COURSE GUIDE

BUS 815
MANAGEMENT INFORMATION SYSTEM

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INTRODUCTION

BUS 815, Management Information System is a semester course work of two credit units, for post-graduate students of the Faculty of Business Management.

The course material consists of 15 units that will enable learners understand the design and development of MIS.

COURSE AIMS

This course is designed to expose the student to the practical application of computers to management information processing. The course provides the steps in the followed in the utilization of electronic data processing(EDP) system in producing financial and management information, in feasibility studies, system analysis, system design and system implementation for computerized accounting system. Among other things, the course will examine the following issues: Elements of computing mechanical and electronic, types of computers and their applications, computer programming using COBOL or FORTRAN, data processing manual and mechanized systems, system analysis and design, evaluation and administration of MIS with emphasis on computer based systems, meaning of information technology and its application in business finance and management.

COURSE OBJECTIVES

The comprehensive objectives of this course are to:

- teach the concept of management information systems.
- discuss core concepts: Data, Information and Data Processing
- look at an overview of systems in the organisation
- understand what constitute information system and organisation
- explain contemporary trends in information and communication technologies
- understand perspective on information systems
- discuss about computers and information processing
- teach information systems software and hardware
- look at the concept of managing data resources
- teach programming in computer languages
- discuss information systems development`
- explain communication and network systems
- take a cursory look at the concept of data modelling

- teach and demonstrate practical information system: demo POS for a retail store
- teach ethical and security issues in information systems.

WORKING THROUGH THIS COURSE

To complete this course, learners are expected to have read all the units contained in this course material. Learners are advised to read textbooks recommended under the column for further reading and related materials you can possibly lay your hands on. Attempt all exercises in each unit. Answers to TMA are to be submitted for assessment purpose. At the end of the course, there will be a final examination to test your master of the course.

COURSE MATERIALS

Major components of the course are:

- Course Guide
- Study Units
- Textbooks
- Assignment
- Presentation Schedule

TEXTBOOKS

At the end of each unit of the course, there are reference materials to which you can refer in order to increase the depth of your knowledge on the course. Please take this seriously.

ASSIGNMENT FILES

A number of assignments have been prepared to help you succeed in this course. They will guide you to have understanding and good grasp of the course.

PRESENTATION SCHEDULE

The presentation schedule included in your course materials also have important dates of the year for the completion of tutor-marked assignments (TMAs) and your attendance at tutorials.

Remember, you are to submit all your assignments by the due date. You should guard against falling behind in your work.

ASSESSMENTS

There are two aspects to the assessment of the course: first are the tutor-marked assignments and a written examination.

In tackling the assignments, you are expected to apply information, knowledge and techniques gathered during the course. The assignments must be submitted to your tutor for formal assessment in accordance with the deadlines stated in the presentation schedule and the assignment file. The work you submitted to your tutor will count for 30 per cent of your total course mark.

At the end of the course, you will need to sit for a final written examination of three hour duration. This examination will also count for 70 per cent of your total coursework.

TUTOR-MARKED ASSIGNMENTS (TMAs)

Each of the units in the course material has a tutor-marked assignment (TMA) in this course. You only need to submit five of the eight assignments. You are to answer all the TMAs and compare your answers with those of your course mates. However, you should ensure that you collect four (TMAs) from the Study Centre. It is compulsory for you to answer four (4) TMAs from the Study Centre. Each TMA is allocated a total of 10 marks. However, the best three (3) of the four marks shall be used as your continuous assessment score.

You will be able to complete your assignment from the information and materials contained in your reading, references and study units. However, it is desirable in all degree level education to demonstrate that you have read and researched more widely than the required minimum. Using other references will give you a broader viewpoint and may provide a deeper understanding of the subject.

FINAL EXAMINATION AND GRADING

The final examination for BFN721 will not be more than three hours' duration and has a value of 70 percent of the total course grade. The examination will consist of questions, which reflect the types of practice exercises and tutor-marked problems you have previously encountered. All areas of the course will be assessed.

When you have gone through the whole course, ensure you revise it again before sitting for the final examination. You may find it useful to review your tutor-marked assignments and comments on them before the examination. The final examination covers information from all parts of the course.

COURSE MARKING SCHEME

Table showing the total course marking scheme is shown below:

ASSESSMENT	**MARKS**
Assignment 4 (TMAs)	Best three marks of the 4 TMAs @ 10 marks is 30 marks of the course = 30%
Final Examination	70% of overall course marks
Total	**100% of course marks**

HOW TO GET THE MOST FROM THIS COURSE

In distance learning, the study units replace the university lecturer. This is one of the great advantages of distance education. You can read and work through the specially designed study materials at your own pace, and at a time and place that suits you best. Think of it as you read the lecture notes and that a lecturer might set you some readings to do.

The study unit will tell you when to read your other materials. Just as a lecturer might give you an in-class exercise, your study units also provide assignments for you to do at appropriate points.

Each of the study units follows a common format. The first item is an introduction to the subject matter of the unit, and how a particular unit is related with the other units and the course as a whole.

Next is a set of learning objectives. These objectives let you know what you should be able to do by the time you have completed the unit. You should use these objectives to guide your study. When you have finished the unit, you must go back and check whether you have achieved the objectives set. If you make a habit of doing this, you will significantly improve your chances of passing the course.

The main body of the unit guides you through the required reading from other sources. This will usually be either from **Reading Section** or some other sources.

Self-tests/assignments are interspersed throughout the end of units. Working through these tests will help you to achieve the objectives of the unit and prepare you for the examinations. You should do each of the assignments as you come to it in the study unit. There will also be numerous examples given in the study units, work through these when you come to them too.

The following is a practical strategy for working through the course. If you run into any trouble, telephone your tutor. When you need help, don't hesitate to call and ask your tutor to provide it. In summary:

(1) Read this course guide.

(2) Organise a study schedule. Refer to the course overview for more details. Note the time you are expected to spend on each unit and how the assignments relate to the unit. Important information e.g. details of your tutorials and the date of the first day of the semester is available. You need to gather together all information in one place, such as your diary or a wall calendar. Whatever method you choose to use, you should decide on and write in your own dates for working on each unit.

(3) Once you have created your own study schedule, do everything you can to stick to it. The major reason that students fail is that they get behind with their coursework. If you get into difficulty with your schedule, please let your facilitator know before it is too late for help.

(4) Turn to unit 1 and read the introduction and the objectives for the unit.

(5) Assemble the study materials. Information about what you need for a unit is given in the 'Overview' at the beginning of each unit. You will always need both the study unit you are working on and one of your set books, on your desk at the same time.

(6) Work through the unit. The content of the unit itself has been arranged to provide a sequence for you to follow. As you work through this unit, you will be instructed to read sections from your set books or other articles. Use the unit to guide your reading.

(7) Well before the relevant due dates (about 4 weeks before the dates) access the Assignment file on the web and download your next required assignment. Keep in mind that you will learn a lot by doing the assignments carefully. They have been designed to help you meet the objectives of the course and, therefore, will help you pass the examination. Submit all assignments not later than the due dates.

(8) Review the objectives for each study unit to confirm that you have achieved them. If you feel unsure about any of the objectives, review the study material or consult your tutor.

(9) When you are confident that you have achieved a unit's objectives, you can then start on the next unit. Proceed unit by unit through the course and try to pace your study so that you keep yourself on schedule.

(10) When you have submitted an assignment to your tutor for marking, do not wait for its return before starting on the next unit. Keep to your schedule. When the assignment is returned, pay particular attention to your facilitator's comments. Consult your tutor as soon as possible if you have any questions or problems.

(11) After completing the last unit, review the course and prepare yourself for the final examination. Check that you have achieved the unit objectives and the course objectives.

TUTORS AND TUTORIALS

There are eight (8) hours of tutorials provided in support of this course. You will be notified of the dates, times and location of these tutorials, together with the names and phone number of your tutor, as soon as you are allocated a tutorial group.

Your tutor will mark and comment on your assignments, keep a close watch on your progress and on any difficulties you might encounter as they would provide assistance to you during the course. You must mail your tutor-marked assignments to your tutor well before the due date (at least two working days are required). They will be marked by your tutor and returned to you as soon as possible. Do not hesitate to contact your tutor by telephone, e-mail, or discussion board if you need help. The following might be circumstances in which you would find help necessary.

Contact your tutor if you:

- do not understand any part of the study units or the assigned readings;
- have difficulty with the tutor-marked assignments;
- have a question or problem with an assignment or with your tutor's comments on an assignment or with the grading of an assignment.

You should try your possible best to attend the tutorials. This is the only chance to have face-to-face contact with your tutor and to ask questions which are answered instantly. You can raise any problem encountered in the course of your study during such contact. To gain the maximum benefit from course tutorials, prepare a question list before attending them. You will learn a lot from participating in discussions actively.

SUMMARY

This course is designed to expose the student to the practical application of computers to management information processing. The course provides the steps in the followed in the utilization of electronic data processing (EDP) system in producing financial and management information, in feasibility studies, system analysis, system design and system implementation for computerized accounting system.

We hope you enjoy your acquaintances with the National Open University of Nigeria (NOUN) and wish you every success in the future.

MAIN COURSE

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MODULE 1

UNIT 1 INTRODUCTION TO MIS CONTENTS

1.0 INTRODUCTION

In this unit we give the basic definition and relevant concepts of MIS such as need of MIS, history of MIS, components of MIS, impact and factors contributing to the success of it in organizations.

2.0 OBJECTIVE

The objective of this unit is to give an overview of management information system.

3.0 MAIN CONTENT

3.1 Management information System (MIS)

We will begin this course by looking at what makes up a management information system.

3.1.1 What is MIS?

Management Information System (MIS) is a concept of the last decade or two. It has been understood and described in a number way. It is also known as the Information System, the Information and Decision System, the Computer- based information System.

MIS has more than one definition, some of which are given below:

MIS is defined as a system which provides information support for decision making in the organisation.

MIS is defined as an integrated system of man and machine for providing the information to support the operations, the management and the decision-making function in the organisation.

MIS is defined as a system based on the database of the organisation evolved for the purpose of providing information to the people in the organisation.

MIS is the use of information technology, people, and business processes to record, store and process data to produce information that decision makers can use to make day to day decisions.

MIS is the acronym for **Management Information Systems.** In a nutshell, MIS is a collection of systems, hardware, procedures and people that all work together to process, store, and produce information that is useful to the organisation.

Though there are a number of definitions, all of them converge on one single point, i.e., the MIS is a system to support the decision making functions in the organisation. The difference lies in defining the elements of the MIS. However, in today's world MIS is a computerised, business processing system generating information for the people in the organisation to meet the information needs and assisting in taking decisions to achieve the corporate objective of the organisation and in the Public sector.

3.1.2 The Need for MIS

The following are some of the justifications for having an MIS system:

i. **Decision makers need information to make effective decisions.**
ii. Management Information Systems (MIS) make this possible.
iii. **MIS systems facilitate communication within and outside the organization**: Employees within the organisation are able to easily access the required information for the day to day operations. Facilities such as Short Message Service (SMS) & Email make it possible to communicate with customers and suppliers from within the MIS system that an organization is using.
iv. **Record keeping**: Management information systems record all business transactions of an organisation and provide a reference point for the transactions.

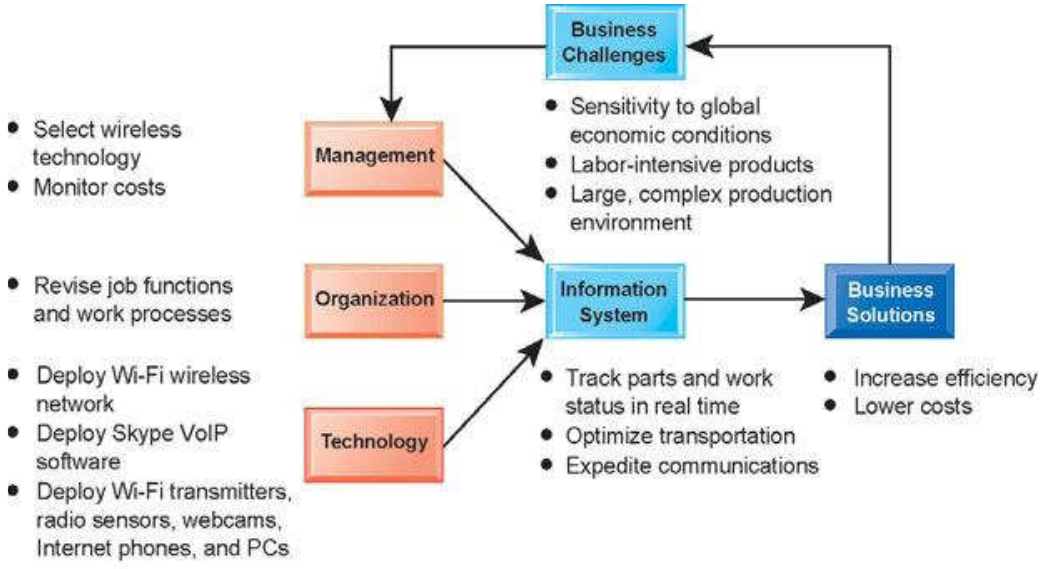

Fig 1.1: Integrated framework of an Information System

This framework depicted in fig 1.1 above shows information systems composed of management, organisation, and technology elements and is reinforced in every information system development project

3.1.3 Components of MIS

A management information system is made up of five major components namely people, business processes, data, hardware, and software. All of these components must work together to achieve business objects.

People: These are the users who use the information system to record the day to day business transactions. The users are usually qualified professionals such as accountants, human resource managers, etc. The ICT department usually has the support staff that ensures that the system is running properly.

Business Procedures: These are agreed upon best practices that guide the users and all other components on how to work efficiently. Business procedures are developed by the people i.e. users, consultants, etc.

Data: The recorded day to day business transactions. For a bank, data is collected from activities such as deposits, withdrawals, etc.

Hardware: Hardware is made up of the computers, printers, networking devices, servers, workstations, networking equipment, printers, keyboards, mouse, light pens, scanners, laptops, notebooks etc. The hardware provides the computing power for processing data. It also provides networking and printing capabilities. The hardware speeds up the processing of data into information.

Software: These are programs that run on the hardware. These are programs used to handle the data. These include programs such as spread sheet programs, database software, word processing programs, desktop publishing packages, graphics packages, communication packages, operating systems, language translators, utility programs etc. the software is broken down into two major categories namely system software and applications software. System software refers to the operating system i.e. Windows, Mac OS, and Ubuntu, etc. Applications software refers to specialized software for accomplishing business tasks such as a Payroll program, banking system, point of sale system, etc.

Management information systems are distinct from other information systems because they are used to analyze and facilitate strategic and

operational activities. Academically, the term is commonly used to refer to the study of how individuals, groups, and organizations evaluate, design, implement, manage, and utilize systems to generate information to improve efficiency and effectiveness of decision making, including systems termed decision support systems, expert systems, and executive information systems.

3.1.4 MIS Concepts

The concept of the MIS has evolved over a period of time comprising many different facets of the organisational functions. MIS is a necessity in all the organizations.

The initial concept of MIS was to process the data available in the organisation and present it in the form of reports at regular intervals. The system was largely capable of handling the data from collection to processing. It was more impersonal, requiring each individual to pick and choose the processed data and use it for his requirements. This concept was further modified when a distinction was made between data and information.
Information is a product of an analysis of data. This concept is similar to a raw material and the finished product. However, data can be analyzed in a number of ways, producing different shades and specifications of the information as a product. It was, therefore, demanded that the system concept be individual- oriented, as each individual may have a different orientation towards the information.

This concept was further modified, that the system should present information in such a form and format that it creates an impact on its user, provoking a decision or an investigation. It was later realized then even though such an impact was a welcome modification, some sort of selective approach was necessary in analysis and reporting.

Hence, the concept of exception reporting was imbibed in MIS. The norm for an exception was necessary to evolve in the organisation. The concept remained valid till and to the extent that the norm for an exception remained true and effective. Since the environment turns competitive and is ever changing, fixation of the norm for an exception becomes a futile exercise at least for the people in the higher echelons of the organization. The concept was then evolved that the system should be capable of handling a need based exception reporting. This need may be either of an individual or a group of people. This called for keeping all data together in such a form that it can be accessed by anybody and can be processed to suit his needs. The

concept is that the data is one but it can be viewed by different individuals in different ways.

Over a period of time, when these conceptual developments were taking place, the concept of end user computing using multiple databases emerged. This concept brought a fundamental change in MIS. The change was decentralization of the system and the user of the information becoming independent of computer professionals. When this becomes a reality, the concept of MIS changed to a decision making system. The job in the computer department is to manage the information resource and leave the task of information processing to the user. The concept of MIS in today‘s world is a system which handles the databases, provides computing facilities to the end user and gives a variety of decision making tools to the user of the system and also enable the citizens /beneficiaries to use the MIS from external source and connect with organisation.

The concept of MIS gives high regard to the individual and his ability to use information. MIS gives information through data analysis. While analyzing the data, it relies on many academic disciplines. These include the theories, principles and concepts from the Management Science, Psychology and Human Behavior, making the MIS more effective and useful. These academic disciplines are used in designing MIS, evolving the decision support tools for modelling and decision making.

The foundation of MIS is the principles of management and its practices. The concept of management Information System can be evolved for a specific objective if it is evolved after systematic planning and design. It calls for an analysis of a business, management views and policies, organization culture and the management style.

Information should be generated in this setting and must be useful in managing the business. This is possible only when it is conceptualized as a system with an appropriate design. MIS, therefore, relies heavily on the systems theory and offers solutions to handle the complex situations of the input and output flows. It uses theories of communication which helps to evolve a system design capable of handling data inputs, process, and outputs with the least possible noise or distortion in transmitting the information form a source to a destination. It uses the principles of system Design, Viz., an ability of continuous adjustment or correction in the system in line with the environmental change in which the MIS operates. Such a design help to keep the MIS tuned with the business managements needs of the organisation.

The concept, therefore, is a blend of principle, theories and practices of the Management, Information and System giving rise to single product known as Management Information System (MIS).

3.1.5 History of MIS

Kenneth C. Laudon and Jane Laudon identify five eras of Management Information System evolution corresponding to the five phases in the development of computing technology:

1) Mainframe and minicomputer computing
2) Personal computers
3) Client/server networks
4) Enterprise computing, and
5) Cloud computing.

The first era (mainframe and minicomputer) was ruled by IBM and their mainframe computers. These computers would often take up whole rooms and require teams to run them - IBM supplied the hardware and the software. As technology advanced, these computers were able to handle greater capacities and therefore reduce their cost.
The second era (personal computer) began in 1965 as microprocessors started to compete with mainframes and minicomputers and accelerated the process of decentralizing computing power from large data centres to smaller offices. In the late 1970s minicomputer technology gave way to personal computers and relatively low-cost computers were becoming mass market commodities, allowing businesses to provide their employees access to computing power that ten years before would have cost millions of naira.

