or electronic media or a letter, with a deadline for submission of proposals. • Evaluating the RFP: This could be a difficult

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124/190 **SUBMITTED TEXT** 61 WORDS **81%** **MATCHING TEXT** 61 WORDS

of cost and quality. A score-based system of evaluation is used to rank vendors' proposals. Scores are assigned to each attribute of a vendor's proposal, such as cost, goodwill, track record and service quality guarantee. Based on the weightage given to each attribute, a composite score is prepared, which is used to evaluate the proposals. Whatever the methodology for evaluating the proposal, the same evaluation criteria

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125/190 **SUBMITTED TEXT** 16 WORDS **90%** **MATCHING TEXT** 16 WORDS

vendor: Based on the evaluation, a single vendor or a select set of vendors, is chosen

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126/190 **SUBMITTED TEXT** 15 WORDS **100%** **MATCHING TEXT** 15 WORDS

hardware. Contract negotiations and price negotiations are held with this select group of vendors, and

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127/190 **SUBMITTED TEXT** 16 WORDS **90%** **MATCHING TEXT** 16 WORDS

Creating the Database The new system will have data stores. In modern systems, data stores are

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128/190 **SUBMITTED TEXT** 46 WORDS **72%** **MATCHING TEXT** 46 WORDS

a separate application software package. The database and its structures, such as tables and queries, have to be created to enable it to store data. The implementation team creates the database, its structures and rules, so that the information system being implemented can be plugged into the database and

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129/190 **SUBMITTED TEXT** 84 WORDS **72%** **MATCHING TEXT** 84 WORDS

to understand the training needs of the users. A training programme is then planned and users are trained. This is an important part of the implementation process and enables a reduction in the resistance to change within the user community. Training also enables users to appreciate the new features of the new system and build trust in and appreciation for the new system. 8. Creating Physical Infrastructure The new system may require physical infrastructure. The implementation team ensures that system performance does not suffer due to infrastructure bottlenecks. The implementers have to

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to the New System Transition is the last step in the implementation process. If not done

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131/190 **SUBMITTED TEXT** 20 WORDS **60%** **MATCHING TEXT** 20 WORDS

of Information Technology in other Areas 5.3 Summary 5.4 Key Terms 5.5 Answers to 'Check Your Progress' 5.6 Questions and Exercises 5.7 Further Reading 5.0

of Information System in Decision-Making 3.4 Summary 3.5 Key Terms 3.6 Answers to 'Check Your Progress' 3.7 Exercises and Questions 3.8 Further Reading

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132/190 **SUBMITTED TEXT** 16 WORDS **81%** **MATCHING TEXT** 16 WORDS

UNIT OBJECTIVES After going through this unit, you will be able to: • Understand the application of

UNIT OBJECTIVES After going through this unit, you will be able to: ?Define the concept of

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133/190 **SUBMITTED TEXT** 57 WORDS **80%** **MATCHING TEXT** 57 WORDS

It is necessary to move slowly on the transition front. After the new system is installed and ready, the new system and the old system are both used for some time to ensure that the company performance does not suffer due to transition problems. As the users become more comfortable with the new system, the old one is phased out. 4.8

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134/190 **SUBMITTED TEXT** 9 WORDS **41%** **MATCHING TEXT** 9 WORDS

Databases of internal data Databases of external data Manufacturing DSS Business transactions Business transactions Business transactions Internet or Extranet Transaction processing systems Manufacturing applications databases Manufacturing ES Manufacturing MIS Operational databases

Databases of internal data Databases of external data Manufacturing DSS Business transactions Databases of valid transactions for each TPS Manufacturing applications databases Transaction processing systems Manufacturing MIS Business transactions Operational databases

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135/190 **SUBMITTED TEXT** 14 WORDS **78%** **MATCHING TEXT** 14 WORDS

Summary 6.4 Key Terms 6.5 Answers to 'Check Your Progress' 6.6 Questions and Exercises 6.7 Further Reading 6.0 INTRODUCTION

Summary 5.8 Key Terms 5.9 Answers to 'Check Your Progress' 5.10 Exercises and Questions 5.11 Further Reading Introduction

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136/190	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

organization. 6.1 UNIT OBJECTIVES After going through this unit, you will be able to: •

organization. 1.1 UNIT OBJECTIVES After going through this unit, you will be able to: ?