As technological complexity increased and costs decreased, the need to share information within an enterprise also grew, giving rise to the third era (client/server), in which computers on a common network access shared information on a server. This lets thousands and even millions of people access data simultaneously.

The fourth era (enterprise) enabled by high speed networks, tied all aspects of the business enterprise together offering rich information access encompassing the complete management structure. Every computer is utilized.

The fifth era (cloud computing) is the latest; and employs networking technology to deliver applications as well as data storage independent of the configuration, location or nature of the hardware. This, along with high

speed cell phone and Wi- Fi networks, led to new levels of mobility in which managers access the MIS remotely with laptop and tablet computers, plus smart phones.

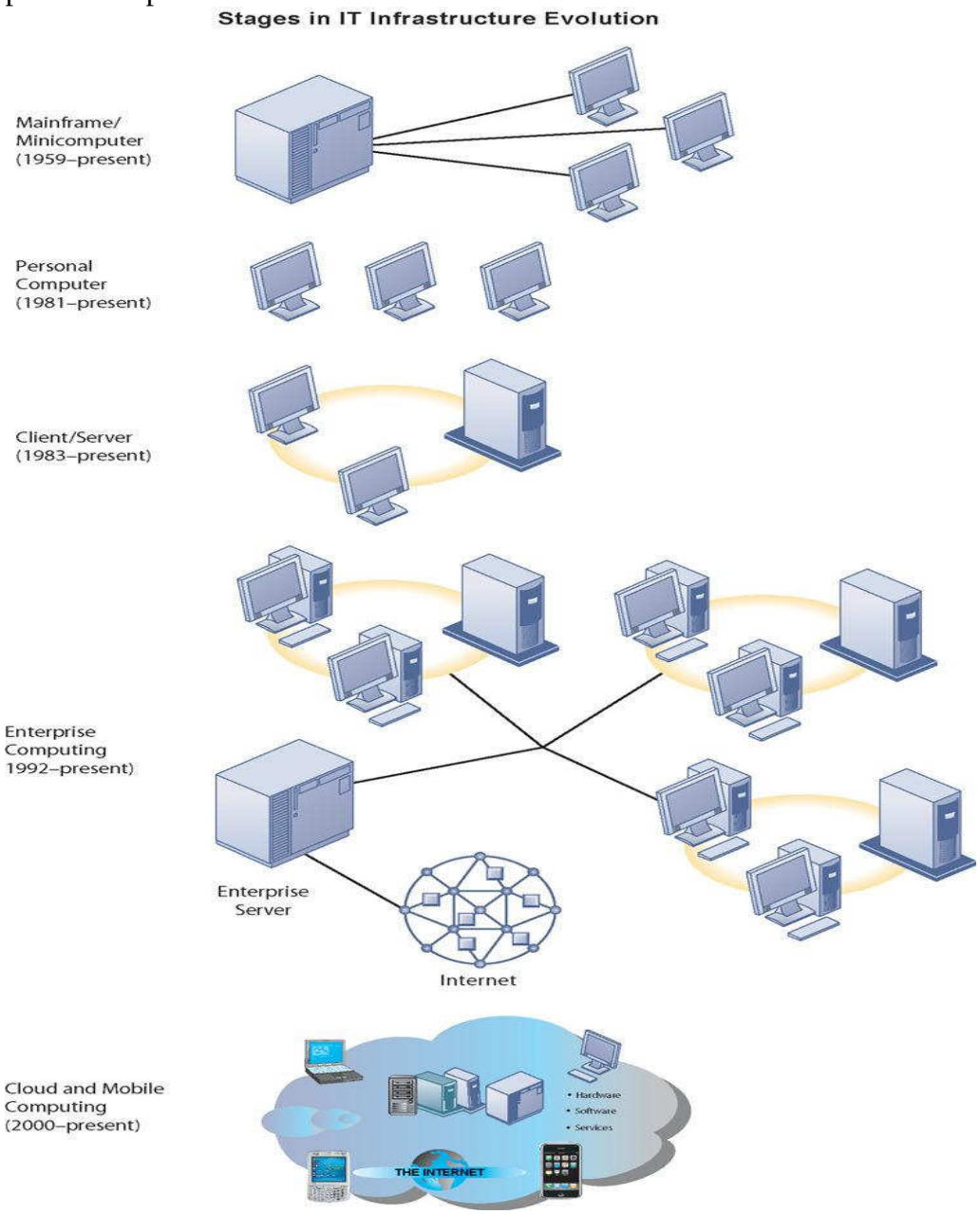

Fig. 1.1: Stages in IT infrastructure evolution

Illustrated here are the typical computing configurations characterizing each of the five eras of IT infrastructure evolution.

3.1.6 Physical view of MIS

The Physical view of the MIS can be seen as an assembly of several subsystems based on the databases in the organization. These subsystems range from data collection, transaction processing and validating, processing, analyzing and storing the information in databases. The subsystem could be at a functional level or a corporate level. The information is evolved through them for a functional or an operational management and it provides the information for the management of business at the corporate level and also analyzes and provides huge data for the governments in a systematic way for analysis and for designing welfare schemes.

MIS, therefore, is a dynamic concept subject to change, time and again, with a change in the business management process. It continuously interacts with the internal and the external environment of the business and provides a corrective mechanism in the system so that the changed needs of information are met effectively. MIS, therefore, is a dynamic design, the primary objective of which is to provide the information for decision making and it is developed considering the organisational fabric, giving due regard to the people in the organisation that handles the management functions and the managers and the managerial control.

3.1.7 Role of MIS in an Organization

The role of the MIS in an organization can be compared to the role of heart in the body. The information is the blood and MIS is the heart. In the body the heart plays the role of supplying pure blood to all the elements of the body including the brain. The heart works faster and supplies more blood when needed. It regulates and controls the incoming impure blood, processes it and sends it to the destination in the quantity needed.

It fulfils the needs of blood supply to human body in normal course and also in crisis. MIS plays exactly the same role in the organisation. The system ensures that an appropriate data is collected from the various sources, processed, and sent further to all the needy destinations. The system is expected to fulfil the information needs of an individual, a group of individuals, the management functionaries, the managers and the top management. MIS satisfies the diverse needs through a variety of systems such as Query Systems, Analysis Systems, Modelling Systems and Decision Support Systems, MIS helps in Strategic Planning, Management Control, Operational Control and Transaction Processing.

MIS helps the clerical personnel in the transaction processing and answers their queries on the data pertaining to the transaction, the status of a particular record and references on a variety of documents. MIS helps the junior management personnel by providing the operational data for planning, scheduling and control, and helps them further in decision making at the operations level to correct an out of control situation.

MIS helps the middle management in short term planning, target setting and controlling the business functions. It is supported by the use of the management tools of planning and control. MIS helps the top management in goal setting, strategic planning and evolving the business plans and their implementation. MIS plays the role of information generation, communication, problem identification and helps in the process of decision making. MIS, therefore, plays a vital role in the management, administration and operations of an organisation.

3.1.8 Impact of MIS on an Organisation

Since the MIS plays a very important role in the organisation, it creates an impact on the organization‘s functions, performance and productivity. With good support, the management of marketing, finance, production and personnel become more efficient. The tracking and monitoring of the functional targets becomes easy. The functional, managers are informed about the progress, achievements and shortfalls in the probable trends in the various aspects of business. This helps in forecasting and long-term perspective planning.

The manager‘s attention is brought to a situation which is exceptional in nature, inducing him to take an action or a decision in the matter. A disciplined information reporting system creates a structured data and a knowledge base for all the people in the organisation. The information is available in such a form that it can be used straight away or by blending analysis, saving the manager‘s valuable time.

MIS creates another impact in the organisation which relates to the understanding of the business itself. MIS begins with the definition of a data entity and its attributes. It uses a dictionary of data, entity and attributes, respectively, designed for information generation in the organisation. Since all the information system use the dictionary, there is common understanding of terms and terminology in the organisation bringing clarity in the communication and a similar understanding throughout the organisation. MIS calls for a systemization of the business operation for an affective system design.

A well-designed system with focus on the manger makes an impact on the managerial efficiency. The fund of information motivates an enlightened manger to use a variety of tools of management. It helps him to resort to such exercises as experimentation and modelling. The use of computers enables him to use the tools techniques which are impossible to use manually.

Since the MIS works on the basic systems such as transaction processing and databases, the drudgery of the clerical work is transferred to the computerized system, relieving the human mind for better work. It is observed that a lot of manpower is engaged in this activity in the organisation. The study of the individual‘s time utilization and its application has revealed that seventy per cent of the time is spent in recording, searching, processing and communication. This is a large overhead in the organisation.

MIS has a direct impact on this overhead. It creates an information based work culture in the organisation.

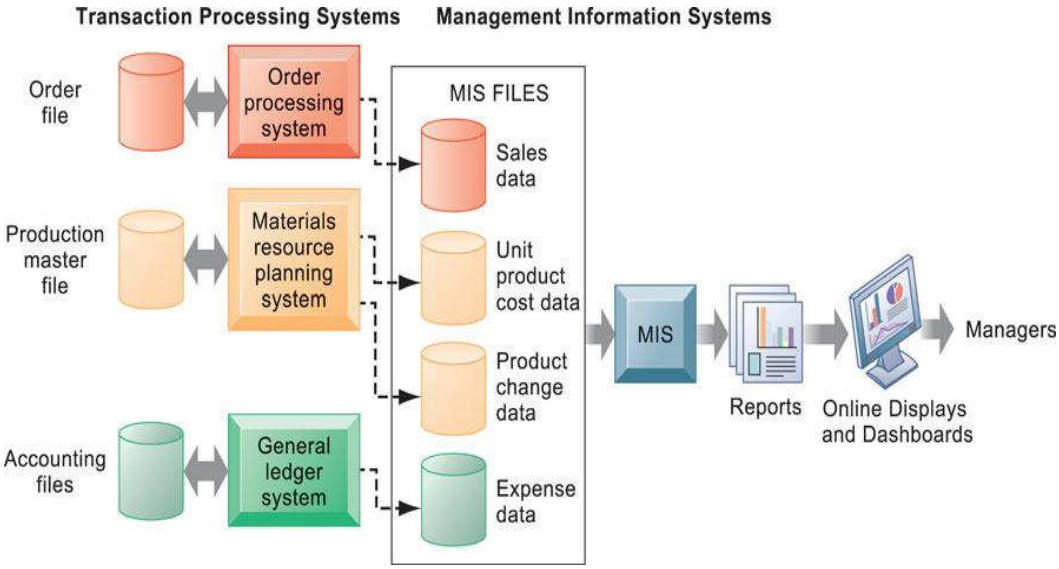

Fig. 1.2: How management information systems obtain their data from the organization’s Transaction Processing System (TPS)

In the system illustrated by this diagram, three TPS supply summarized transaction data to the MIS reporting system at the end of the time period. Managers gain access to the organizational data through the MIS, which provides them with the appropriate reports.

3.1.9 MIS Objective

MIS is the use of hardware, software and telecommunication networks to achieve business objectives. The objective of the MIS is to provide information for a decision support in the process of management. It helps in such a way that the business goals are achieved in the most efficient manner. Since decision making is not restricted to a particular level, MIS is expected to support all the levels of the management in conducting the business operations. Unless MIS becomes a management aid, it is not useful to the organisation.

The following diagram shows the architecture of a typical MIS infrastructure;

Fig. 1.3: A Typical MIS Infrastructure

3.1.10 Factors Contributing to the Success of MIS in Organizations

If an MIS has to become successful then it should have all the features listed as Follows:

- MIS is integrated into the managerial functions. It sets clear objectives to ensure that the MIS focuses on the major issues of the business. Adequate development resources are provided and the

human and organisational barriers to progress are removed.

i. An appropriate information processing technology required to meet the data processing and analysis needs of the users of the MIS is selected.
ii. MIS is oriented, defined and designed in terms of the user‘s requirements and its operational viability is ensured.
iii. MIS is kept under continuous surveillance, so that its open system design is modified according to the changing information needs.
iv. MIS focuses on the results and goals, and highlights the factors and reasons for non-achievement.
v. MIS is not allowed to end up into an information generation mill avoiding the noise in the information and the communication system.
vi. MIS recognizes that a manager is a human being and therefore, the systems must consider all the human behavioural factors in the process of the management.
vii. MIS recognizes that the different information needs for different objectives must be met with. The globalization of information in isolation from the different objectives leads to too much information and its non-use.
viii. MIS is easy to operate and, therefore, the design of the MIS has such features which make up a user-friendly design.
ix. MIS recognizes that the information needs become obsolete and new needs emerge. MIS design, therefore, has a basic potential capability to quickly meet new needs of information.
x. MIS concentrates on developing the information support to manage critical success factors. It concentrates on the mission critical applications serving the needs of top management.

3.1.11 Factors Contributing to MIS Failure in Organizations

The common factors which are responsible for MIS failures in Organizations are listed as follows:

i. MIS is conceived as a data processing tool and not as information processing tool and MIS does not provide that information which is needed by the managers but it tends to provide the information generating the function calls. In this case MIS becomes an impersonal system.

ii. Underestimating the complexity in the business systems and not

recognizing it in the MIS design leads to problems during implementation.

iii. Adequate attention is not given to the quality control aspects of the inputs, the process and the outputs leading to insufficient checks and controls in the MIS.

iv. MIS is developed without streamlining the transaction processing systems in the organisation and lack of training on MIS to stakeholders. Failing to appreciate that the users of the information and the generators of the data are different and not identifying that both of them have to play an important and responsible role in the MIS.

v. MIS does not meet certain critical and key factors of its users such as, response to the query on the database, inability to get the processing done in a particular manner, lack of user-friendly system and dependence on the system personnel.

vi. A belief that the computerized MIS can solve all the management problems of planning and control of the business and lack of administrative discipline in following the standardized systems and procedures, faulty coding and deviating from the system specifications result in incomplete and incorrect information.

3.1.12 Advantages of MIS

The following are some of the benefits that can be attained from MIS.

Organizations are able to highlight their strengths and weaknesses due to the presence of revenue reports, employees' performance records etc. The identification of these aspects can help the company improve their business processes and operations. MIS gives an overall picture of the company and acts as a communication and planning tool.

The availability of customer data and feedback in the MIS can help the company to align their business processes according to the needs of the customers. The effective management of customer data can help the company to perform direct marketing and promotion activities. MIS can help an organization to gain a competitive advantage.

Competitive advantage is a firm‘s ability to do something better, faster, cheaper, or uniquely, when compared with rival firms in the market.

3.2 MIS in Public Sector Organizations

Public administration in Government has changed considerably over the past few years as did the use of MIS. A ‗stage of growth frame work is developed and used to describe the relations between various government departments and use of MIS over a period of time.

Communication and Information are the lifeblood of any organisation. Neither planning nor designing nor any other managerial process is possible without them. Communication may be viewed as the process of exchange of information; it provides the means of contact between organisational members and organisational decision centres.

In the recent times, government organizations are inundated with data and information that are either generated by internal government transactions or gathers from outside sources. Such data and information are needed for designing future welfare schemes by the government. The government officials must equip themselves to cope up with the phenomenon of information explosion, not to be buried in the avalanche of irrelevant data. They must manage information, that is, a system or structure must be developed to collect, organise, process and disseminate the right type of information at the right time to the right person. Awareness of this need is very essential in the development of MIS for public sector organizations.

IT is transforming not only the functioning of the government organizations and its processes but is also redefining the existing systems in the bureaucratic setup at a very faster pace.

In the coming decade most of the citizens would become IT savvy and public- sector organizations must therefore be prepared to offer services tailored to the citizen‘s needs. MIS has evolved as an integration system for financial transactions, procuring, delivery of services online, auditing etc. It has become very essential for the staff in public sector organizations to use MIS almost for every work. Under these circumstances, MIS is expected to provide the staff with various sets of information for decision making and better communication environment which can be used just on the computer terminal for every day’s work.

Furthermore, communication between the head office and regional offices has become more and more necessary in the recent times.

IT is a resource for any public-sector organization to use in the processes and activities of the organisation. But the similarity of IT with other

technologies ends here. While other technologies tend to be applicable only in specific areas and in well-defined areas of operation, the potential uses for IT in government sector is universal. IT can be used both in operational and management processes in the organizations.

3.2.1 Centralized Vs Decentralized Management of Public Information Systems

In dealing with information systems, public sector organizations have to cover eight main areas of responsibility: information systems planning, organizational structures and staffing, data management, computing and data management architecture, information systems development, information technology acquisition, training, and technical support. Adopting a centralized approach to these responsibilities can bring efficiency benefits, but requires some severe constraints to be overcome. Adopting a decentralized approach can help spread computing in the organization, but is often wasteful. A ‗core-periphery' approach to public information systems, combining both central and local action, is therefore considered as being most effective.

4.0 CONCLUSION

Though there are a number of definitions, all of them converge on one single point, i.e., the MIS is a system to support the decision-making functions in the organisation. The difference lies in defining the elements of the MIS. However, in today's world MIS is a computerised, business processing system generating information for the people in the organisation to meet the information needs and assisting in taking decisions to achieve the corporate objective of the organisation and in the Public sector.

5.0 SUMMARY

You have learnt of the meaning and a brief history of MIS.

6.0 TUTOR-MARKED ASSIGNMENT

1. What exactly is management information system? How does it work? What are its management, organization, and technology components?

2. Airlines maintain large computer systems and computer networks to allow travel agents, tour operators and individual customers around

the world to check on the availability of flights, to make bookings and to print tickets or download them. Considering this as an information system, identify the main components in the system, the technology used, the various people and organizations involved, and the types of information that they require (their information requirements).

7.0 REFERENCES/FURTHER READING

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UNIT 2 CORE CONCEPTS: DATA, INFORMATION AND DATA PROCESSING

CONTENTS

1.0 INTRODUCTION

This unit introduce the basic building concepts of information system; here we take a cursory look at the concepts of data, information and electronic data processing (EDP).

2.0 OBJECTIVES

At the end of this unit, you would be able to:

- define what is meant by data
- understand the concept of data hierarchy
- explain how data are represented in a computer system
- discuss method of data processing
- define and categorize information.

3.0 MAIN CONTENT

3.1 Data and Information

3.1.1 Data

Data may be defined as unprocessed raw facts consisting of details relating to business transactions. Data is input to a data processing system so that it may be converted into information. The smaller unit of definable data is called ̲data element e.g. customer name, address, employee, etc. Data elements are referred to as fields.

Data relating to a particular application, for example, payroll (or inventory control, sales analysis or invoicing to customers) is organized as a separate file. Each file is made up of a number of records which in turn, contains a number of fields or properties. On a payroll file, comprising the many records of every staff, each record will have certain fields to represent the individual employee‘s name, number, gross pay, NPF contribution, income tax etc.