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137/190	SUBMITTED TEXT	28 WORDS	94%	MATCHING TEXT	28 WORDS

In the mainframe and minicomputer environment, each user is connected to the main system through a dumb terminal that is unable to perform any of its own processing tasks.

In the mainframe and minicomputer environment, each user is connected to the main system through a dumb terminal is unable to perform any of its own processing tasks. ?

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138/190	SUBMITTED TEXT	59 WORDS	93%	MATCHING TEXT	59 WORDS

this type of computerization has its merits, the major disadvantage is that the system can easily get overloaded as the number of users, and consequently, terminals increase. Second, most of the information is centralized to one group of people, the systems professionals, rather than the end-users. This type of centralized processing system differs from the distributed processing system used by LANs. In

this type of computerization has its merits but the major disadvantage is that the system could get easily overloaded as the number of users and consequently terminals increase. Second, most of the information is centralized to one group of people, the systems professionals rather than the end-users. This type of centralized processing system differs from the distributed processing system used by LANs. In

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139/190	SUBMITTED TEXT	29 WORDS	90%	MATCHING TEXT	29 WORDS

distributed processing system, most of the processing is done in the memory of the individual PCs or workstations. Besides they share expensive computer resources like software, disk files, printers and plotters, etc.

distributed processing system, most of the processing is done in the memory of the individual PCs or workstations besides sharing expensive computer resources like software, disk files, printers and plotters, etc.

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140/190	SUBMITTED TEXT	30 WORDS	94%	MATCHING TEXT	30 WORDS

point-to-point manner. The point-to-point scheme provides separate communication channels for each pair of computers. When more than two computers need to communicate with one another, the number of connections grow quickly as

point- to-point manner. The point-to-point scheme provides separate communication channels for each pair of computers. When more than two computers need to communicate with one another, the number of connections grows very quickly as

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141/190	SUBMITTED TEXT	52 WORDS	83%	MATCHING TEXT	52 WORDS

number of computers increase. Figure 6.1 illustrates that two computers need only one connection, three computers need three connections and four computers need six connections. Figure 6.1 illustrates that the total number of connections grow more rapidly than the total number of computers. Mathematically, the number of connections needed for N computers is proportional to square

number of computer increases. Figure 4.9 illustrates that two computers need only one connection, three computers need three connections and four computers need six connections. 98Self-Instructional Material Overview of Data Communication NOTES Figure 4.9 illustrates that the total number of connections grows more rapidly than the total number of computers. Mathematically, the number of connections needed for N computers is proportional to the square

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142/190	SUBMITTED TEXT	9 WORDS	82%	MATCHING TEXT	9 WORDS

Quality control reports Process control reports JIT reports MRP reports Production schedule CAD output

Quality control reports Manufacturing ES Process control reports Internet or Extranet JIT reports MRP reports Production schedule CAD output

W https://slideplayer.com/slide/12550099/

143/190	SUBMITTED TEXT	58 WORDS	97%	MATCHING TEXT	58 WORDS

Point-to-point connections required = (N 2 –N)/2 Figure 6.1 (a), (b), (c) Number of Connections for 2, 3, 4 Computers, Respectively Adding the Nth computer requires N–1 new connections, which becomes a very expensive option. Moreover, many connections may follow the same physical path. Figure 6.2 shows a point-to-point connection for five computers located at two different locations, say,

Point-to-point connections required = (N 2 – N)/2. Fig. 4.9 (a), (b), (c) Number of Connections for 2, 3, 4 Computers, Respectively Adding the Nth computer requires N-1 new connections which becomes a very expensive option. Moreover, many connections may follow the same physical path. Figure 4.10 shows a point-to-point connection for five computers located at two different locations, say,

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144/190	SUBMITTED TEXT	13 WORDS	87%	MATCHING TEXT	13 WORDS

first floor of a building. Figure 6.2 Five PCs at Two Different Locations

first floor of a building. Fig. 4.10 Five PCs at Two Different Locations

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145/190	SUBMITTED TEXT	23 WORDS	100%	MATCHING TEXT	23 WORDS

a connection to other networks either through a computer, which is attached to both networks, or through a dedicated device called a gateway.

a connection to other networks either through a computer, which is attached to both networks, or through a dedicated device called a gateway.

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146/190	SUBMITTED TEXT	35 WORDS	57%	MATCHING TEXT	35 WORDS

LAN technology connects people and machines within a site. A local area network is a network that is confined to a relatively small area as shown in Figure 6.3. LANs are described as privately owned networks

LAN technology connects people and machines within a site. A LAN is a network that is restricted to a relatively small area as shown in Figure 4.35. LANs can be defined as privately owned networks

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147/190 **SUBMITTED TEXT** 106 WORDS **89%** **MATCHING TEXT** 106 WORDS

an office, a building, complex of buildings, and a school campus. A LAN is a form of local (limited distance), shared packet network for computer communications. LANs interconnect computers and peripherals over a common medium so that users share host computers, databases, files, applications and peripherals. They can also provide a connection to other networks either through a computer which is attached to both networks, or through a dedicated device called a gateway. Figure 6.3 Local Area Network (LAN) The components used by LANs can be divided into cabling standards, hardware, and protocols. The various LAN protocols are Ethernet, Token Ring, TCP/IP, SMB, NetBIOS and NetBeui, IPX/SPX, Fibre Distributed Data Interchange (FDDI) and Asynchronous Transfer Mode (ATM).

an office, a building, a complex of buildings, a school or a campus. A LAN is a form of local (limited-distance), shared packet network for computer communications. LANs interconnect computers and peripherals over a common medium so that users are able to share access to host computers, databases, files, applications, and peripherals. They can also provide a connection to other networks either through a computer, which is attached to both networks, or through a dedicated device called a gateway. Fig. 4.35 Local Area Network (LAN) The components used by LANs can be categorized into hardware, cabling standards and protocols. The various LAN protocols are Ethernet, Token Ring, TCP/ IP, SMB, NetBIOS and NetBeui, IPX/SPX, Fibre Distributed Data Interchange (FDDI) and Asynchronous Transfer Mode (ATM).

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148/190 **SUBMITTED TEXT** 49 WORDS **70%** **MATCHING TEXT** 49 WORDS

Metropolitan Area Network (MAN) covers large geographic areas such as cities or districts. By interconnecting smaller networks within a large geographic area, information is easily disseminated throughout the network. Local libraries and government agencies often use a MAN to connect with citizens and private industries. It may also connect MANs together within

Metropolitan Area Network (MAN) A MAN covers large geographic areas such as towns, cities or districts. By linking or interconnecting smaller networks within a large geographic area, information is conveniently distributed throughout the network. Local libraries and government agencies often use a MAN to establish a link with private industries and citizens. A MAN may also connect many MANs together within

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149/190 **SUBMITTED TEXT** 23 WORDS **100%** **MATCHING TEXT** 23 WORDS

a LAN. The geographical limit of a MAN may span a city. Figure 6.5 depicts how a MAN may be available within a city.

a LAN. The geographical limit of a MAN may span a city. Figure 4.36 depicts how a MAN may be available within a city. 130

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150/190 **SUBMITTED TEXT** 36 WORDS **91%** **MATCHING TEXT** 36 WORDS

Metropolitan Area Network (MAN) In MAN, different LANs are connected through a local telephone exchange. Some of the widely used protocols for MAN are RS-232, X.25, Frame Relay, Asynchronous Transfer Mode, ISDN, OC-3 lines (155 Mbps), Asymmetrical Digital

Metropolitan Area Network (MAN) In MAN, different LANs are connected through a local telephone exchange. Some of the widely used protocols for MAN are RS-232, X.25, Frame Relay, Asynchronous Transfer Mode (ATM), ISDN (Integrated Services Digital Network), OC-3 Mbps), ADSL (Digital