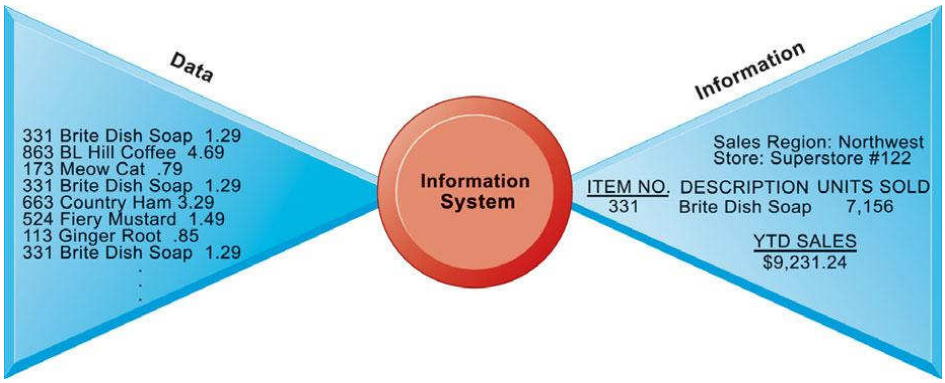

Fig. 2.1: Data and Information

Raw data from a supermarket checkout counter can be processed and organized to produce meaningful information, such as the total unit sales of dish detergent or the total sales revenue from dish detergent for a specific store or sales territory.

3.1.2 Data Hierarchy

Each information system has a hierarchy of data and each succeeding level in the hierarchy result from combining element of a proceeding level.

BITS → CHARACTER → FIELD → RECORDS → FILE → DATABASE The hierarchy is from lowest (bits) to the highest (database). Bits an acronym for binary digits, 0s and 1s which conforms with the internal representation of data in the computer, which represents off and on physically.

The bits are basic unit of primary and secondary storage.

Bytes (Character) are collection of related bits. It is the smallest element on a file and could be alphabetic or numeric. Character is the basic unit of human perception, e.g. A, 2, 5, C etc.

Field (Data Element): Is a combination of related bytes to form meaningful data item such as name, number, etc.

Record: Is a collection of related data elements, e.g. Reg/Matric No., name, address, next-of-kin, date of birth, sex, etc. A record is a description of an event (e.g. sales) or a thing (e.g. students).

File: Is a logical collection of related records (with the same fields) for a set of occurrences i.e. it consists of a number of related sets of data e.g. customer file, student file etc.

Database: Is an integrated collection of related data about an organization with minimum duplication, serving as pool of information for many users.

A computer system organizes data in a hierarchy that starts with the bit, which represents either a 0 or a 1. Bits can be grouped to form a byte to represent one character, number, or symbol. Bytes can be grouped to form a field, and related field can be grouped to form a record. Related records can be collected to form a file, and related files can be organized into a database.

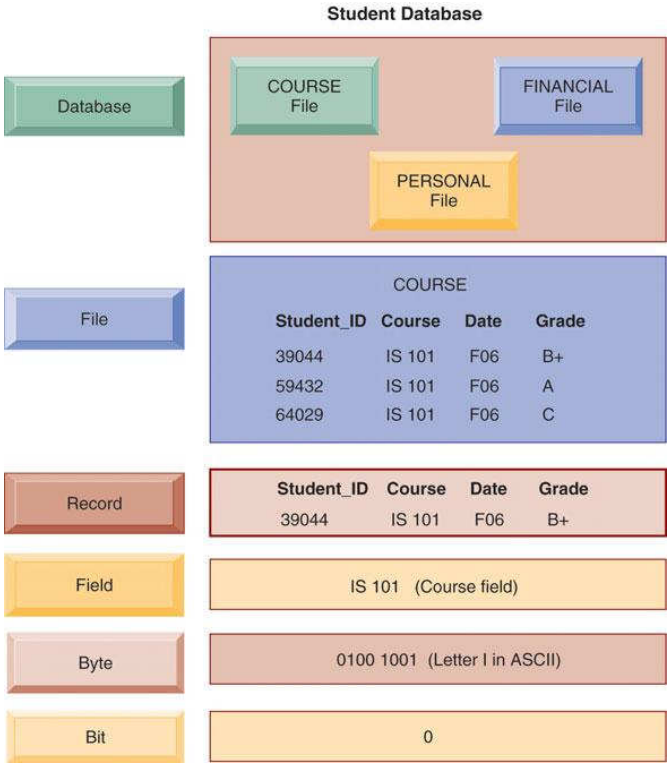

Fig.2.1: Data Hierarchy

3.1.3 Data Representation

In order for information to flow through a computer system and be in a form suitable for processing, all symbols, pictures, or words must be reduced to a string of binary digits. A binary digit is called a bit and represents either a zero or a one. In the computer, the presence of an electronic or magnetic symbol means one and its absence signifies zero.

Everything stored in a computer is data, and that includes programs, both systems software and applications. From the point of view of the storage devices of a computer, it is all the same. Data in a computer takes the form of binary patterns − sequences of 1s and 0s. The one and the zero can be stored in terms of an electrical charge or a magnetic polarity.

The basic unit of storage is the bit (one binary digit − a 0 or a 1), but it is common to group 8 bits together as a byte. Each byte can be used to represent a decimal number, a symbol, or part of a picture.

Example below shows how decimal numbers are represented using true binary digits. Each position in a decimal number has certain value. Any number in the decimal system (base 10) can be reduced to a binary number. The binary number system (base 2) can express any number as a power of the number 2.

Worked example 1:

Convert 1111_2 to base 10

Solution 9:

1 1 1 ~~1~~
this is the given number

2 2 2 ~~2~~
this is the base of given number

3 2 1 ~~0~~
Place of each binary digit

$1x2^3 + 1x2^2 + 1x2^{\sim\sim 1 \sim\sim} + 1x2^0$ to power of 2

- (1x 2x2x2) + (1x 2x2) + (1x2) + (1x1)
- 1x8 + 1x4 + 2 + 1
- $8 + 4 + 2 + 1 = 15_{10}$

Therefore, 1111_2 is equivalent to 15_{10} ($1111_2 = 15_{10}$)

By using a binary number system, a computer can express all numbers as group of zeros and ones. True binary cannot be used by a computer because, in addition to representing numbers, a computer must represent alphabetic characters and many other symbols used in natural language, like $ and @. This requirement led manufacturers of computer hardware to develop standard binary codes.

There are two common codes: EBCDIC and ASCII, which are illustrated in the table below. The first is the Extended Binary Coded Decimal Interchange Code (EBCDIC – pronounced ib-si-dick). This binary code, developed by IBM in the

1950s, represents every number, alphabetic character, or special character with 8 bits. EBCDIC can be used to code up to 256 different characters in one byte (2 to the eighth power equal 256).

ASCII, which stand for the American Standard Code for Information Interchange, was developed by the American National Standards Institute(ANSI) to provide a standard code that could be used by many different manufacturers in order to make machinery compatible.

Table 7.1: ASCII Codes

Character	**ASCII-8-Binary**	**Decimal Code**
A	0100 0001	65
B	01000010	66
C	01000011	67
.		
.		
Z		

For Lower Case Alphabets we have:

Character	**Binary Code**	**Decimal Code**
a	01100001	97
b	01100010	98
c	01100011	99
.	.	.
.	.	.
z	01111010	122

Bytes form the basis for measuring storage capacity, as in these approximations:

- a kilobyte (kB) 1000 = 103 bytes – which is close to 210 (1024) bytes
- a megabyte (MB) 1,000,000 = 106 bytes – which is close to 220 bytes (just over 1 million in decimal)
- a gigabyte – 109 bytes close to 230
- a terabyte – 1012 bytes close to 240
- a petabyte – 1015 bytes close to 250
  kilobyte, megabyte, etc. should be abbreviated to kB, MB, GB, TB. MB and kB are often just left as M or K, etc.

Strictly speaking we should differentiate between quantities defined as powers of 2 and as powers of 10. Thus in the strict international definitions,

1 megabyte (1
MB) = 106 while 1 Mebibyte (1 MiB) = 220.
However, most of the world uses megabytes and gigabytes without making any distinctions between powers of 2 or of 10.

Data in a computer can be of different types; for example: numeric data, textual data, graphical data (pictures), video, sound data, programs (program instructions).

Each form of data has its own way of using the raw storage capability (RAM or secondary storage). Just by looking at a pattern of 1s and 0s, it is not possible to tell what type of data is being stored, but once the type is known, then the pattern can be decoded. For example, the pattern 01001011 represents the letter ‗K' in the ASCII code for representing text; but it represents the decimal number 75 if this binary code is interpreted as a binary number. It might also represent the machine code instruction ‗add'.

Text is stored in a computer according to standard systems of encoding – usually some version of the ASCII code. Each character is stored in one byte (made up of eight individual bits). Thus, a name and address of 80 characters will use 80 bytes of storage. All the printing characters that you can generate from your keyboard have an equivalent representation in the ASCII code; in addition, there are some non-printing codes – such as end of line, backspace, line feed, etc.

3.1.4 Types of data

The type of data with which a business is concerned may be categorized as:

i. External Environment Data: These include matters relating to social political and economic factors.
ii. Competitive data refer details with regard to past performance of main competitors, their present activities and future plans.
iii. Qualitative and quantitative data relating to quality control, levels of performance, costs, overheads, profits and losses, financial strengths and weaknesses relating to cash flows and lines of credits.
iv. Organisational data relating to manpower levels, the structure of department, etc.
v. Reference data such as stock control, parameters.

Examples of data relating to specific business and system include:

A GPA: Student Registration Number, Name, Course Code, Course Title, Credit Unit etc.
B Payroll: Employee Number, Name, Department, Tax Code, Hours Worked, Hourly Rate, etc.
C Credit Card: Cardholder Number, Name, Address, Credit Limit, Minimum Payment, Details of Purchases, Interest Rate, etc.
D Car Hire: Type of Car, Model, Colour, Number of Seats, Engine Capacity, Registration Number etc.

3.1.5 Data Collection and Data Capture

These are terms concerned with the process of collecting data relating to business transactions for processing by any appropriate means but very often by computer.

The primary objective is to capture data in the most economical way and to avoid having to convert it from human-sensible form to machine-sensible form, if possible. This can eliminate encoding stage.

Data collection is used for recording and transmitting data from remote locations such as branches of banks by means of on-line terminals. Banks also use auto- teller terminals for collecting details of cash dispensed automatically. This method makes use of a keyboard to enable customers to key in their personal numbers and also the amount required. Customers are also provided with a plastic card to validate the personal number.

Data Encoding involves extracting data from human readable format to machine- sensitive form. Various data encoding methods are widely used in batch processing environment including key-to-tape, etc. Data can then be input to a computer at a higher speed than is possible using a terminal keyboard. Direct entry of data is also practiced in multi-user on-line processing environments which enables many users to process concurrently data relating to diverse applications such as payroll, sales-ledger, budgetary control etc.

Data Transmission
The primary objective is to transmit data from one point to another point at high speed. Such facilities enable diverse operating units to communicate with each other during the course of business activities in the most efficient manner thereby eliminating, unnecessary delays.

Data transmission takes many forms:

i. Remote entry of data for processing by remote job entry facilities, consisting of communication oriented key-to-disk systems.
ii. On-line terminal operations.
iii. Local area networks, including provision for communicating with a centralized system supporting random enquiries by means of a corporate database.

Data Administration
In order to control the flow of data in and out of the data processing system, it is normal practice to incorporate a data control section in the data processing organization.

The data control section receives all incoming data for processing from internal operating departments or outlying branches usually in batches. Each batch of data has a batch control slip (or cover note) attached on which is recorded batch number, department or branch number, control total, batch total and hash total. Each batch is recorded in a register in the control section for maintaining a record of the data when the batch was received.

The batches may be vetted for correctness and completeness of data and then sent to the data preparation section for encoding on magnetic tape. Data is verified to ensure the accuracy of data preparation operations before being sent for processing.

After processing, the batches of documents and the printed output from the computer are sent to the data control section, where they are entered in the register as a record that all batches have been processed or otherwise.

3.2 Methods of data processing

We can classify techniques of data processing as follows:

- Batch processing
- On-line processing
- Real-time system
- Time-sharing system

Batch Processing
This is where a stack or batch of programs together with the associated data are read onto the computer for processing and results printed on paper before next batch of jobs are entered.

In a batch processing system, data and transactions are collected into batches of similar size and are input and processed together, each batch being a job for a particular application. This involves the processing of transactions, which are accumulated over some interval of a time into batches, at pre-defined periods of time.

Such systems are associated with considerable use of manual recording on input documents with processing being undertaken through the transfer of batches from users to data preparation, to data control, and then to operator. Much of the control is clerical checking and reconciliation of input fields to output.

Batch processing gives good internal control, but it only lends itself to systems where processing need not be immediate and reports and enquiries are standard and known in advance.

The most obvious batch applications are ledger processing in large organizations where rapid processing and response are not essential i.e. routine high-volume applications: Invoicing, Payroll, Sales ledger updating, Stock ledger updating, Nominal ledger updating, etc.

Features of Batch Processing

i. Data are collected for a defined period of time and processed in batches.
ii. No direct access to system by user departments, i.e. no interaction between a user and his job during processing.
iii. Response time equals job turnaround time because the user is isolated from his job.
iv. Files are only on-line during a processing run.
v. Information on master files are only as up to date as last updating run.
vi. Detailed documents, reports and transaction lists are printed.
vii. Audit trails are well provided for by printing out details of transactions.
viii. Costly and time-consuming data preparation operation.

On-line Processing

On-line processing involves the connection of a computer with user oriented terminals. If a terminal is in direct communication with the main unit (CPU) then the processing is on-line. It is a system that has some or all data files directly accessible to users via application software for interrogation purposes. It is a technique of processing data in which data

entry equipment (e.g. terminal) are connected to and controlled by the CPU of a computer, input is of individual transactions by users. This may take one form of direct-entry input, via interactive terminals with immediate input validation and updating in integrated systems. It may also take the form of individual transactions entry with front-end processing and subsequent updating at a later or predetermined time.

Most on-line systems are menu-driven with immediate input validation. On-line systems give rapid response to enquiries and are suited to situations like:

i. Sales Order Processing and Stock Control Systems: Terminals located in Warehouse provides the means for automatic re-ordering of stocks, follow- up of outstanding orders.

ii. Banking: Informing bank customers of the status of their account by assessing the relevant file using an on-line terminal.

iii. Stock Exchange: Terminals are located in major stock exchange throughout the country and the offices of participation brokerage firms enable the speedy processing of share dealings.

iv. Insurance: On-line policy maintenance by means of terminals located in branch offices.

Advantages of On-line system

- It assists in harnessing the activities of clerical staff to the computer by the use of terminals.

- It eliminates routine clerical tedious tasks thereby increasing the degree of operating efficiency and job satisfaction.

- It reduces the volume of printouts required for management report as information may be displayed on terminal screens on demand thereby reducing associated administrative costs.

- It improves the level of computer service especially with account enquiries, holiday bookings, etc.

- It reduces data preparation costs since data can be input directly without the need to convert human-sensible data into machine sensible form manually. This process eliminates encoding and verifying operations.

- Management information becomes more readily available by direct access facilities, which enables managers to obtain a greater degree of control over the operations for which they are responsible.

- Master files more easily updated by terminal keyboard with regard to transaction data as special runs do not require to be set up as in the case with batch processing system.

Real-Time System

Real time system describes the processing situation where computer is able to respond to urgent signals realistic in human reaction time. For a computer system to be real-time, the devices must be on-line. Thus, Real-time is an On-line system that allows immediate processing such that the results of any processing step can be obtained immediately, i.e. transactions are subject to immediate processing upon data capture on the transaction taking place.

Data is processed immediately and the appropriate master file is updated after input validation. That is, a transaction is entered, it passes through all processing stages at once such as validation, updating and reporting.

Real-time systems are used for:

- Airline (seat) ticket reservation
- Stock control
- Steel making
- Hotel and holiday booking system
- Theatre tickets
- Space exploration
- Retail banking for processing drawings against current/savings accounts.

Features of the Real-time system:

- Random data input at random time intervals events occur
- Direct access to system by user departments using terminals
- Files are permanently On-line
- Information on master files are updated dynamically as events occur
- Information is normally displayed on VDU screen as messages
- Audit traits are not so well provided for as control is centered around the number of messages/input rather than details of transactions.

- Absence of costly and time-consuming data preparation operations.
- Information is permanently accessible on demand

Requirements for Real-time system:

- Immediate access to the computer when required (under password control).
- Immediate availability of programs (and protection of program integrity)
- Immediate availability of master files from direct access storage (with proper file security procedures of dumping, restricted access to authorized users).
- Accurately assessed response times – the system must cope with all loads it is likely to encounter.
- Most Real-time systems involve remote input/output stations.
- Multiprogramming facilities usually been controlled by operating system.
- Remote terminals uses VDUs, minicomputers, etc.
- Data transmission equipment (moderns, multiplexors, telephone lines, etc.).
- A large computer (or two) with sophisticated operating system software (with multi programming capabilities).
- A large main store to hold the operating system software, application programs and the data. Larger input and output buffer stores are required.
- Direct access files are permanently on-line.

Time-sharing system (or interactive system)
A time-sharing system implies sharing of the computer time among many users. It is associated with a computer system in a multi-access mode. Time sharing is an on-line processing technique, which enables many users to gain access to a centrally located computer by means of terminals.

Users are geographically remote from the computer and from each other. The computer time is shared among these users with each of them having the impression that the computer is dedicated to his job.

This is made possible by the computer continually switching between the various terminals at extremely high speed under the control of an operating system.

File Classification

Electronic data processing (EDP) file may be categorized as follows:

- Master file
- Transaction file
- Reference file
- Output file
- Back-up file
- Archival file
- Table file

3.3 Information

Information is the output element of a data processing system; it is derived from data, which has been subjected to data processing operations converting meaningless data into a useful form for its recipients.

Information is an important part in the day-to-day management of a business and the decision-making process. Information flows must be designed and integrated into the business systems. Information can be produced either in printed form, graphically displayed on VDU or as graphs on a graph plotter.

Attributes/Properties of Information

- It must enable management to make effective decisions
- It must be suitable for taking effective control action
- It must be compatible with the responsibilities of specific managers i.e. to the proper person who is responsible for the decision in hand.
- It must relate to current situation
- It must contain an appropriate level of detail for the recipient.
- It must be based on exceptions or variances to accord to the principle of management by exception when appropriate lengthy reports take time to read and digest, resulting in overlooking vital facts.
- It must be produced at an optimum cost i.e must be cost effective.
- It must be easily understandable by the recipient else it will not be usable.
- It must not contain unnecessary redundancy i.e. be relevant for reliable decisions by managers.
- It must be provided at a suitable frequency i.e. not too frequently.
- It must be accurate enough for the purpose in hand.