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151/190 **SUBMITTED TEXT** 12 WORDS **100%** **MATCHING TEXT** 12 WORDS

etc. These protocols are quite different from those used for LANs. Wide Area Network

etc. These protocols are quite different from those used for LANs. Wide Area Network (

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152/190	SUBMITTED TEXT	75 WORDS	88%	MATCHING TEXT	75 WORDS

the world. The geographical limit of WAN is unlimited. Dedicated transoceanic cabling or satellite uplinks may be used to connect this type of network. Hence, a WAN may be defined as a data communications network that covers a relatively broad geographic area to connect LANs between different cities with the help of transmission facilities provided by common carriers, such as telephone companies. WAN technologies function at the lower three layers of the OSI reference model. These are the physical

the world. The geographical limit of a WAN is unlimited. Dedicated transoceanic cabling or satellite uplinks may be used to connect this type of network. Hence, a WAN may be defined as a data communications network covering a relatively broad geographical area to connect LANs together between different cities with the help of transmission facilities provided by such common carriers as telephone companies. WAN technologies operate at the lower three layers of the OSI reference model. These are the physical

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153/190	SUBMITTED TEXT	18 WORDS	97%	MATCHING TEXT	18 WORDS

WAN, which connects many LANs together. It also uses switching technology provided by local exchange and long distance

WAN, which connects many LANs together. It also uses the switching technology provided by local exchange and long distance

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154/190	SUBMITTED TEXT	70 WORDS	79%	MATCHING TEXT	70 WORDS

Wide Area Network (WAN) Packet switching technologies, such as Asynchronous Transfer Mode , Frame Relay, Switched Multimegabit Data Service (SMDS) and X.25 are used to implement WAN along with statistical multiplexing to enable devices to share these circuits. The difference between MAN and WAN may be understood only from the services being used by them. WAN uses both local and long-distance carriers while MAN uses only a local carrier. Hardware and protocols are same for both.

Wide Area Network (WAN) Packet switching technologies such as Asynchronous Transfer Mode (ATM), Switched Multimegabit Data Service (SMDS), Frame Relay and X.25 are used to implement WAN along with statistical multiplexing to allow devices to use and share these circuits. The difference between MAN and WAN may be understood only from the services that they use. WAN uses both the local and long distance carrier while MAN uses only a local carrier. Hardware and protocols are the same for both.

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155/190	SUBMITTED TEXT	46 WORDS	92%	MATCHING TEXT	46 WORDS

Analog and Digital Signals Data communications and networks deal with data or information transmission. Data can be represented in many ways such as a human voice, a group of numbers, images, text and sounds, etc. There are two ways to communicate, display, store or manipulate information. These are: • Analog • Digital

Analog and Digital Communication Data communication and networks deal with data or information transmission. Data can be represented in many ways, such as a human voice, a bunch of numbers, images, text and sounds, etc. There are two ways to communicate, display, store or manipulate information. These are as follows: ?Digital

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156/190	SUBMITTED TEXT	14 WORDS	78%	MATCHING TEXT	14 WORDS

Analogous variations in electrical or radio waves are created in order to transmit the

Analogous variations in radio or electrical waves are created in order to transmit the

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157/190 **SUBMITTED TEXT** 27 WORDS **100% MATCHING TEXT** 27 WORDS

information signal for video or audio or both, over a network from a transmitter (TV station or CATV source) to a receiver (TV set, computer connected with antenna).

information signal for video or audio or both over a network from a transmitter (TV station or CATV source) to a receiver (TV set, computer connected with antenna).