- It must be compatible with response time needs of the systems i.e. it should be available when the planning or control decisions are to be taken or ought to be taken.

3.3.1 Categories/Levels of Information

There are three main categories of information. They tend to related to the levels of information. Higher levels of information tend to be associated with strategic information and lower level with operational information.

Strategic Information: relates to long-term planning policies and is therefore of most interest to top management. In business organization strategic information include market availability and penetration figures, product development, manpower changes, projected raw material costs and new technologies.

Strategic information covers overall profitability, capital equipment needs and future market prospects, profit comparisons with previous periods, trend of cash flows, current share prices. It is communicated not too often.

Tactical Information: is used in short-term planning, i.e. months rather than years, and is of more interest at department level. This is used by middle management to ensure that the resources of the business are employed to achieve the strategic objectives of the organisation, or is usually prepared regularly, weekly or monthly.

Such information includes sales analysis and forecasts, cash flow projections, production resources requirements and the annual financial statements, manpower levels both current and projected, operating expenses, amount of capital expenditure incurred on various projects and the level of productivity being attained.

Operational Information: applies to shorter-term, perhaps hourly running of a department. It is usually of direct interest to a fewer number of people than is tactical information but is more specific to those persons.

It includes current stock-in-hand, outstanding and overdue purchase orders, work- in-progress levels etc. Operational information can generally be derived from current activity data.

It is often connected with the need for emergency action and so demands rapid preparation. In a payroll office, for example, operational information

relating to labour cost will include hours worked each week by employee, his rate of pay per hour, details of deductions and details of the time each man spent on individual jobs during the week. Such information is required weekly but more urgent information, such as raw materials available is required on daily basis.

3.3.2 Types of Information

Quantitative Information deals with the magnitude of variables, their variability and absolute value expressed in terms of the quantity of various entities. Examples include:

- variations in the level of income and expenditure, stocks, product costs
- variations from the credit limit allowed to customers
- variations in the amount of capital expenditure on projects
- average queuing time in the banking floor
- level of labour turnover
- actual quantity produced or sold

Qualitative Information relates to the attributes of an entity in respect of quality factors. It is useful for managerial control and entails comparisons with quality standards and actual achievements as a basis for ‗management by exception'. Examples are:

i. Effectiveness of current methods of producing information.
ii. Quality of information for effective decision-making.
iii. Variations of quality of the ingredients used in the manufacture of foodstuffs which after taste and texture.

4.0 CONCLUSION

In this unit, you learn about the concepts of data, information and data processing.

5.0 SUMMARY

The knowledge of data, information and electronic data processing is a prerequisite to understanding the fundamental underpinnings of information system.

6.0 TUTOR-MARKED ASSIGNMENT

1. List and describe each of the components in the data hierarchy.
2. Distinguish between data and information and between information systems literacy and computer literacy.

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UNIT 3 OVERVIEW OF SYSTEMS IN THE ORGANISATION

CONTENTS

1.0 INTRODUCTION

No single system provides all the information an organization needs. Organizations have many information systems serving different organizational levels and functions. Thus, the typical systems found in organisations are designed to assist workers or managers at each level and in the functions of sales and marketing, manufacturing, accounting, finance, and human resources. In this unit, we describe the specific categories of systems serving each organizational level.

2.0 OBJECTIVE

The objective of this unit is to classify the basic information systems in an organisation.

3.0 MAIN CONTENT

3.1 Classification of Information System

The type of information system that a user uses depends on their level in an organization. The following diagram shows the three major levels of users in an organization and the type of information system that they use.

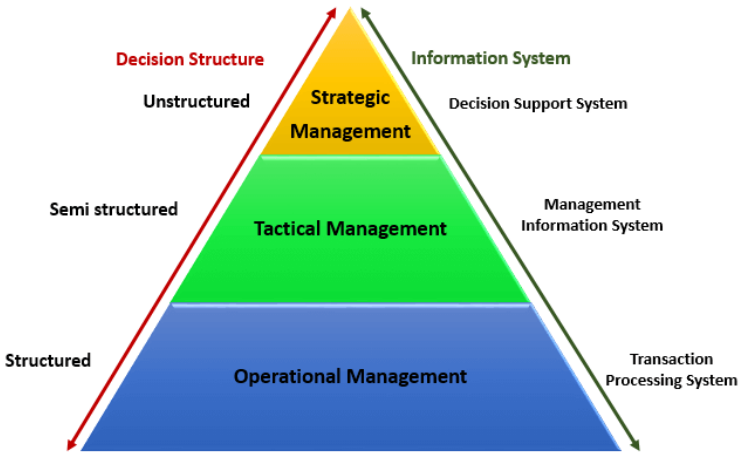

Fig. 3.1: Information systems in an organisation

3.1.1 Transaction Processing Systems (TPS)

Transaction processing systems serve the operational level of the organization. A transaction processing system is a computerized system that performs and records the daily routine transactions necessary to the conduct of the business. Examples are sales order entry, hotel reservation systems, client information systems, payroll systems, employee record keeping.

This type of information system is used to record the day to day transactions of a business. An example of a Transaction Processing System is a Point of Sale (POS) system. A POS system is used to record the daily sales.

Tasks, resources, and goals at the organisation‘s operational level are predefined and highly structured. The decision to grant credit to customer, for instance, is made by a lower-level supervisor according to predefined criteria. The decision, in that sense, has been programmed. All that must be determined is whether the customer meets the criteria.

Two features of TPS are noteworthy. First, TPS span the boundary between the organisation and its environment. They connect customers to the firm‘s warehouse, factory, and management. If TPS do not work well, the organisation fails either to receive inputs from the environment (orders) or to deliver outputs (assembled goods). Secondly, TPS are major producers of information for the other types of systems. Because TPS track relations with the environment, they are the only place where managers can obtain both up-to-the-minute assessments of organisational performance and long term

records of performance. TPS can be viewed as ―organisational message processing systems‖ (Huber, 1982), informing managers about the status of internal operations and about the firm‘s relations with the external environment, and supporting other information systems that facilitate management decision making (Culnan, 1989). TPS failure for a few hours can spell the demise of a firm and perhaps other firms linked to it.

All organizations have five kinds of TPS, even if the systems are manual. These five kinds of TPS are sales/marketing, manufacturing/production, finance/accounting, human resources, and other types of TPS that are unique to a particular industry. The master file in each of the systems is composed of discrete pieces of information (such as a name, address, or customer number) called data elements. Data are keyed into the system, updating the data elements. The elements on the master file are combined in different ways to make up reports of interest to management. These TPS can generate other report combinations of existing data elements.

3.1.2 Management Information Systems (MIS)

Management information system (MIS) help managers monitor the organisation‘s current performance and predict future performance, so that they can intervene when things are not going well. The system helps management control the organisation.

MIS are generally dependent on underlying transaction processing systems (TPS) for their data. MIS summarize and report on the basic operations of the company, often using data supplied by TPS. The basic transaction data are compressed by summarization and are usually presented in long reports. The reports are usually produced on a regular schedule; they answer structured, routine questions. A typical MIS will transforms transaction level data from inventory, production, accounting or any other unit into a sample report that might be produced by an MIS system for managers to use.

MIS serve managers interested in weekly, monthly, and yearly results not day-to- day activities. MIS address structured questions that are known well in advance, are generally not flexible, and have little analytical capability.

Newer MIS are more flexible and may include software that lets managers structure their own reports and combine data from separate files and TPS. For instance, suppose a director of sales wanted to know if prices charged to major customers this year are keeping pace with cost increases. An MIS could tell the sales director if the customer bought as much this year as last year and could compare the profit margin between this year and last.

Management Information Systems are used to guide tactic managers to make semi- structured decisions. The output from the transaction processing system is used as input to the MIS system.

Table 3.1: A sample Report that might be produced by an MIS System

Consolidated Consumer Product Corporation
Sales by Product and Sales Region

PRODUCT CODE	PRODUCT DESCRIPTION	SALE REGION	ACTUAL SALES	PLANNED	ACTUAL VS PLANNED
490389	Roll-on	North	4,066,700	4,800,000	0.85
		West	3,778,112	3,750,000	1.01
		East	4,867,001	4,600,000	1.06
		South	4,003,440	4,400,000	0.91
	TOTAL		16,715,253	17,550,000	0.95
		West	5,608,112	4,700,000	1.19
		East	4,711,001	4,200,000	1.12
		South	4,563,440	4,900,000	0.95
	TOTAL		18,559,255	17,700,000	1.05

3.1.3 Decision Support Systems (DSS)

Any system that supports a decision is a decision support system. Nonetheless, systems support decisions in a vastly different way, and there is a class of systems that supports decisions in a unique way.

DSS are quick-hit, interactive, model-oriented, and action-oriented, whereas MIS systems tend to be ponderous, batch-oriented, and data-oriented (Sprague and Carlson 1982; Keen 1985). DSS have to be responsive enough to run several times a day in order to correspond to changing conditions.

DSS have a different set of users from MIS.

DSS are used by managers and also by the vast army of knowledge workers, analysts, and professionals whose primary job is handling information and making decisions. Clearly by design, DSS have more analytical power than other systems; they are built explicitly with a variety of models to analyze data. The database is important as well, but the emphasis is on analysis. Second, DSS are designed so that users can work

with them directly; these systems explicitly include user- friendly software. This follows both from their purpose (to inform personal decision making by key actors) and from the method of design. Third, these systems are interactive; the user can change assumptions and include new data.

Decision support systems are used by top level managers to make semi-structured decisions. The output from the Management Information System is used as input to the decision support system. DSS systems also get data input from external sources such as current market forces, competition, etc.

3.2 Manual Information Systems Vs. Computerized Information Systems (MIS)

Data is the bloodstream of any business entity. Everyone in an organisation needs information to make decisions. An information system is an organized way of recording, storing data, and retrieving information.

In this section, we will look at manual information systems vs. computerized information systems.

3.2.1 Manual Information System

A manual information system does not use any computerized devices. The recording, storing and retrieving of data is done manually by the people, who are responsible for the information system.

The following are the major components of a manual information system

- **People:** They are the recipients of information system
- **Business Procedures:** These are measures put in place that define the rules for processing data, storing it, analyzing it and producing information
- **Data:** These are the recorded day to day transactions
- **Filing system:** This is an organized way of storing information
- **Reports:** The reports are generated after manually analyzing the data from the filing system and compiling it.

The following diagram illustrates how a typical manual information system works

Fig. 3.2: Typical Manual Information System

Advantages and Disadvantages of a manual information system

Advantages:
The following are the advantages of manual information systems

- **Cost effective:** it is cheaper compared to a computerized system because there is no need to purchase expensive equipment such as servers, workstations, printers, etc.
- **Flexible:** evolving business requirements can easily be implemented into the business procedures and implemented immediately

Disadvantages:
The following are some of the disadvantages of a manual information system.

- **Time consuming:** All data entries need to be verified before filing, this is a time-consuming task when done by humans. Retrieving data from the filing system also takes a considerable amount of time

- **Prone to error:** The accuracy of the data when verified and validated by human beings is more prone to errors compared to verification and validation done by computerized systems.

- **Lack of security:** The security of manual systems is implemented by restricting access to the file room. Experience shows unauthorized people can easily gain access to the filing room

- **Duplication of data:** Most departments in an organization need to have access to the same data. In a manual system, it is common to duplicate this data to make it easy to accessible to all authorized users. The challenge comes in when the same data needs to be updated

- **Data inconsistency:** Due to the duplication of data, it is very common to update data in one file and not update the other files. This leads to data inconsistency

- **Lack of backups:** If the file gets lost or mishandled; the chances of recovering the data are almost zero.

3.2.2 Computerized Information System

Computerized systems were developed to address the challenges of manual information systems. The major difference between a manual and computerized information system is a computerized system uses a combination of software and hardware to record, store, analyze and retrieve information.

Advantages and Disadvantages of a Computerized Information System

The following are some of the advantages and disadvantages of a computerized information system.

Advantages:

The following are the advantages of computerized information systems

- **Fast data processing and information retrieval:** this is one of the biggest advantages of a computerized information system. It processes data and retrieves information at a faster rate. This leads to improved client/customer service
- **Improved data accuracy:** easy to implement data validation and verification checks in a computerized system compared to a manual system.
- **Improved security:** in addition to restricting access to the database

server, the computerized information system can implement other security controls such as user's authentication, biometric authentication systems, access rights control, etc.

- **Reduced data duplication:** database systems are designed in such a way that minimized duplication of data. This means updating data in one department automatically makes it available to the other departments
- **Improved backup systems:** with modern day technology, backups can be stored in the cloud which makes it easy to recover the data if something happened to the hardware and software used to store the data
- **Easy access to information:** most business executives need to travel and still be able to make a decision based on the information. The web and Mobile technologies make accessing data from anywhere possible.

Disadvantages:

- **It is expensive to set up and configure:** the organisation has to buy hardware and the required software to run the information system. In addition to that, business procedures will need to be revised, and the staff will need to be trained on how to use the computerized information system.
- **Heavy reliance on technology:** if something happens to the hardware or software that makes it stop functioning, then the information cannot be accessed until the required hardware or software has been replaced.
- **Risk of fraud:** if proper controls and checks are not in place, an intruder can post unauthorized transactions such as an invoice for goods that were never delivered, etc.

4.0 CONCLUSION

No single system provides all the information an organization needs. Organizations have many information systems serving different organizational levels and functions. Thus, the typical systems found in organisations are designed to assist workers or managers at each level and in the functions of sales and marketing, manufacturing, accounting, finance, and human resources. In this unit, we describe the specific categories of systems serving each organizational level.

5.0 SUMMARY

- MIS is the acronym for Management Information System. It is a collection of people, procedures, data, and information technology that aids managers to make informed decisions.
- Computerized information systems are more efficient compared to manual information systems. Manual information systems are cheaper compared to computerized information systems.
- Transaction processing systems (TPS) are by operational staff to record day to day business transactions, and they are used to make structured decisions
- Management Information Systems (MIS) are used by middle-level managers to make semi-structured decisions
- Decision Support Systems are used by top level managers, and they help top level managers to make unstructured decisions.

6.0 TUTOR-MARKED ASSIGNMENT

1. Compare and contrast the three main types of information system in Organizations
2. Why are information systems so essential for running and managing a business today?
3. List and describe six reasons why information systems are so important for business today.

7.0 REFERENCES/FURTHER READING

Laudon, K.C. & Laudon J.P. (2012). *Management Information Systems: Managing the Digital Firm*. (12th ed.). Boston; London: Pearson.

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UNIT 4 INFORMATION SYSTEM AND ORGANISATION

CONTENTS

1.0 INTRODUCTION

A typical organization is divided into operational, middle, and upper level. The information requirements for users at each level differ. Towards that end, there are number of information systems that support each level in an organization.

This Unit will explore the different types of information systems, the organizational level that uses them and the characteristics of the particular information system.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define an organization
- State features of organizations

- Discuss organizational politics
- explain organizational cultures
- examine organizational environments
- analyse information system
- discuss information system department
- explain organizational levels and information requirements.

3.0 MAIN CONTENT

3.1 Organizations and Information Systems

Information systems and organizations influence one another. Information systems are built by managers to serve the interests of the business firm. At the same time, the organization must be aware of and open to the influences of information systems to benefit from new technologies.

The interaction between information technology and organizations is complex and is influenced by many mediating factors, including the organization‘s structure, business processes, politics, culture, surrounding environment, and management decisions (see Figure 4.1). You will need to understand how information systems can change social and work life in your firm. You will not be able to design new systems successfully or understand existing systems without understanding your own business organization.

In contemporary systems there is a growing interdependence between a firm’s information systems and its business capabilities. Changes in strategy, rules, and business processes increasingly require changes in hardware, software, databases, and telecommunications. Often, what the organization would like to do depends on what its systems will permit it to do.

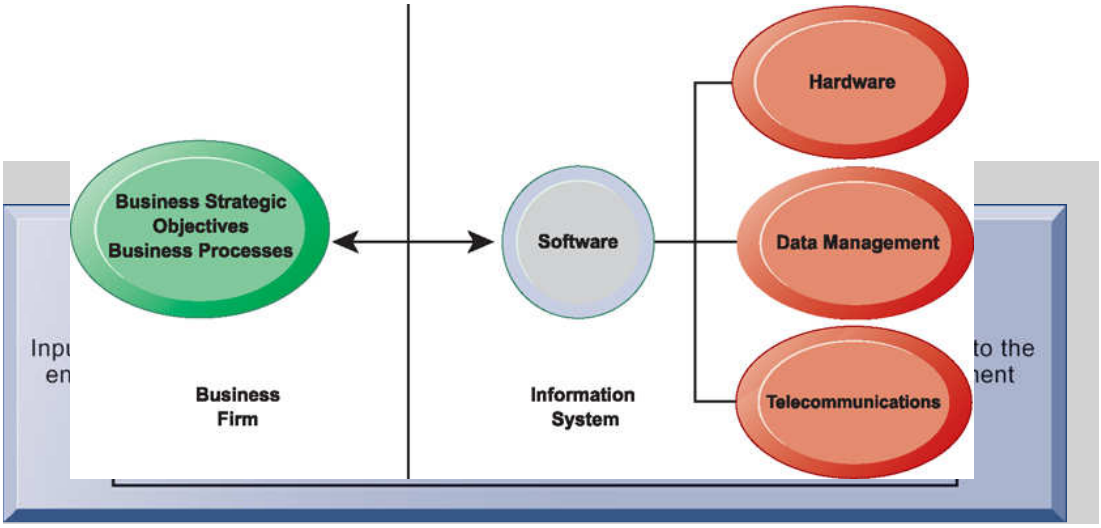


Fig. 4.1: The interdependence between Organisation and Information system

3.1.1 What is an Organization?

An organization is a stable, formal social structure that takes resources from the environment and processes them to produce outputs. This technical definition focuses on three elements of an organization. Capital and labour are primary production factors provided by the environment. The organization (the firm) transforms these inputs into products and services in a production function. The products and services are consumed by environments in return for supply inputs (see Figure 4.2).

An organization is more stable than an informal group (such as a group of friends that meets every Friday for lunch) in terms of longevity and routineness. Organizations are formal legal entities with internal rules and procedures that must abide by laws. Organizations are also social structures because they are a collection of social elements, much as a machine has a structure—a particular arrangement of valves, cams, shafts, and other parts.

This definition of organizations is powerful and simple, but it is not very descriptive or even predictive of real-world organizations. A more realistic behavioural definition of an organization is that it is a collection of rights, Privileges, obligations, and responsibilities that are delicately balanced over a period of time through conflict and conflict resolution (see Figure 4.3).

In this behavioural view of the firm, people who work in organizations develop customary ways of working; they gain attachments to existing relationships; and they make arrangements with subordinates and superiors about how work will be done and the amount of work that will be done.