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158/190 **SUBMITTED TEXT** 102 WORDS **78% MATCHING TEXT** 102 WORDS

Information which is analog in its native form (audio and image) can vary continuously in terms of intensity (volume or brightness) and frequency (tone or colour). Those variations in the native information stream are translated in an analog electrical network into variations in the amplitude and frequency of the carrier signal. In other words, the carrier signal is modulated (varied) in order to create an analog of the original information stream. The electromagnetic sinusoidal (waveform) or sine wave can be varied in amplitude at a fixed frequency, using Amplitude Modulation (AM). Alternatively, the frequency of the sine wave can be varied at constant amplitude using Frequency Modulation (FM). Additionally, both

Information that is analogue in its native form (image and audio) can vary continuously in terms of intensity (brightness or volume) and frequency (color or tone), as shown in Figures 4.2 and 4.3. These variations in the native information stream are translated, in an analogue electrical network, into variations in the frequency and amplitude of the carrier signal. In other words, the carrier signal is modulated (varied) in order to create an analogue of the original information stream. The electromagnetic sinusoidal waveform or sine wave as shown in Figure 4.4 can be varied in amplitude at a fixed frequency, using Amplitude Modulation (AM). Alternatively, the frequency of the sine wave can be varied at constant amplitude, using Frequency Modulation (FM). Additionally, both

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159/190 **SUBMITTED TEXT** 15 WORDS **100% MATCHING TEXT** 15 WORDS

information in binary form, i.e., in the combination of 1s and 0s, which has

information in binary form, i.e., in the combination of 1s and 0s, which has

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160/190 **SUBMITTED TEXT** 30 WORDS **94% MATCHING TEXT** 30 WORDS

computer language. A binary digit (bit) is an individual 1 or 0. Multiple bit streams are used in a computer network. Contemporary computer systems communicate in binary mode through variations in

computer language. A binary digit (bit) is an individual 1 or 0. Multiple bit streams are used in a computer network. The computer systems communicate in binary mode through variations in

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161/190 **SUBMITTED TEXT** 44 WORDS **88% MATCHING TEXT** 44 WORDS

Digital signalling, in an electrical network, involves a signal which varies in voltage to represent one of two discrete and well-defined states, such as either a positive (+) voltage and a nill or zero (0) voltage (unipolar) or a positive (+) or a negative (–) voltage (bipolar).

digital signaling, in an electrical network, involves a signal which varies in voltage to represent one of two discrete and well-defined states as depicted in Figure 4.7, such as either a positive (+) voltage and a null or zero (0) voltage (unipolar) or a positive (+) or a negative (–) voltage (bipolar).

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162/190	SUBMITTED TEXT	14 WORDS	82%	MATCHING TEXT	14 WORDS

and digital data can be converted to analog, each format has its own advantages. 6.3

and digital data can be converted to analogue, even then, each format has its own advantages.

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163/190	SUBMITTED TEXT	28 WORDS	94%	MATCHING TEXT	28 WORDS

In the mainframe and minicomputer environment, each user is connected to the main system through a dumb terminal that is unable to perform any of its own processing tasks.

In the mainframe and minicomputer environment, each user is connected to the main system through a dumb terminal is unable to perform any of its own processing tasks. ?

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164/190	SUBMITTED TEXT	14 WORDS	78%	MATCHING TEXT	14 WORDS

Summary 7.5 Key Terms 7.6 Answers to 'Check Your Progress' 7.7 Questions and Exercises 7.8 Further Reading 7.0 INTRODUCTION

Summary 5.8 Key Terms 5.9 Answers to 'Check Your Progress' 5.10 Exercises and Questions 5.11 Further Reading Introduction

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165/190	SUBMITTED TEXT	16 WORDS	78%	MATCHING TEXT	16 WORDS

The Internet is a global system of interconnected computer networks, which uses the standard protocol suite

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166/190	SUBMITTED TEXT	16 WORDS	78%	MATCHING TEXT	16 WORDS

Internet and the WWW. 7.1 UNIT OBJECTIVES After going through this unit, you will be able to: •

Internet services and applications. 4.1 UNIT OBJECTIVES After going through this unit, you will be able to: ?

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167/190	SUBMITTED TEXT	89 WORDS	75%	MATCHING TEXT	89 WORDS

The role of the Internet can be seen in the areas of education, economic productivity, healthcare, quality of life, etc. There are several other areas where the the Internet can contribute largely. In the area of education, this can contribute by way of shared databases, organization of conferences, circulation of papers and discussion, collaborative research and writing undertaken, web-based registration, online digital library privileges, other online learning facilities like virtual classrooms and information regarding courses, and so on. Economic productivity may be increased as the Internet run over telephone infrastructure at relatively marginal cost,

The role of Internet can be seen in the area of education, economic productivity, healthcare, democracy and human rights and quality of life, etc. There are several more areas where the Internet can make contributions. In the area of education, the Internet can contribute by way of shared databases, organization of conferences, circulation of papers and discussion, collaborative research and writing undertaken, web-based registration, online digital library privileges, other online learning facilities like virtual classrooms and information regarding courses and so forth. Economic productivity may be enhanced as the Internet that runs over telephone infrastructure at a relatively marginal cost,

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168/190	SUBMITTED TEXT	41 WORDS	54%	MATCHING TEXT	41 WORDS

provides increased economic benefit. The Internet enables global communication with suppliers and customers, etc. This can help to open global markets to developing nations. In this manner, the Internet has facilitated the opening up of e-commerce. The Internet is being effectively utilized in

provides more economic advantage. The Internet enables global communication with suppliers and customers, etc. This can open global markets to the developing countries. In this manner, the Internet has facilitated the opening of 132Self-Instructional Material Overview of Data Communication NOTES e-commerce. The Internet is being effectively utilized in

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169/190	SUBMITTED TEXT	39 WORDS	76%	MATCHING TEXT	39 WORDS

the health sector. The rapid growth of the Internet and related areas like switched leased lines, terrestrial and satellite packet radio and videoconferencing, etc., has led to the development of telemedicine. One may expect the Internet to encourage democracy by providing

the health sector. The rapid growth of the Internet and its related areas like switched leased lines, terrestrial and satellite packet radio and videoconferencing, etc., has lead to the development of telemedicine. The Internet is expected to encourage democracy by providing

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170/190	SUBMITTED TEXT	23 WORDS	83%	MATCHING TEXT	23 WORDS

to share ideas and coordinate political activity within their nations. The Internet may force transparency in administrations and therefore, may be considered a catalyst

to share ideas and coordinate political activity within their countries. The internet may force transparency in the administration and therefore, may be considered as a catalyst

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171/190	SUBMITTED TEXT	23 WORDS	84%	MATCHING TEXT	23 WORDS

consists of millions of private, public, academic, business, and government networks, which are linked by a broad array of electronic, wireless and optical networking technologies.

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172/190	SUBMITTED TEXT	14 WORDS	82%	MATCHING TEXT	14 WORDS

The Internet may force transparency in administrations and therefore, may be considered a catalyst

The internet may force transparency in the administration and therefore, may be considered as a catalyst

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173/190	SUBMITTED TEXT	23 WORDS	63%	MATCHING TEXT	23 WORDS

Creating a Control Environment 8.5.4 Ensuring System Quality 8.5.5 Software Quality 8.6 Summary 8.7 Key Terms 8.8 Answers to 'Check Your Progress' 8.9 Questions and Exercises 8.10 Further Reading 8.0

Creating a Control Environment 2.6.4 Protecting the Digital Firm 2.6.5 Ensuring the System Quality 2.6.6 Software Quality Assurance Tools 2.6.7 Analysing Security Vulnerabilities 2.7 Summary 2.8 Key Terms 2.9 Answers to 'Check Your Progress' 2.10 Exercises and Questions 2.11 Further Reading

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174/190	SUBMITTED TEXT	17 WORDS	80%	MATCHING TEXT	17 WORDS

Search Engines A search engine is a software system that enables users to search for information on the

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175/190	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

UNIT OBJECTIVES After going through this unit, you will be able to: •

UNIT OBJECTIVES After going through this unit, you will be able to: ?

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176/190	SUBMITTED TEXT	14 WORDS	62%	MATCHING TEXT	14 WORDS

DECISION SUPPORT SYSTEMS A decision support system is an information system, which assists in decision-making

Decision Support System (DSS) A decision support system (DSS) is an information system application that assists decision-making.