Figure 4.2: The Technical Microeconomic Definition of the Organization

In the microeconomic definition of organizations, capital and labour (the primary production factors provided by the environment) are transformed by the firm through the production process into products and services (outputs to the environment). The products and services are consumed by the environment, which supplies additional capital and labour as inputs in the feedback loop.

The behavioural view of organizations emphasizes group relationships, values, and structures.

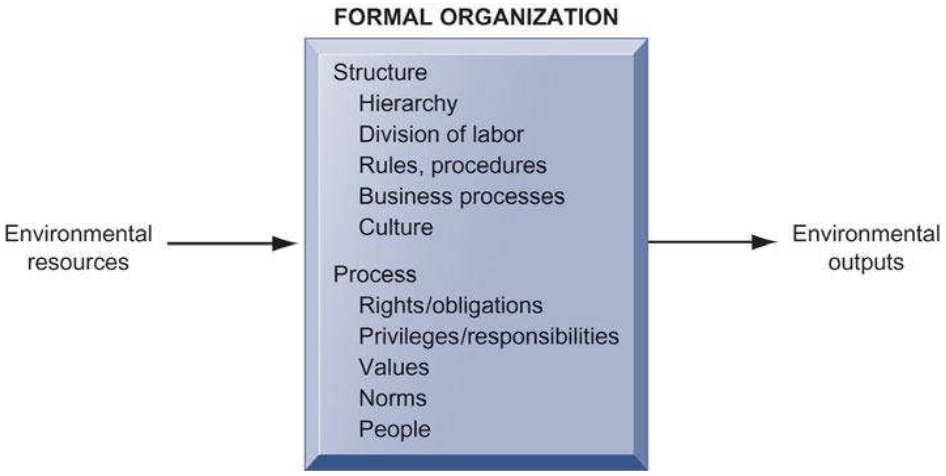


Figure 4.3: The Behavioural View of Organizations

3.1.2 Features of Organizations

All modern organizations have certain characteristics. They are bureaucracies with clear-cut divisions of labour and specialization. Organizations arrange specialists in a hierarchy of authority in which everyone is accountable to someone and authority is limited to specific actions governed by abstract rules or procedures. These rules create a system of impartial and universal decision making. Organizations try to hire and promote employees on the basis of technical qualifications and professionalism (not personal connections). The organization is devoted to the principle of efficiency: maximizing output using limited inputs. Other features of organizations include their business processes, organizational culture, organizational politics, surrounding environments, structure, goals,

constituencies, and leadership styles. All of these features affect the kinds of information systems used by organizations.

Routines and Business Processes
All organizations, including business firms, become very efficient over time because individuals in the firm develop **routines** for producing goods and services. Routines - sometimes called **standard operating procedures** - are precise rules, procedures, and practices that have been developed to cope with virtually all expected situations. As employees learn these routines, they become highly productive and efficient, and the firm is able to reduce its costs over time as efficiency increases. For instance, when you visit a doctor‘s office, receptionists have a well-developed set of routines for gathering basic information from you; nurses have a different set of routines for preparing you for an interview with a doctor; and the doctor has a well-developed set of routines for diagnosing you.

3.1.3 Organizational Politics

People in organizations occupy different positions with different specialties, concerns, and perspectives. As a result, they naturally have divergent viewpoints about how resources, rewards, and punishments should be distributed. These differences matter to both managers and employees, and they result in political struggle for resources, competition, and conflict within every organization. Political resistance is one of the great difficulties of bringing about organizational change, especially the development of new information systems. Virtually all large information systems investments by a firm that bring about significant changes in strategy, business objectives, business processes, and procedures become politically charged events. Managers that know how to work with the politics of an organization will be more successful than less-skilled managers in implementing new information systems.

3.1.4 Organizational Culture

All organizations have bedrock, unassailable, unquestioned (by the members) assumptions that define their goals and products. Organizational culture encompasses this set of assumptions about what products the organization should produce, how it should produce them, where, and for whom. Generally, these cultural assumptions are taken totally for granted.

3.1.5 Organizational Environments

Organizations reside in environments from which they draw resources and

to which they supply goods and services. Organizations and environments have a reciprocal relationship. On the one hand, organizations are open to, and dependent on, the social and physical environment that surrounds them.

Organizations must respond to legislative and other requirements imposed by government, as well as the actions of customers and competitors.

On the other hand, organizations can influence their environments. For example, business firms form alliances with other businesses to influence the political process; they advertise to influence customer acceptance of their products.

Figure 4.5 illustrates the role of information systems in helping organizations perceive changes in their environments and also in helping organizations act on their environments. Information systems are key instruments for **environmental scanning,** helping managers identify external changes that might require an organizational response.

Environments generally change much faster than organizations. New technologies, new products, and changing public tastes and values (many of which result in new government regulations) put strains on any organization‘s culture, politics, and people. Most organizations are unable to adapt to a rapidly changing environment. Inertia built into an organization‘s standard operating procedures, the political conflict raised by changes to the existing order, and the threat to closely held cultural values inhibit organizations from making significant changes. Young firms typically lack resources to sustain even short periods of troubled times. It is not surprising that only 10 per cent of the Fortune 500 companies in 1919 still exist today.

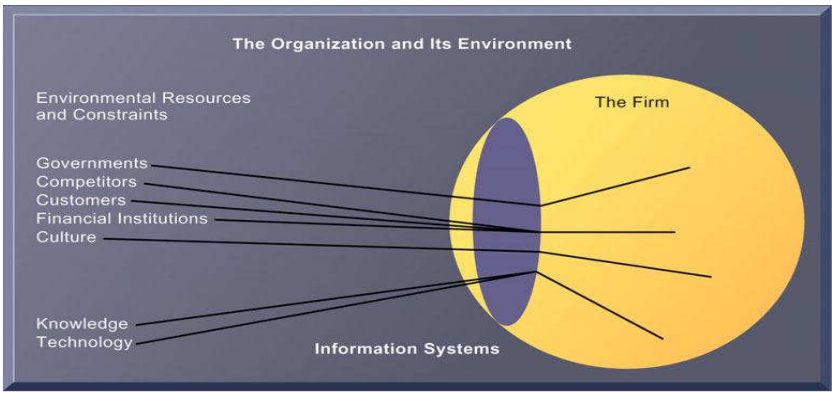


Figure 4.5: Environments and Organizations have a Reciprocal Relationship

Environments shape what organizations can do, but organizations can influence their environments and decide to change environments altogether. Information technology plays a critical role in helping organizations perceive environmental change and in helping organizations act on their environment.

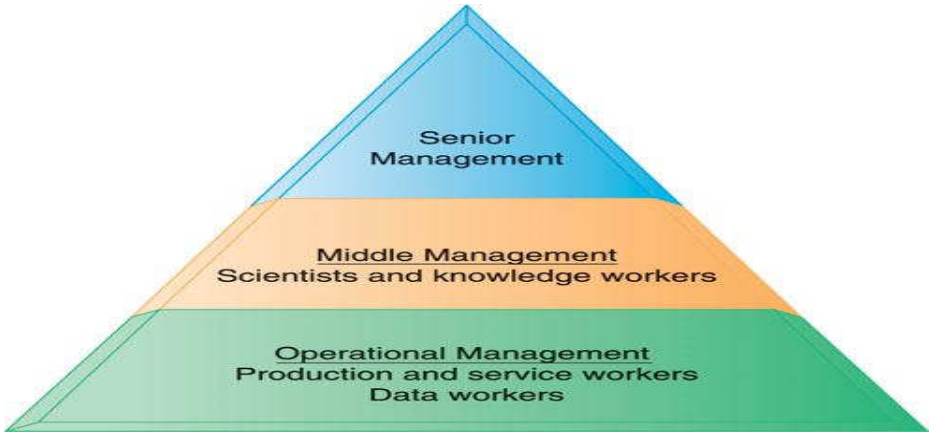


Fig. 4.6: Levels in an Organisation

Business organizations are hierarchies consisting of three principal levels: senior management, middle management, and operational management. Information systems serve each of these levels. Scientists and knowledge workers often work with middle management.

3.1.6 What is an Information System?

An **information system** can be defined technically as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and control in an organization. In addition to supporting decision making, coordination, and control, information systems may also help managers and workers analyze problems, visualize complex subjects, and create new products.

Information systems contain information about significant people, places, and things within the organization or in the environment surrounding it.

By **information** we mean data that have been shaped into a form that is meaningful and useful to human beings. **Data**, in contrast, are streams of raw facts representing events occurring in organizations or the physical environment before they have been organized and arranged into a form that people can understand and use.

A brief example contrasting information and data may prove useful. Supermarket checkout counters scan millions of pieces of data from bar codes, which describe each product. Such pieces of data can be totalled and analyzed to provide meaningful information, such as the total number of bottles of dish detergent sold at a particular store, which brands of dish detergent were selling the most rapidly at that store or sales territory, or the total amount spent on that brand of dish detergent at that store or sales region

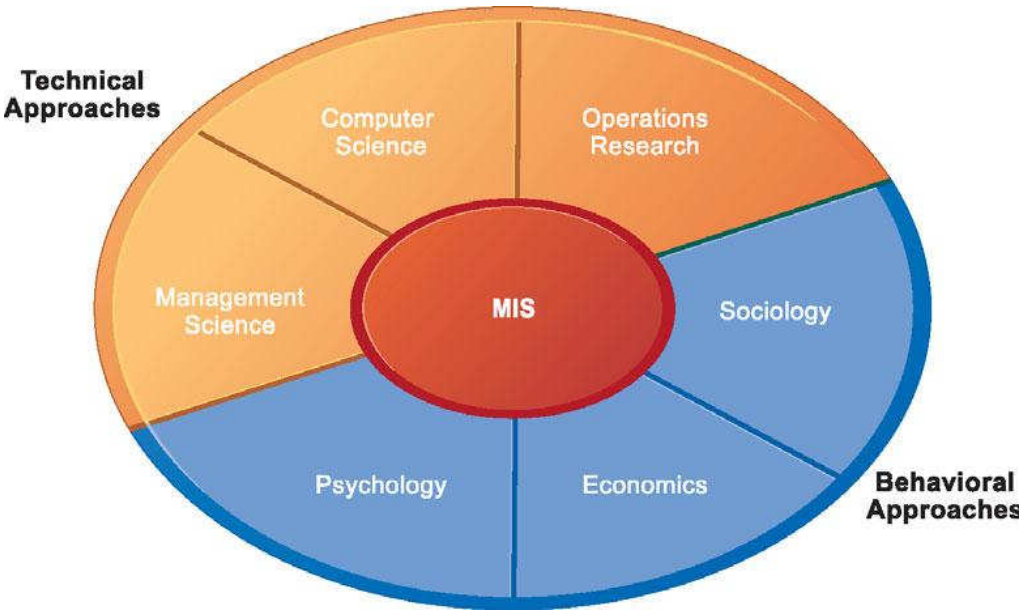


Fig. 4.7: Approaches to study of information Systems

The study of information systems deals with issues and insights contributed from technical and behavioural disciplines.

3.1.7 The Information Systems Department

The information systems department consists of specialists, such as programmers, systems analysts, project leaders, and information systems managers.

Programmers are highly trained technical specialists who write the software instructions for computers.

Systems analysts constitute the principal liaisons between the information systems groups and the rest of the organization. It is the systems analyst‘s

job to translate business problems and requirements into information requirements and systems.

Information systems managers are leaders of teams of programmers and analysts, project managers, physical facility managers, telecommunications managers, or database specialists. They are also managers of computer operations and data entry staff. Also, external specialists, such as hardware vendors and manufacturers, software firms, and consultants, frequently participate in the day- to-day operations and long-term planning of information systems.

In many companies, the **information systems department** is headed by a **chief information officer (CIO)**. The CIO is a senior manager who oversees the use of information technology in the firm. Today‘s CIOs are expected to have a strong business background as well as information systems expertise and to play a leadership role in integrating technology into the firm‘s business strategy. Large firms today also have positions for a chief security officer, chief knowledge officer, and chief privacy officer, all of whom work closely with the CIO.

The **chief security officer (CSO)** is in charge of information systems security for the firm and is responsible for enforcing the firm‘s information security. Sometimes this position is called the chief information security officer (CISO) where information systems security is separated from physical security. The CSO is responsible for educating and training users and information systems specialists about security, keeping management aware of security threats and breakdowns, and maintaining the tools and policies chosen to implement security.

Information systems security and the need to safeguard personal data have become so important that corporations collecting vast quantities of personal data have established positions for a **chief privacy officer (CPO)**. The CPO is responsible for ensuring that the company complies with existing data privacy laws.

The **chief knowledge officer (CKO)** is responsible for the firm‘s knowledge management program. The CKO helps design programs and systems to find new sources of knowledge or to make better use of existing knowledge in organizational and management processes.

End users are representatives of departments outside of the information systems group for whom applications are developed. These users are playing an increasingly large role in the design and development of information systems.

In the early years of computing, the information systems group was composed mostly of programmers who performed highly specialized but limited technical functions. Today, a growing proportion of staff members are systems analysts and network specialists, with the information systems department acting as a powerful change agent in the organization. The information systems department suggests new business strategies and new information-based products and services, and coordinates both the development of the technology and the planned changes in the organization.

3.2 Organizational Levels and Information Requirements

Understanding the various levels of an organization is essential to understand the information required by the users who operate at their respective levels.

The following diagram illustrates the various levels of a typical organization.

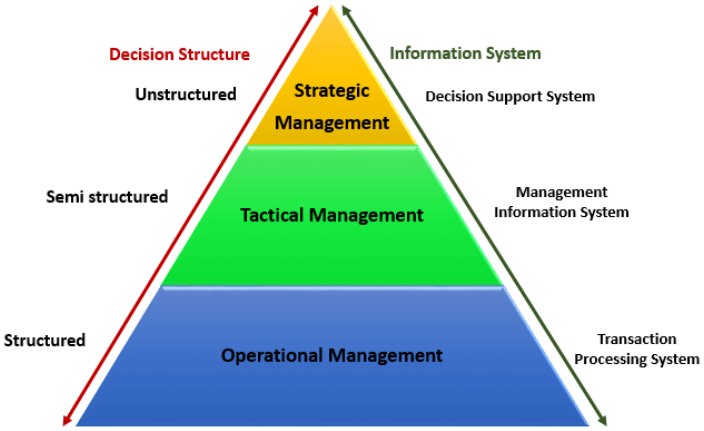


Fig. 4.8: Organizational Levels and Information Requirements

3.2.1 Operational management level

The operational level is concerned with performing day to day business transactions of the organization.

Examples of users at this level of management include cashiers at a point of sale, bank tellers, nurses in a hospital, customer care staff, etc.

Users at this level use make structured decisions. This means that they have defined rules that guide them while making decisions.

For example, if a store sells items on credit and they have a credit policy that has some set limit on the borrowing. All the sales person needs to decide whether to give credit to a customer or not are based on the current credit information from the system.

3.2.2 Tactical Management Level

This organization level is dominated by middle-level managers, heads of departments, supervisors, etc. The users at this level usually oversee the activities of the users at the operational management level.

Tactical users make semi-structured decisions. The decisions are partly based on set guidelines and judgmental calls. As an example, a tactical manager can check the credit limit and payments history of a customer and decide to make an exception to raise the credit limit for a particular customer. The decision is partly structured in the sense that the tactical manager has to use existing information to identify a payments history that benefits the organization and an allowed increase percentage.

3.2.3 Strategic Management Level

This is the most senior level in an organization. The users at this level make unstructured decisions. Senior level managers are concerned with the long-term planning of the organization. They use information from tactical managers and external data to guide them when making unstructured decisions.

Transaction Processing System (TPS)
Transaction processing systems are used to record day to day business transactions of the organization. They are used by users at the operational management level. The main objective of a transaction processing system is to answer routine
questions such as:

- How many printers were sold today?
- How much inventory do we have at hand?
- What is the outstanding due for John Doe?

By recording the day to day business transactions, TPS system provides answers to the above questions in a timely manner.

For example, banks that give out loans require that the company that a person works for should have a memorandum of understanding (MoU) with

the bank. If a person whose employer has a MoU with the bank applies for a loan, all that the operational staff has to do is verify the submitted documents. If they meet the requirements, then the loan application documents are processed. If they do not meet the requirements, then the client is advised to see tactical management staff to see the possibility of signing a MoU.

Examples of transaction processing systems include:

- **Point of Sale Systems**: records daily sales
- **Payroll systems:** processing employees' salary, loans management, etc.
- **Stock Control systems**: keeping track of inventory levels
- **Airline booking systems**: flights booking management

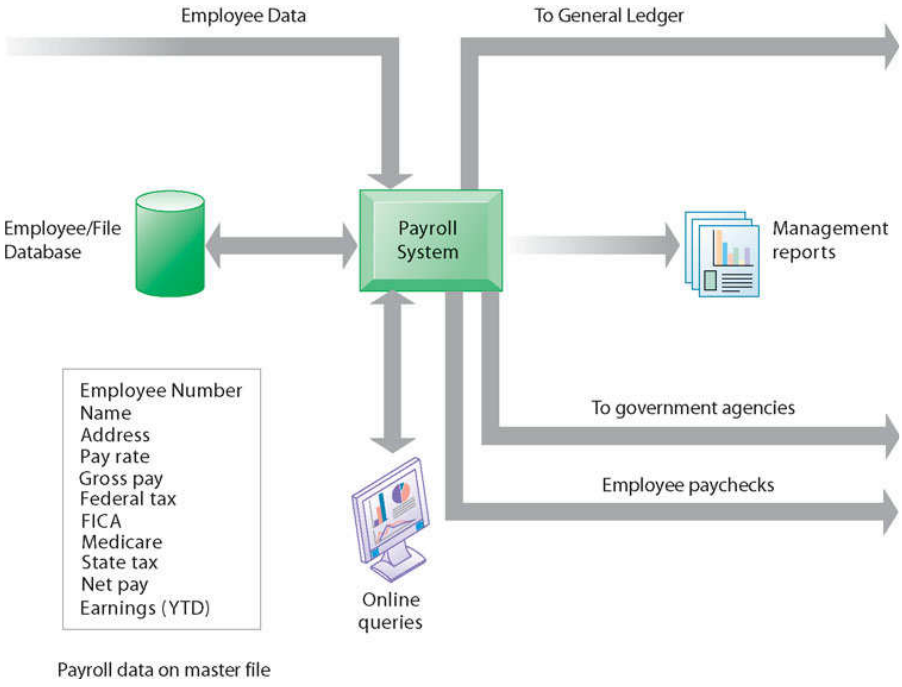


Fig.4.9: Fig. 4.1: A Payroll TPS

A TPS for payroll processing captures employee payment transaction data (such as a time card). System outputs include online and hard-copy reports for management and employee paychecks.

Management Information System (MIS)
Management Information Systems (MIS) are used by tactical managers to monitor the organization's current performance status. The output from a transaction processing system is used as input to a management information system.

The MIS system analyzes the input with routine algorithms i.e. aggregate, compare and summarizes the results to produced reports that tactical managers use to monitor, control and predict future performance.

For example, input from a point of sale system can be used to analyze trends of products that are performing well and those that are not performing well. This information can be used to make future inventory orders i.e. increasing orders for well-performing products and reduce the orders of products that are not performing well.

Examples of management information systems include:

- **Sales management systems**: they get input from the point of sale system
- **Budgeting systems**: gives an overview of how much money is spent within the organization for the short and long terms.
- **Human resource management system**: overall welfare of the employees, staff turnover, etc.

Tactical managers are responsible for the semi-structured decision. MIS systems provide the information needed to make the structured decision and based on the experience of the tactical managers, they make judgement calls i.e. predict how much of goods or inventory should be ordered for the second quarter based on the sales of the first quarter.

Decision Support System (DSS)
Decision support systems are used by senior management to make non-routine decisions. Decision support systems use input from internal systems (transaction processing systems and management information systems) and external systems.

The main objective of decision support systems is to provide solutions to problems that are unique and change frequently. Decision support systems answer questions such as:

i. What would be the impact of employees' performance if we double the production lot at the factory?
ii. What would happen to our sales if a new competitor entered the market?

Decision support systems use sophisticated mathematical models, and statistical techniques (probability, predictive modelling, etc.) to provide solutions, and they are very interactive.

Examples of decision support systems include:

i. **Financial planning systems**: it enables managers to evaluate alternative ways of achieving goals. The objective is to find the optimal way of achieving the goal. For example, the net profit for a business is calculated using the formula Total Sales less (Cost of Goods + Expenses). A financial planning system will enable senior executives to ask what if questions and adjust the values for total sales, the cost of goods, etc. to see the effect of the decision and on the net profit and find the most optimal way.

ii. **Bank loan management systems**: it is used to verify the credit of the loan applicant and predict the likelihood of the loan being recovered.

Competitive advantage of information

Competitive advantage is a position that makes a business more profitable than its competitors. For example, producing products at a lower cost than your competitors make you more profitable.

Information systems have the capacity to help an organization into such a position. They do so in the following ways:

Operational excellence: operational excellence seeks to improve the operations of the business. Let's take an example of a retail store. A retail store can use information systems to automatically place an order with a supplier once the inventory level reaches the re-order limit. This ensures that the retail store never runs out of inventory and customers can always count on it to find what they need.

New business models, products, and services: let's continue with the example of a retail store. The retail store can develop a web based order system or smartphone application that clients can use to buy items from the comfort of their homes or wherever they are. The order system can be linked to a delivery business and have support for online payments. This is a new business model compared to customers walking in to make purchases versus doing it from web based or smartphone apps.

Improved supplier and customer relations: historical data is used to understand the needs of the customers and suppliers. This data is then used to create services and products that address the needs. This leads to long-term relationships with customers and business which puts an organization in a more profitable position.

Improved decision making: information is critical when making decisions. Information systems if designed and operated efficiently that have all the characteristic of good information described in the above section. This enables an organization to make decisions that bring results.

Porter's Value chain

Think of a company such as Apple Inc. Why are they successful? Why do customers love and buy the iPhone? It is because the iPhone adds value to their lives. This is why Apple Inc. is a successful business. Value chain refers to activities that a company performs to create value for its customers.

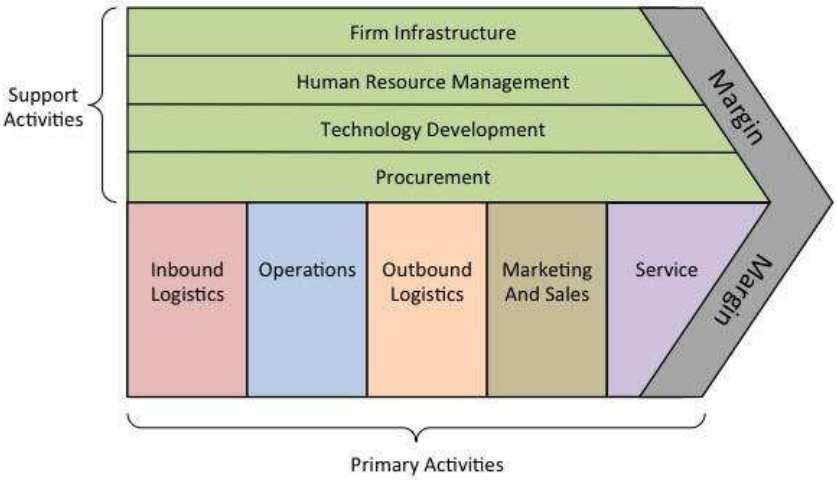
The concept of a value chain was developed by Michael Porter. Porter's value chain has two activities namely;

- **Primary activities:** these are activities that are related to the creating products/services, marketing and sales, and support. Primary activities consist of inbound logistics, operations, outbound logistics, marketing and sales, and service.

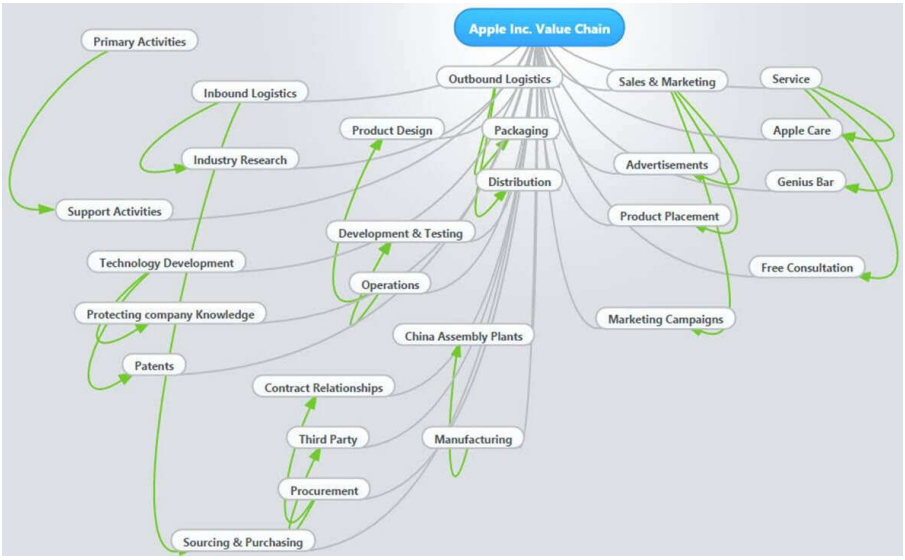
- **Support activities**: these are activities that support the primary activities.

Support activities consist of procurement (purchasing), human resource management, technological development and infrastructure.

The following diagram depicts the value chain



The following illustration shows the value chain for Apple Inc.



The overall goal of the value chain is to help a business gain competitive advantage. Competitive advantage is a business's position in a market that makes it to be more profitable than its direct competitors.

3.3 Influence of IT on Organizational Goals

Organizational goals refer to objectives and the mission of the organization, especially in the long term. Regardless of the type of business that an organization engages in, the overall goal is to create value for the customers or clients as stated in the above section.

Business Information Technology alignment is concerned with using information technology to effectively achieve business goals.

Two of the most common ways that an organization can provide value is by offering a quality product at a lower price than the competitor or at a high price but with more features that add value to the customers.

Information technology enables businesses to process and analyze large amounts of data at a cheaper cost and within the shortest possible time. This enables organizations to provide quality products at a cheaper price.

Let's take a bank example. A bank can use ATM to allow the clients to withdraw money and other automated means to deposit money. Customers with queries can be directed to a website that has frequently asked questions. Both individuals and businesses can view the statements online if they subscribe to internet banking.

The above IT business practices lead to reduced costs of doing business and creating new products and services. Reduced cost of doing business enables a bank to reduce the bank charges, therefore, offering a quality product or service at a cheaper rate.

Artificial intelligence techniques in business

Artificial intelligence systems mimic human expertise to identify patterns in large data sets. Companies such as Amazon, Facebook, and Google use artificial intelligence techniques to identify data that are most relevant to you.

Let's use Facebook as an example. Facebook usually makes very accurate predictions of people that you might know or went with to school. They use the data that you provide to them, the data that your friends provide and based on this information make predictions of people that you might know.

Amazon uses artificial intelligence techniques too to suggest products that you should buy also based on what you are currently getting.

Google also uses artificial intelligence to give you the most relevant search results based on your interactions with Google and your location.

These techniques have greatly contributed in making these companies very successful because they are able to provide value to their customers.

Online Analytical Processing (OLAP)
Online analytical processing (OLAP) is used to query and analyze multi-dimensional data and produce information that can be viewed in different ways using multiple dimensions.

Let's say a company sells laptops, desktops, and Mobile device. They have four (4) branches A, B, C and D. OLAP can be used to view the total sales of each product in all regions and compare the actual sales with the projected sales.

Each piece of information such as product, number of sales, sales value represents a different dimension

The main objective of OLAP systems is to provide answers to ad hoc queries within the shortest possible time regardless of the size of the datasets being used.

4 .0 CONCLUSION

In this unit we look at the information system and organization; and how they relate with the environment. We also look at organizational levels of information systems along with their requirements.

5.0 SUMMARY

Business entities exist to make profits. Not-for-profit organizations exist to deliver quality services or products cost effectively. Regardless of the type of organization, Information systems have a major role to play in achieving the objectives. Information systems enable organizations to make sound decisions by providing decision makers with information.

6.0 TUTOR-MARKED ASSIGNMENT

1. What exactly is an information system? How does it work? What are its management, organization, and technology components?
2. Define an information system and describe the activities it performs.
3. List and describe the organizational, management, and technology dimensions of information systems.
4. Define an organization and compare the technical definition of organizations with the behavioural definition.
5. Identify and describe the features of organizations that help explain differences in organizations' use of information systems.

7.0 REFERENCE/FURTHER READING

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UNIT 5 CONTEMPORARY TRENDS IN INFORMATION AND COMMUNICATION TECHNOLOGIES

CONTENTS

1.0 INTRODUCTION

This unit is about information systems, not about technology taken on its own. The technology we primarily consider, information technology(IT) or information communication technology (ICT), is the subject of other academic fields such as electronics, computer science, software engineering, or communications engineering. Each of these fields is relevant to us at times, but they are in general our primary concerns in this course. Thus for this course, it is not appropriate to see these technologies in isolation from their use by organisations and by people, the tasks they help us achieve, the reasons we use them, and the various services and infrastructures that they rely on. And yet, it is hard to talk about information systems without at the very least making some fairly important assumptions about the technology that is present as part of the information system, and what it is expected to do.

Even the most business oriented discussion of e-commerce for example, will be based on an assumption that the internet is widely available, generally reliable, safe and secure, and that certain software (e.g. web browsers) and various types of devices (PC, tablets, smartphones) are available and work.

Such a discussion may also need to reflect how the availability, characteristics and mode of use of all this technology changes over time. Ten or more years ago we really had no mobile devices like today – laptops in those days were known as "luggables" and mobile phones in films from

the late 1980s are the size of a house brick. Today in countries both rich and poor, we are used to using mobile phones to access information systems (or perhaps we should say as ‗part of' information systems), and increasingly we are moving to multi-function tablet devices such as the Apple iPad. It is also fairly clear that in 10 more years (2027) things will have changed again.

Many introductory books provide adequate coverage of basic technologies, and most students taking this course will have some experience of using some types of ICT – although more in their personal lives than in a business or organisational context. What you read about technology in textbooks may at times seem a little detail. This is not surprising. First, because it takes time for a text book author to conclude that something is important, to write about it with examples, for the manuscript to be edited and the book to appear in a shop. (Although these same technologies might be able to speed up this process a bit perhaps). But it also reflects the need for people who study technologies in organisational settings to understand that, while our attention may be drawn to all things new in technology, real organizations with long histories will have lots of older technology within them. So, a little history, or attention to past trends, is still relevant knowledge today. And the language we use to speak about information systems is also influenced by that past.

Working with information systems today is not all about smartphones, iPads and social networking. It is a lot about managing the results of previous decisions and the technologies of previous generations. We even have a name for such systems and technology – we call them legacy systems or legacy technologies – that is, systems and technologies that are handed down from a previous generation. Often a project to develop a new information system is quite constrained by the legacy systems that surround it and which it will need to interact with.

The unit also initiates a discussion over the possible impact that specific types of technology may have on how organizations are structured or how they go about their business.

2.0 OBJECTIVES

At the end of this unit, you would be able to:

- express a logical understanding of how the technical parts of a computer-based information system work, their principal structures and components including contemporary software technologies for

information processing and communications
- demonstrate a good understanding of the significance of history for
- understanding contemporary information systems and the concept of legacy systems
- discuss the evolution of different types of information and communication
- technologies (eras) and the extent to which new technologies have led to changes in the way organizations use technology and are structured and operate
- explain client–server, enterprise and cloud computing and give examples of each
- describe the database approach and offer examples of its advantages over a file- based approach.

3.0 MAIN CONTENT

3.1 Communications Technologies and Distributed Systems

Modern information systems rely on the technology of communications as much as on the traditional technology of computers and data handling. It is common for the information systems of organizations to need multiple elements in many geographical locations (distributed systems). For example, an oil company with sites on five continents would expect to be able to share information and build common systems to help run the business. This would all be based on a set of interlocking networks in buildings, on oil rigs, in refineries and across oceans. The benefits of being able to develop such systems might be more efficient operations, more sharing of information and the use of standard procedures. The use of a distributed approach extends beyond one organisation, and networks become a part of the way organizations do business with each other. For example, through a B2B e-commerce application an oil company might take orders for chemicals from its main customers or reserve wharf space for its tankers in various ports.

The internet; the network of networks that we all have access to and through which we can all share information has provided an even stronger impetus for using communications in information systems. (For information on the history of the internet try www.internetsociety.org/internet/what-internet/history-internet/) Today this communications medium – the net – is seen by many as both the principal new challenge and the most exciting opportunity for building and using information systems. In the case above, the oil company may well use the internet as the basis for their distributed

business systems, but they will almost certainly be concerned that the internet is too open and vulnerable. to serve as a basis for their business. One means to provide secure communications across the internet is to use the technology of virtual private networks (VPN).

3.1.1 Wide Area Networks and Local Area Networks

The basis of most wide area networking was, in the past, the old landline telephone system. Simple telephone connections were once used to transmit data with the aid of modems. But, since telephone networks were built to transmit voices in analogue form, not computer data in a digital form, they are not really suitable for high volumes and high-speed data transmission. The result was the establishment of special-purpose data communications networks that are able to provide far better performance characteristics – although they may use the telephone wires for the final link to the house or office – the last mile. Today in most countries we expect to receive such data at speeds of, say, 5 to 20 megabits per second – maybe more if we are lucky and live in a big city.

But things have changed more fundamentally. Once it was a question of forcing data onto an essentially voice-oriented telephone network. Now we see the opposite. The most general network available to us is the digital network – the internet – and voice traffic can now be easily integrated into this. Thus, we see a huge growth in Voice over IP technology (VOIP). The most common example is the service of Skype (www.skype.com), but there are many other VOIP providers and 4G mobile phones all work using VOIP.

Of course, traditional telephone companies do not like their business being hijacked by new start-up internet companies that can offer international calls at zero cost.

Local area networks (LANs) are used to link computers within a restricted geographical range. A LAN will typically connect computers in one building or one city block. They use special cabling – often based on fibre optics – and can transfer data at speeds in excess of 100 megabits per second. (100 megabits per second may be a conservative figure – whatever figure we write here is bound to be exceeded before this subject guide is revised again!) If a dedicated computer is attached to a local area network to provide services, it is called a **server**. For example, a college computer system may have 20 microcomputers in a room connected by a **100 Mb/sec** network to one **print server** and one **file server**. The file server would allow the sharing of data and programs among a class of students. Today

such a network may well not be based on wired connections, but might use a **wireless** technology (WiFi) although probably slower than 100 Mb/sec, to allow machines to communicate.

We should also note that networks are usually described in terms of raw speed of transmission in terms of bits per second (MB/sec). But quantities of data are expressed in bytes (megabytes or kilobytes). So, if we need to answer a question about how long it would take to transmit a file measured in megabytes across a network whose speed is expressed in megabits per second, we need to multiply the file size by 8 – to convert bytes into bits – before dividing by the network speed. Even then we may not have a very accurate answer. First, because the raw capacity of a network may be being shared by many users – we don‘t have the full capacity available to us.

Second, because there are plenty of housekeeping and control overheads that also need to be taken into account. In particular, assuming we are using the main network protocols of the internet – **TCP/IP** – we will have to add considerably more data to the total to transmit as the data is split up into separate packages; each one is numbered, and the destination address is added to each. What is more, a network may not be very reliable; we have to expect some packets of data will be lost, and we will need to identify these (through the packet numbers), and ensure that they are resent.

3.1.2 The Internet and the World Wide Web

The internet came about through academic and military projects in the 1970s and 1980s. In the 1990s it mushroomed, becoming a great network of networks that spans the globe and provides services to the largest multinational corporation as well as to individual people. The internet is used to communicate – as in email or chat programs, to move data and files around – as well as to publish information to a worldwide community. The internet manages to operate around the world through the standard adoption of certain rules and **protocols** for addressing and passing messages. The principal standard is known as TCP/IP (transmission control protocol/internet protocol). Access to the internet is usually made via an **internet service provider** (ISP), which is often part of a telecommunications or media company.

The basis of the universal and worldwide acceptance of the internet as the basis for digital communication has been the establishment of certain standard protocols **(rules and conventions)** for exchanging data. We have already briefly discussed the two main protocols that are at the heart of the internet – **TCP**, the transmission control protocol that ensures data is sent

completely from one point to another, and **IP** – the internet protocol that ensures that each individual packet of data is routed through the internet to the right destination. There are a number of other protocols that are in common use, for example for the World Wide Web **HTTP** – hypertext transfer protocol, which allows web pages to be located and retrieved.

From a user‘s point of view, the main technologies they see as they use the internet are perhaps an email client, which prepares, sends and receives messages, and a **browser program** such as **Firefox, Chrome or Internet Explorer**, through which they navigate around the world wide web. Other applications could include instant messaging, file transfer or voice over IP telephony (e.g. Skype).

To find information, World Wide Web users usually need to access some kind of **search engine** such as **Google or Bing** to provide a list of relevant sites based on some **key words**. If and when a user wishes to trust the internet with sensitive information – for example, to send a credit card number to a company – then a user may need to become aware of the various means of securing information, such as **encryption** and the protocols that secure servers use such as **HTTPS**; a protocol enabling the secured transmission of web pages. Finally, when we come to publish our own information, we will need to master the simple language used to prepare web pages – HTML (hypertext mark-up language).