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177/190	SUBMITTED TEXT	58 WORDS	95%	MATCHING TEXT	58 WORDS

Components of DSS Even though DSS can be of several types, fundamentally each DSS will have the following components: • Interactive User–System Dialog Management Subsystem: DSS requires continuous user interaction. Sometimes, the system should prompt the user to give an input at other times the user should be able to control the process. A typical user-system dialog management subsystem will have the following elements:

Components of DSS Even though DSS can be of several types, fundamentally each DSS will have the following components: • Interactive User-System Dialog Management Subsystem-DSS requires continuous user interaction. Sometimes the system should prompt the user to give an input at other time the user should be able to control the processing. A typical user system dialog management subsystem will have the following elements: •

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178/190	SUBMITTED TEXT	97 WORDS	95%	MATCHING TEXT	97 WORDS

User Interface: The user interface of a DSS has to be dynamic and GUI- based. It has to be an easy-to-use user interface as most of the people who will be using it are not technical experts but management experts (top management) and hence the interface should be minimalist in design. Also, the system should be able to interact with the user in an interactive mode and hence, the user interface has to be dynamic. o Request Constructor: Since DSS works on an interactive dynamic mode, it needs a request constructor (incorporating aspects of Language Query Interface) which can convert the user's instructions into

User Interface – the user interface of a DSS has to be dynamic and GUI based. It has to be an easy to use user interface as most of the people who will be using it are not technical experts but management experts (top management) and hence the interface should be minimalist in design. Also the system should be able to interact with the user in a interactive mode and hence the user interface has to be dynamic. • Request Constructor – since DSS works on an interactive dynamic mode, it needs a request constructor (incorporating aspects of Language Query Interface) which can convert the user's instructors into

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179/190	SUBMITTED TEXT	153 WORDS	91%	MATCHING TEXT	153 WORDS

the model's data request to the database, and the model's instructions/requests to the user. • Data Management Subsystem: Data is the most important component of a DSS. Without data a DSS cannot function. The data management subsystem manages data for a DSS. Data is accessed in a DSS in many ways like ad hoc basis, structured query basis, heuristic search basis, etc. Hence, a strong data management subsystem is required to service the varied data requests from a DSS. The subsystem has the following elements: o Database Management System: It is the data store for the DSS. It manages the data and performs all the functions that a typical DBMS package does. In fact, in most DSS, a commercial DBMS or RDBMS package is used to perform this task. o Query Control: This is an element tailored to handle the query requirements of DSS. It may connect the database, directly to the user interface or to the model base or both. o Meta Data: This contains data/

the model's data request to the database and the model's instructions/requests to the user. • Data Management Subsystem – data is the most important component of a DSS. Without the data a DSS cannot function. The data management subsystem manages the data for DSS. Data is accessed in a DSS in many ways like ad hoc basis, structured query basis and heuristic search basis and hence a strong data management subsystems is required to service the varied data requests from a DSS. The subsystem has the following elements: • Database Management System – it is the data store for the DSS. It manages the data and performs all the functions that a typical DBMS package does. In fact, in most DSS a commercial DBMS or RDBMS package is used to perform this task. • The Query Control – this is a tailored element to handle the query requirements of DSS. It may connect the database, directly to the user interface or to the model base or both. • Meta Data – this contains data

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180/190	SUBMITTED TEXT	38 WORDS	96%	MATCHING TEXT	38 WORDS

about the data that is stored in the database. This helps the DSS in understanding the data in the database properly and helps in creating ad hoc queries. • Model Management Subsystem: This is a unique feature of a DSS

about the data that is stored in the database. This helps the DSS in understanding the data in the database properly and helps in creating ad hoc queries. • Model Management Subsystem – this is the unique feature of a DSS.