The existence of the internet has also given rise to new areas of business, including ISPs, and the vast range of old and new companies do business over the internet i.e. **e-commerce**. As one example, Amazon has pioneered selling books over the internet. Likewise, airlines now sell tickets over the net, and most banks offer online banking services. Other types of organisation also use the internet; for example, most governments around the world now publish much of their material on the web and allow all manner of transactions to be processed by citizens directly – what is commonly known as **e-government.**

SELF-ASSESSMENT EXERCISE

The UK government‘s main presence on the web in terms of services to citizens is www.direct.gov.uk/ Find your own government’s main website or portal. In this way, it is argued, all manner of services can become more accessible and available to their population. There are, however, some problems, and not everybody can access the web, has the skills to do so, or even the right equipment.

Individuals and large corporations use the internet. However, for companies, the example of publishing information using browsers to find what is needed and generally sharing information has led them to consider using the same model for their internal communication needs. These are known as intranets (intra means inside).

The internet has very significant consequences in breaking down national boundaries and jurisdictions. A business may be registered in country A, operate from country B and sell goods to consumers in country C and perhaps avoiding any **tax liability** in any of the three countries.

Information of all kinds can flow into and out of countries with almost no effective control. Some see this as a good thing, bringing the world together; others see it as a significant risk. For these reasons the question of regulating the internet is often raised in international forum and by some governments.

SELF-ASSESSMENT EXERCISE

i. Find out which businesses from your country offer their products or services over the internet. Are any targeted to overseas clients?
ii. Which are most successful?
iii. Why do you think that is so?
iv. Are there any obvious missing business – what do you think this may be so? There may be some cultural or developmental explanations for lack of take-off; for example, the desire to bargain and haggle, or lack of credit cards or the desire to keep transactions informal.
v. What is the most successful e-government service in your country?
vi. What do you think lies behind this success?
vii. What benefits do people, and the government, obtain from these services? Do they both obtain benefits equally?
viii. What are the main issues that arise in your country about the way that the internet opens up information and allows it to flow across borders?
ix. Are there any controls on information accessed through the web in your country?
x. Are they effective?
xi. Do you believe this situation should be changed in any way?

3.2 Databases and the Database Approach

In a traditional file-based approach, each application has its own separate files to store relevant data. This may make it easier to develop each

individual application, but it may cause longer term problems. It is likely that data will need to be shared between applications, and storing it many times will be wasteful and will lead to inconsistencies.

It has therefore become standard in business to approach data storage using a database approach rather than a file-based approach.

The principles behind this are to store data in an integrated and coordinated manner, so that many users or application programs can share it. Items of data should be stored only once. This will allow improved control of information, avoid inconsistencies and allow security to be carefully managed. On the negative side, a database approach requires careful design, and if done poorly, may allow data errors to propagate among every application that uses the database. If your bank stores your email address just once, and all applications use that single record when they want to contact you, but it is not entered correctly or is corrupted, then you will get no email from the bank.

When designing a database, the data to store has to be carefully assessed and the way it is stored carefully designed to take into account the needs of all the various users and the various requirements they may have.

Such design is also important to ensure that as data is updated (added to, deleted, changed, etc.), the overall database still remains consistent. As a simple example of updating, if a company deletes a customer record from their database (for example, because the customer has gone out of business), they should probably also delete all the outstanding orders from this customer. Should they delete all the orders that have been supplied in the past, or all the payments that have been made? Certainly not particularly if they want the accounts to be balanced at end of the year and the stock records to be accurate.

The database approach is supported by using software called a **database management system** (DBMS). This software takes care of the details of storage of data, and provides the user or the application programs with a simple interface through which they can request items of data and return them for storage. Such interfaces are provided for programs to use as they run and for individual users who wish to extract some information directly from a database on an ad hoc basis – a query language – one example of which is **SQL** (Structured Query Language).

Database software can also be slower and less efficient than file-based processing if absolute speed is of the essence (which it usually is not these days).

Various models have been used to structure data in databases, including the relational model, network model, hierarchical model and object model. For this course, we only consider the relational model for design of a database although we do use an object-oriented style of diagramming for undertaking analysis.

Big enterprise scale databases can be centralized or distributed. That is, they can pull all the data together and store it in a single location. Users then access it as they need to, probably by using networks. The alternative is to distribute the database. We could store, for example, all data relating to motor cars in Nigeria in one place, and all data relating to Ghana in another. Logically it might be one database, but operationally data is stored closer to where it is used. Software might take care of all this detail as seen by any user – in the case of photos stored on Picasa or Dropbox you and I have no idea where in the world they really are, or where there are backup copies of the photos! We just trust the service supplier.

We may also choose to replicate a database, with a full copy of the database held in two or more locations. This could be a way to ensure security and integrity. If one data Centre is out of action, another is available, but there is the problem of ensuring that updates and changes made in one copy are reproduced on the others and that the copies remain synchronized. Again, software can help, but this is more complex to do and may at times fail.

SELF-ASSESSMENT EXERCISE

i. Describe what is meant by the phrase "the database approach"?
ii. What benefits should an organisation get from adopting such an approach?
iii. What problems or specific issues do you foresee if a database approach is combined with a distributed approach (for example, a distributed database)?
iv. Based on your own online research, prepare a brief report for the senior management of a medium sized chain of department stores on the potential benefits and challenges of moving a substantial share of the company's data processing and data storage to a cloud provider, and scaling down dramatically the company's in-house data processing facilities and staff.

4.0 CONCLUSION

The logical understanding of how a computer based information system works; including the software and communication technologies is the focal discuss in this unit.

5.0 SUMMARY

Having completed this unit, you should be able to:

i. Express a logical understanding of how the technical parts of a computer-based information system work, their principal structures and components including contemporary software technologies for information processing and communications.
ii. Demonstrate a good understanding of the significance of history for understanding contemporary information systems and the concept of legacy systems.
iii. Discuss the evolution of different types of information and communication technologies (eras) and the extent to which new technologies have led to changes in the way organizations use technology and are structured and operate.
iv. Explain client–server, enterprise and cloud computing and give examples of each.
v. Describe the database approach and offer examples of its advantages over a file- based approach.

6.0 TUTOR-MARKED ASSIGNMENT

1. Research and write up a brief description of what each of the following internet related protocols and standards do and how they work: TCP, IP (often combined with TCP), FTP, SMTP, HTTP and HTTPS, HTML and XML.

2. New types of Information and Communication Technology will often drive really substantial and necessary change in how business or governments operate. For this reason, information systems professionals need to know a lot about technology and keep abreast of new trends, while managers and executives need to work hard to keep their businesses on the leading edge of technology innovation. Employees and workers have a responsibility to accept technology and willingly adapt to these changes – the world does not stand still. Critically assess the ideas in this assertion. Do you agree fully, fully disagree, or do you have reservations or nuances to add? In answering this question, use modern and relevant examples to illustrate your points.

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UNIT 6 PERSPECTIVE ON INFORMATION SYSTEMS

CONTENTS

1.0 INTRODUCTION

It is important to have understanding about systems, various types available, classifications and their relationship. This will guide organizations in knowing the appropriate information system suitable for their organization. This is the essence of this unit.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- Define information system
- List types of information systems
- Analyse the relationships among information systems.

3.0 MAIN CONTENT

3.1 Information System

Information system may be defined as a system or related group of systems, which collects and presents management information relating to a

business in order to facilitate its control. It applies to systems, which make use of database facility for the storage and retrieval of information.

In general, an information system may be defined as a data processing system which provides information to management for the purpose of controlling the business and as a basis for making decisions.

Information system is a systematic formal, assemblage of components that perform data processing operations to:

- Provide information to management for support of planning, control and decision making.
- Provide a variety of reports.
- Meet legal and transactional data requirements for production process that may be required daily or hourly.

Management needs to know about the efficiency of individuals so that direct positive action may be taken to improve it. For example, credit control can only be effective by knowing the accounts status of individual customers. It is also necessary to know the stock position of each item in the stores to avoid unfortunate stock-out situations on one hand and overstocking on the other hand.

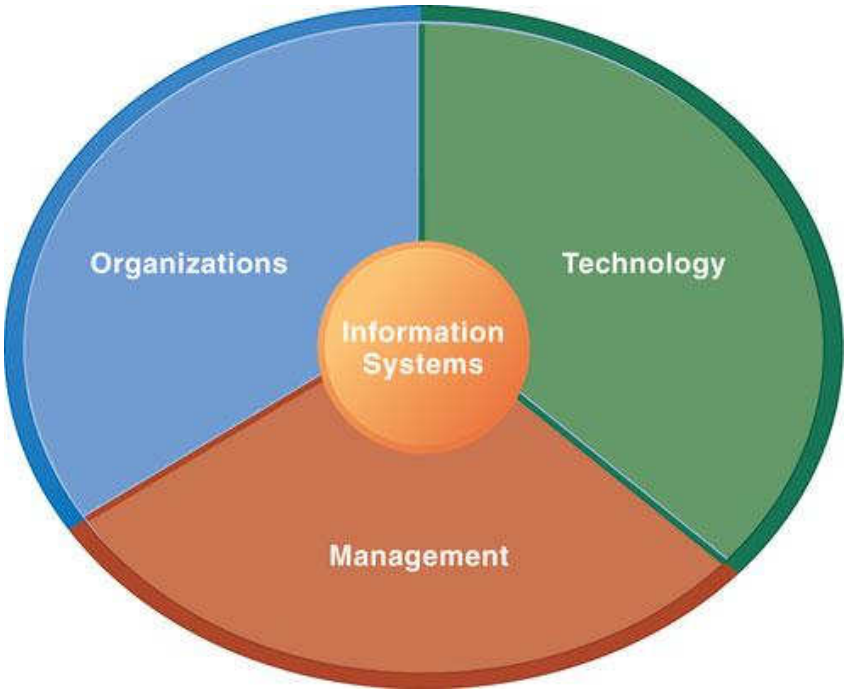

Fig. 6.1: Information Systems are more than Computers

Using information systems (see figure 6.1) effectively requires an understanding of the organization, management, and information technology shaping the systems.

An information system creates value for the firm as an organizational and management solution to challenges posed by the environment.

3.1.1 Objective of Information System

The main objective of information system is to use formalized procedures to provide management with appropriate information from all relevant sources, which would enable the manager make timely and effective decisions.

Information system's component includes hardware, programs, data, procedures and people. Hardware and people are the actors; data is the bridge while programs and procedures are the instructions. Business in organization consists of several procedures which have been grouped logically into information systems. A procedure can be described as a specific sequence of steps performed to complete one or more information processing activities.

3.1.2 Elements of an Information System

- Communication process or model
- Management
- Information
- System

Communication Model: Communication is at the base of every MIS. It describes the process by which information is communicated in an organization. A communication can be one-way or two-way.

A one-way communication system is the one in which communication flows from the originator to the receiver only e.g. radio broadcast. A two-way communication system is that in which communication flows from the originator to the receiver and back to the communicator e.g. a classroom discussion or telephone conversation. Feedback is the essence of a two-way communication system. Two- way communication system is more relevant to business organizations than one- way communication system.

Management: This is the primary source within an organization which co- ordinates the activities of the sub-systems and relates them to the environment.

The management process involves planning, organizing, control and communication.

Management can be categories into top, middle and lower management. These levels correspond to the different division of activities between the management groups in an organization.

At the top where the greater responsibility and accountability is expected, strategic decisions are taken. These consist of defining the objective of the organization and outlining the strategy of achieving them.

To ensure that desirable results are achieved, control is exercise first by establishment of standards and the measurement of performance against standard using feedback reports.

Information: Information is a processed data. This could be in the form of annual reports and accounts research reports, or even a listed total or outstanding debtors of a bank branch. Information is usually categorized as strategic, management control and operations.

- Strategic information has the characteristics of being futuristic, environmental, non-routine and important fact that affect both the health and existence of an organization etc.

- Management control information is made of performance reports both current and historical, predictive (though short- term) and stimulate i.e. what if sort of information. Operations information consists largely of performance.

Management information required for effective and efficient planning, decision making and control activities should ideally be accessible, accurate, comprehensive, appropriate, timely, clear, flexible, verifiable, free from bias and quantifiable.

System can be defined as an organized or complex whole. It is made up of sub- concepts, yet all concepts. It connotes plans, order and method of arrangement.

Thus there are business system, communication system, solar system, digestive system, etc.

A system can be characterized in terms of predictability. When the inputs, the processors and the outputs are known, the system is said to be deterministic. But when elements of uncertainty feature the system is said to be probabilistic.

Where a system does not interact within its environment in any way, it is a closed system. When it is affected and in turn affects its environment. It is an open system.

When the working of the processor is neither known of definable it is referred to as black contents of information system.

The information system will include some or all of the following:

- data entry and preparation devices
- data storage device
- telecommunications and equipment
- data processing equipment to record, verify, classify, arrange, summarize, calculate, store, retrieve, reproduced and communicate
- terminal information devices.

3.1.3 Functions of an Information System

Data Processing: A data processing information system is organized to collect and process raw data into valuable information in an efficient and effective manner whether manual or computerized system. The electronic data processing (EDP) system has the advantage of being capable of producing information (such as financial statements and budgets) much more accurately speedily and cheaply. Thus management of efficiency and effectiveness can be improved considerably by a mechanized data processing system.

Decision-making: An information system can monitor by itself disturbances in a system, determine a cause of action and take action to get the system in control i.e. information constitutes an efficient tool to management. For instance, a computer programmed to determine automatically the Economic Order Quantity (EOQ), the re-order levels, and to prepare purchase orders for items below re-order levels.

For non-programmable decisions, an information system provides support by supplying information for the search, the analysis, the evaluation and the choice and implementation processes of decision-making.

Planning: Planning involves the establishment of organizational goals, the identification of problems and resource constraints and the establishment of strategies to help achieve set objectives**.** Information is required to identify as many alternatives as possible.

Control: involves three elements:

i. Establishment of a standard output i.e. the desired performance level of the system.
ii. Design and implementation of a sensor which gathers data that relates to the output, evaluates and measures the performance of the output, and communicates the resulting information to management.
iii. Employment of a manager or mechanism, which takes corrective action should the information so indicate.

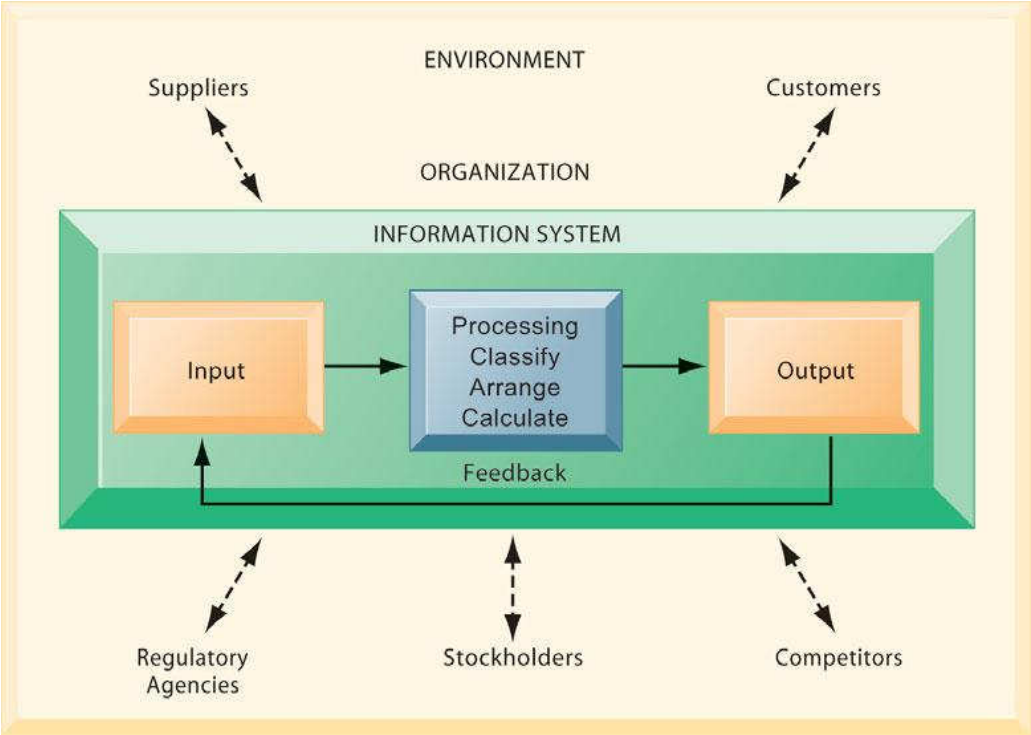

Fig. 6.2: Functions of an Information System

An information system (see figure 6.2) contains information about an organization and its surrounding environment. Three basic activities—input, processing, and output - produce the information organizations need. Feedback is output returned to appropriate people or activities in the organization to evaluate and refine the input. Environmental actors, such as customers, suppliers, competitors, stockholders, and regulatory agencies, interact with the organization and its information systems.

This corrective action results in the release of decisions, which act as inputs, back into the process of the system. All these management activities require information.

Information flows horizontally and vertically, and it is with the vertical flow (between superiors and subordinates) that management information system is most concerned.

Reports generated by an information system will range between:

- Information for low-level management about the small area of the business under their control.
- Reports of a broader nature for top-level management concerned with overall control.

The central care of MIS is likely to be tactical information for management control, although the MIS will have many sub-systems, and sub-system providing information ranging from operational through tactical to strategic.

The control cycle i.e. the comparison of actual results against a plan; and the production of exception reports to show where control action may be needed but cannot be effective unless the plan is carefully prepared, a precise and carefully drawn up specification of the areas of management responsibility is essential, this specification is necessary to ensure that information will flow to the managers who need it.

The information produced must be able to measure actual results against the plan in such a way that control decisions can be taken at the levels of management. Data must also be available to enable senior management to plan for the future; computers are of especial value in preparing forecasts from large quantities of data.

3.1.4 Attributes of Management Information Report

The primary characteristic of any management information report is that the benefits to be derived from its production and use should outweigh the costs of its production. However the measurements required to carry out such a cost-benefit analysis for each report are difficult to ascertain. Nevertheless a review of all regularly produced reports should be carried out in order to find out whether their continued production is justified. It should be noted that the benefits to be derived from regularly produced reports are frequently of a contingency nature. A control report showing that activity is proceeding according to plan will require no action and its production will have produced no change in activities from which incremental benefit can be derived; but if the report were to show that activities were not proceeding according to plan then the resulting action taken could extremely be valuable.