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181/190	SUBMITTED TEXT	41 WORDS	100%	MATCHING TEXT	41 WORDS

makes the system special. However, this also makes the system very specific. There are very few examples of a generalized DSS as generalized models are not available. Those that exist, work on half-baked solutions. The model management subsystem may use different classes of models

makes the system special. However, this also makes the system very specific. There are very few examples of a generalized DSS as generalized models are not available. Those that exist work on half baked solutions. The model management subsystem may use different classes of models

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182/190	SUBMITTED TEXT	13 WORDS	71%	MATCHING TEXT	13 WORDS

Simulation Models o Heuristic Models o Deterministic Models o Predictive Models Each class of model is

Simulation Models • Heuristic Models • Deterministic Models • Predictive Models Each class of model is

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a routing problem or a scheduling problem or a combinatorial search problem, etc. Model and model management has several connotations in DSS literature and there have been wide-ranging definitions of these terms. The common strain that evolves from

a routing problem or a scheduling problem or a combinatorial search problem etc. Model and Model Management has several connotations in DSS literature and there have been wide ranging definitions of these terms. The common strain that evolves from

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184/190	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

plethora of definitions is that a model is conceived to consist of a solver

plethora of definitions is that a model is conceived to consist of a solver,

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185/190	SUBMITTED TEXT	60 WORDS	100%	MATCHING TEXT	60 WORDS

a model for solving a problem and data (Ramirez, 1993), where model represents relationships between variables, data represents the values of the variables under consideration and the solver is the tool that enables the computation of the variable values and their relationships. It has been also conceptualized in some literature as a procedure which works on the data to give an output after analysis.

a model for solving a problem and data (Ramirez, 1993) where model represents relationships between variables, data represents the values of the variables under consideration and the solver is the tool that enables the computation of the variable values and their relationships. It has been also conceptualized in some literature as a procedure which works on the data to give an output after analysis.

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186/190	SUBMITTED TEXT	58 WORDS	80%	MATCHING TEXT	58 WORDS

The model management subsystem has the following elements: o The Model Base Management System: A model base or rather a model base management system is a software (is conceptually like what the DBMS is to data) which has the capabilitiy to manage a model so that it is useful for the decision-maker. It is the core of a DSS. It supports

The model management subsystem has the following elements: • The Model Base Management System-A model base or rather a model base management system is software is conceptually like what the DBMS is to data which has the capabilities to manage a model for it to be useful to the decision maker. It is the core of a DSS. It supports

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187/190	SUBMITTED TEXT	15 WORDS	97%	MATCHING TEXT	15 WORDS

generation of models and works with data on one hand and user-supplied instructions on the other.

generation of models and works with data on one hand and the user supplied instructions on the other. •

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188/190 **SUBMITTED TEXT** 39 WORDS **95%** **MATCHING TEXT** 39 WORDS

decision support system is a computer-based information system that supports business or organizational decision-making activities. DSS serve the management, operations and planning levels of an organization and help to make decisions, which may be rapidly changing and not easily specified in advance.

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189/190 **SUBMITTED TEXT** 103 WORDS **96%** **MATCHING TEXT** 103 WORDS

is the entity that processes the commands coming from the dialog management subsystem. o The Model Executor or Solver: It is the heart of the system. It is the process through which the model is solved (using some algorithm). It works with the model generated by the model base (with instructions from the user), the request constructor (dialog management subsystem in general) to get the parameters of the model from the user, and data from the data management subsystem. It then solves the problem and displays the results and some variations of the best fit solution through the dialog management subsystem. The alternative solutions, as provided, help the user in decision-making. 8.2.3

is the entity that processes the commands coming from the dialog management subsystem. • The Model Executor or Solver- is the heart of the system. It is the process through which the model is solved using some algorithm. It works with the model as generated by the model base with instructions from the user, the request constructor (dialog management subsystem in general) to get the parameters of the model from the user and data from the data management subsystem. It then solves the problem and displays the results and some variations of the best fit solution through the dialog management subsystem. The alternative solutions as provided help the user in decision-making.

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190/190 **SUBMITTED TEXT** 10 WORDS **100%** **MATCHING TEXT** 10 WORDS

A Firewall is a combination of hardware and software that

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