There are many desirable attributes of management information reports and each of them, apart from the cost attributes mentioned above, concern the effective provision of information on which the recipient contract. Among the attributes are:

i. **Relevance:** for intended purpose – as each statement should be produced to fulfil a specific need it should contain only data directly relevant to that need and extraneous matter should be omitted. For performance and control reporting, only activities within the responsibility of the recipient should be shown.

ii. **Accuracy:** Each report should be accurate, inaccurate reports can result in a reaction by the recipient, which, although justified by his perceptions drawn from the report, is not the correct action to take.

iii. **Factual:** Where possible the report should be based on fact. When factual information is not available, or when the report requires subjective estimations for it to be relevant, then the factual and estimation contents should be clearly distinguished.

iv. **Volume of Information**: The information should be sufficient to give a full, clear description of the subject matter of the report but not so voluminous that the recipient suffers an information overload.

v. **Volume of detail:** The amount of detail incorporated into the report will depend upon the position of the recipient within the organization. A manager needs far less detail shown on his control reports than does a foreman.

vi. **Presentation of information:** The information should be presented such that important features are highlighted. Regularly produced reports should have a consistent ordering and layout so that recipients may easily locate salient features.

vii. **Timeliness:** A report must be produced at a relevant time if it is to be capable of being useful. There is little point in producing a report which complies with all the features listed above but is produced so long after the point when it was required that it is too late to act upon it.

Unfortunately, many of the desirable qualities tend to conflict with each other as a development of one characteristic may offend the development of another. Among the conflicts are:

(a) **Factual versus relevant information**: Information which is relevant, may be subjective rather than factual. This may be especially so when reports are produced to assist in decision making,

(b) **Accuracy versus timeliness**: Producing a report at a time when it can be useful may require an element of estimation and potential loss of accuracy.

(c) **Volume of information and detail**: These requirements will be difficult to satisfy as the requirements tend to be contradictory. Too much or too little detail or volume may produce ineffective reports.

(d) **Cost versus all other traits**: The desire to restrict to reasonable limits the cost of producing a report can act against the satisfaction of each of the other characteristics.

Therefore, each report will have to be a compromise of characteristics.

3.1.5 Types of Report

Reports can be categorized into:

Scheduled reports are reports prepared on regular basis say daily, weekly or monthly. They are usually associated with a cycle of activities such as a payroll. It is important that there is a feedback mechanism to avoid everyone thinking someone else is taking action with the result that nothing happens. Examples include Payroll reports produced on monthly basis, customers' statements of account, a weekly list of stock level,

and a monthly analysis of all overdue balances on customer accounts to monitor possible bad debts.

Exception reports are regular reports, but only include items that are outside the expected norm. This method of reporting is based on the idea that ‗no news is good news'. It is often associated with a system of budgets and the analysis of the actual and variance and variance from the budget. Only exception items, i.e. items that give rise to a variance outside the pre-set tolerance level are reported. This enables management to operate on the management by exception principle, and concentrate its attention on exceptional items.

Demand reports are only produced when requested by a manager. This avoids wasted output, and helps to prevent managers getting an information overload. This method needs a well-defined system of accepting and meeting demands for reports. Managers that are on line can request printouts from their terminals. Managers that are off line must be able to complete a request form knowing the timescale for a response.

Planning reports are used for planning the future strategy and policy of the organization. These will include predictions and forecasts made using various statistical techniques and forecasting packages. It is important that the recipient manager understands how the forecasts have been prepared, and the weaknesses in the statistical methods used.

3.2 Definition of a System

Systems are 'synergistic'. Synergy is used to describe the concept B.5 (11111) i.e. the sum of a whole (the whole being a system) is greater than the sum of individual parts.

A system may be defined as a combination of interrelated elements, or sub- systems, organized in such a way as to ensure the efficient functioning of the system as a whole, necessitating a high degree of co-ordination between sub- systems, each of which is designed to achieve a specified purpose.

System Resources: Business systems require finance resources to enable them operate in the same way that a factory requires resources. Finance is an enabling resource for obtaining the other resources essential to the effective operation of systems. These resources are personnel, office space, machines and equipment and business forms and documents.

Business System: A business system may be defined as a combination of related sub-system consisting of a series of operations arranged in a logical sequence to achieve a particular purpose as efficiently as possible.

System relationship describes relationship of the system with other system that are close to it and how it reacts to or is influences, in its environment by other systems.

3.2.1 Types of Systems Relationship

1. **Closed Systems:** These are systems, which do not interact with their environment either for the exchanged of information or business transactions. Closed systems are isolated from their environment and independent of it so that no environmental influences affect the behaviour of the system. Such systems are self-contained and business systems do not conform to these categories as they interact with their environment to a great degree as no business exit in a vacuum.

2. **Open System:** These are those which interact with their environment either for the collection of data on which to base strategy or for conducting business transactions with suppliers, customers, the general public, trade organization, government, etc.

   Employees are obviously influenced by what they do in their job, but as members of society at large, they are also a part of the environment of the business, and therefore their work inevitably affects the environment. Open systems are adaptive and require speedy reaction to competitive and other situations in the most effective way.

3. **Control Systems:** These are often structurally separate from the systems which they control, i.e. the quality control system controls the quality of production. Control systems are administrative systems for monitoring the results and modifying the state of the physical systems to which they relate.

4. **Input-Output Systems:** Reflect a situation where the output from one system is the input to another even though they may be administered as separate systems. This has been the structure which large systems takes in order to achieve administrative efficiency and convenience.

5. **Coupling and De-coupling or Integration and Disintegration of System:** If systems are over-integrated they become too complex to understand and operate. If one part of the system ceases to function correctly this may cause the system as a whole to deteriorate and perhaps ceases to function completely.

When systems are decoupled, to administer them in some cases become less complex and more flexible. The efficiency with which systems are designed and integrated plays a large part in their failure or success.

3.2.2 Classification of Systems

Systems may be classified according to a hierarchy of level or properties:

1. Cybernetic or Adaptive or Self-organizing System: It is one which adapts and reacts to a stimuli – i.e. adapts to its environment by adjusting its behaviours on a self-organizing basis. The system alerts it‘s input as a result of measuring its performance (outputs) by monitoring its own behaviour.

   Human, plants and organizations are examples of adaptive system. In order to survive in a competitive world, they must react, if they do not react, then they die.

   The most suitable system is the adaptive system. In the human body, a number of adaptive systems control temperature, blood pressure and motor reactions. In electrical systems such as a voltage regulator, the principle of feedback is used.

   Computerized stock control systems are often adaptive as changes in demand are sensed and responses are speedily implemented to change the state of the system to avoid overstocking or stock shortages.

   Computerized credit control system is also adaptive since credit facility will be prevented from exceeding the credit limit in order to minimize exposure to a particular client.

2. Planning System: It deals with the allocation of resources to specific tasks and the setting of performance standards. It establishes the guidelines for future action without which a business is likely to drift in the wrong directions. A budget plan or an

organization is a good example.

3. Probabilistic System: allows its output to be predicted within certain limits i.e. their precise outputs cannot be known in advance. Business and economic systems are of a probabilistic nature, since they are subjected to many internal and external forces.

Information is probabilistic (e.g. forecasts) a set of possible outcomes and their associated probabilities is given.

Production activities are subject to random variations in respect of manpower. Availability and level of productivity achieved, machine breakdowns and materials supply etc.

Production planning and control system are implemented to detect and control such variations in order to minimize their effect on the achievement of desired states.

Similarly, the quality of production varies randomly due to inconsistency in the quality of raw materials, human error and faculty machines operation. Quality control systems are designed to correct such situation.

4.0 CONCLUSION

Knowledge of systems, various types available, classifications and their relationship guide organizations in knowing the appropriate information system suitable for their organization.

5.0 SUMMARY

Here you learn about the main objectives of an information system, types of systems relationships as well as how systems are generally classified.

6.0 TUTOR-MARKED ASSIGNMENT

1. Define the concept System and compare and contrast the various types that exist.
2. Which features of organizations do managers need to know about to build and use information systems successfully? What is the impact of information systems on organizations?

7.0 REFERENCES/FURTHER READING

Adesola, W.A. (2000). 'Management Information System.' Unpublished lecture Note, The Polytechnic Calabar

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MODULE 2

UNIT 1 COMPUTERS AND INFORMATION PROCESSING

CONTENTS

1.0 INTRODUCTION

The unit introduces contemporary information and communications technology including computers of various forms, computer hardware and its logical structure, computer software and networking. The approach is in

part historical, exploring the changes over time (eras) in the dominant model of computing and the way that this technology is deployed by organisations.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- discuss the history of computers
- explain the taxonomy of computers
- discuss about client-server computing.

3.0 MAIN CONTENT

3.1 The History of Computers

The computer that we understand today is widely believed to have been invented during the Second World War (1939 -1945). Both the ENIAC (Electronic Numerical Integrator and Computer) machine and the Harvard Mark 1 were developed by teams in the USA in order to undertake the intensive computations required for the calibration of artillery. At the same time, in Britain, engineers from the British Post Office developed the Colossus machine for deciphering intercepted military communications using electronic technology drawn from telephone exchanges. Of course, ideas of aiding or automating calculation and information storage are much older than that and, for example, the abacus (over 4,000 years old) is still in widespread use today in Asia.

The commercial computer industry started in earnest in the 1950s after the Second World War. For the first 30 years, computers were large, slow (by today's standards), and effectively only available to large organizations. These computers were more or less centralized (located in one place), and data were brought to them, and results (printed on paper) produced and distributed. Until the 1970s, a chain of shops, for example, or the branches of a bank, might have a delivery of printed paper every day or two, and send in stacks of punched cards for processing. The second 30 years, from about 1980, were different. From the mid-1970s computers became small and smaller still, and communications networking became cheaper, faster and increasingly for short distances, wireless. The combination of these two broad trends brought us to where computers are ubiquitous now i.e. found everywhere and in all kinds of devices, and usually networked to other devices and resources.

We are also in the situation where many items have a unique computer identity and can be tracked and monitored. We even have a name for the super linked up assembly of technologies that track and identify just about everything – the internet of things. The key technology driving this change over the last 30 years has been the silicon chip or Very Large Scale Integrated Circuit (VLSI). But this has been accompanied by a range of other hardware technologies such as fibre optics for fast digital networks, optical disks for data storage (CDs), technologies allowing efficient use of the radio spectrum, new battery technologies, flat screens, etc. And behind each of these developments stand dedicated technology companies – large and small – who have driven the pace of development. The most successful companies that drive forward this market are a range of old established names and newcomers.

They each have their own specialty in design, manufacture, marketing etc., and their own business models that allow them to generate revenues and make profits. Some are very technical, some more marketing based, and others more service oriented.

3.2 A Simple model of basic computer hardware

Whether a computer is huge and powerful or small and portable, we can use the same general logical model to understand its structure. The elementary model of a computer is based on four interconnected elements:

- input device
- memory (or storage)
- central processing unit (CPU)
- output device.

In a small PC or mobile phone, the CPU will consist of a single microprocessor fabricated on a silicon chip. Instructions to the computer as to what it is to do (the software, a program) as well as data are entered via the input device and stored in the memory. From there, the instructions can be fetched and executed by the CPU. Software allows the data stored in the memory to be manipulated in various ways, and the results can be displayed via the output device.

This simple model needs to be fleshed out a bit in two directions. First, the processor can be seen as essentially having to perform two functions:

- It must understand program instructions so they can be read and executed in sequence.
- Based on the program instructions, it must manipulate data items

The concept of memory also needs to be explored a little more. It is essential to the character of any computer that it is a stored program device with programs that are stored in memory. The memory that holds the current program and the current data needs to be able to deliver this to the CPU at great speed. There is in this simple model only one CPU and it must not be kept waiting. (In real life, computers big and small will often have multiple processors working in parallel and sharing access to some common storage.) Some memory – referred to as RAM (random access memory) or main memory – is plugged into the body of the computer with direct and high-speed connection to the CPU. RAM is relatively expensive, and the amount of data it can store will be relatively small. When you turn off the computer‘s power, whatever is stored in RAM is lost. Thus, it is said to be volatile storage.

It is fundamental that a computer needs a program to follow in order to do anything useful – but there is a chicken and egg problem here. How do the instructions get into the memory if the volatile memory (RAM) is empty at start up and, hence, the computer has no program to follow to allow it to read some stored program from a secondary storage device? In practice, you know there must be an answer, because when you switch on your computer or phone it does spring into life. That answer is contained in a further form of memory – the ROM (read only memory). ROM is another form of chip memory, but one that will permanently hold the data that is written into it. A computer will have some small program permanently stored within itself, a program that is able to initiate the reading of further programs from the secondary storage devices (for example, discs on a PC, but other, slower chip memory on a phone). This is often referred to as the bootstrap **ROM**, since it pulls the computer up by its bootstraps. Hence the everyday expression to boot or reboot the computer.

As the programs that computers execute have increased in size and complexity, two new approaches to managing memory have been used.

Virtual memory uses portions of the secondary memory (e.g. hard disc) as if they were parts of the main RAM memory of the computer. **Cache memory** speeds up the process of communicating data to and from a secondary storage device, by guessing ahead of time what data is likely to be used by the CPU next and fetching it before it is actually requested.

The description here of computer hardware is brief and somewhat minimal. This is not, after all, the main focus of this course. However, these few basic ideas of how

a computer works logically and schematically are needed to follow the wider discussions and when we come to discuss how computers are used and their consequences in the world.

3.3 Modern Taxonomy of Computers

For a long time, it is usual to classify computers into various distinct types. You need to be familiar with this terminology, even if today it is in some ways too limited to encompass all types of computer-like devices we find and use.

Personal computers (PCs), desktops, workstations: These are the computers we are most familiar with at home and at work – a box of electronics with keyboard and screen that can function as a computer on its own, but which is almost certainly connected to some network and thus to other computers and information resources – for example, the internet and the world wide web. These were far and away the most common type of computer until recently and the emergence of various new devices such as smartphones and tablets. These types of computer still allow all manner of people to have immediate and dedicated access to a computer with a big screen and a keyboard and mouse. Such a computer is usually only used by one person at a time, although they are able to run more than one program at a time.

Workstation is a name sometimes used for a **powerful PC**; for example, the computers used by scientists, engineers and computer professionals. This is in contrast to the general-purpose PC that an office worker may use.

Mobiles, tablets and palm tops: There is now a whole new generation of computers, which are portable, mobile and multifunctional. They may be based on mobile phones, laptops or tablet computers such as the iPad. Such devices use wireless networking (for example, WiFI and/or mobile phone networks) to connect to other computers and information resources. Of course, their small size is a great advantage, but it is also a challenge in providing suitable means of input and output. Today this is often solved (to some degree) by using touch screens and/or voice recognition.

Data centres, enterprise servers and mainframes: A data centre is a large central computing resource for running programs and storing data. Big companies that operate across the world may have just a few such centres to service most of their corporate (enterprise) computing needs. Mainframe is an older term to designate large general-purpose computers. Such machines were long the basis for large, centralized data processing operations; the

name mainframe has been used for at least 50 years. In practice today such a major computer resource would be made up of a number of computers all working in parallel and sharing a set of data storage devices – disks mostly. An example today would be the computers of a bank, which handle customer accounts, or of a government department supporting operations such as the issuing of passports, driving licences or paying people‘s pensions. In each case some of the transactions supported might be done online and directly by a customer or citizen – probably via the internet and a website or perhaps from their phone.

Supercomputers: These are machines built to undertake high-speed computations that may involve vast amounts of data. They are used, for example, for performing engineering and scientific calculations. An example of a use for a supercomputer would be weather forecasting.

Data centres and supercomputers are for high-volume applications with extensive data storage requirements. They generally require special buildings with air- conditioning and cooling systems to keep the computers and storage devices running. One modern example of a supercomputing facility is a GRID. For example, the computing facility that supports the big CERN physics laboratory in Switzerland and in particular the Large Hadron Collider (LHC) where the Higgs boson has been detected, is known as the LHC Computing Grid (LCG) http://public.web.cern.ch. This GRID includes computers in over 100 sites across the world, including about 20 major data centres in different countries, all connected by networks and operating together to share out the work.

The way that CERN explains their GRID on their website is as follows:
The grid is based on the same idea as the Web, which was invented at CERN in the beginning of the 90s: sharing resources between geographically distributed computers. But whereas the Web simply shares information on the computers, the Grid also shares computing power and storage capacity. This means that scientists can log on to the Grid from their PC, and the work they need to be done will be carried out by many machines across the planet. This allows scientists to carry out very complex calculations quickly and simply. (http://public.web.cern.ch/ public/en/spotlight/SpotlightGrid-en.html)

Cloud computing: In the wider world beyond science and engineering, a similar idea to a GRID is today at the forefront of computing and the development of new information systems – called cloud computing. In this case, a large network of computing resources (processors and storage devices) is made available for multiple users to use by the minute or by the

kilobyte of data – just as you pay for phone calls by the second or electricity by the kilowatt. Thus, it is possible for a business organization to rent processing power and data storage capacity on an as-needed basis from a supplier of such services. There may be no need to build and manage a data centre of your own. Two well-known companies that offer such services for business users are Amazon and Microsoft, and they have many clients both big and small. Using the cloud (a public 'for rent' cloud) just to obtain processing power and storage (infrastructure in the jargon – hence Infrastructure as a Service or IaaS), or it may be to also rent the use of software or a specific service – called Software as a Service or SaaS Individual people too may rent storage capacity and software services; for example, in photo sharing sites such as Picasa or general file sharing sites such as DropBox (www.picasa.com; www.dropbox.com). Another example of cloud services for providing software include Google Apps: www.google.com/apps/

3.4 Client Server Computing

In **client/server computing**, desktop or laptop computers called **clients** are networked to powerful **server** computers that provide the client computers with a variety of services and capabilities. Computer processing work is split between these two types of machines. The client is the user point of entry, whereas the server typically processes and stores shared data, serves up Web pages, or manages network activities. The term server refers to both the software application and the physical computer on which the network software runs. The server could be a mainframe, but today, server computers typically are more powerful versions of personal computers, based on inexpensive chips and often using multiple processors in a single computer box.

i. The simplest client/server network consists of a client computer networked to a server computer, with processing split between the two types of machines. This is called **two-tiered client/server architecture**. Whereas simple client/server networks can be found in small businesses, most corporations have more complex, **multitiered** (often called **N-tier**) **client/server architectures** in which the work of the entire network is balanced over several different levels of servers, depending on the kind of service being requested (see Figure 7.1).

For instance, at the first level, a **Web server** will serve a Web page to a client in response to a request for service. Web server software is responsible for locating and managing stored Web pages. If the client

requests access to a corporate system (a product list or price information, for instance), the request is passed along to an **application server**. Application server software handles all application operations between a user and an organization's back-end business systems. The application server may reside on the same computer as the Web server or on its own dedicated computer.

Client/server computing enables businesses to distribute computing work across a series of smaller, inexpensive machines that cost much less than minicomputers or centralized mainframe systems. The result is an explosion in computing power and applications throughout the firm.

Novell NetWare was the leading technology for client/server networking at the beginning of the client/server era. Today, Microsoft is the market leader with its **Windows** operating systems (Windows Server, Windows 7, Windows Vista, and Windows XP).

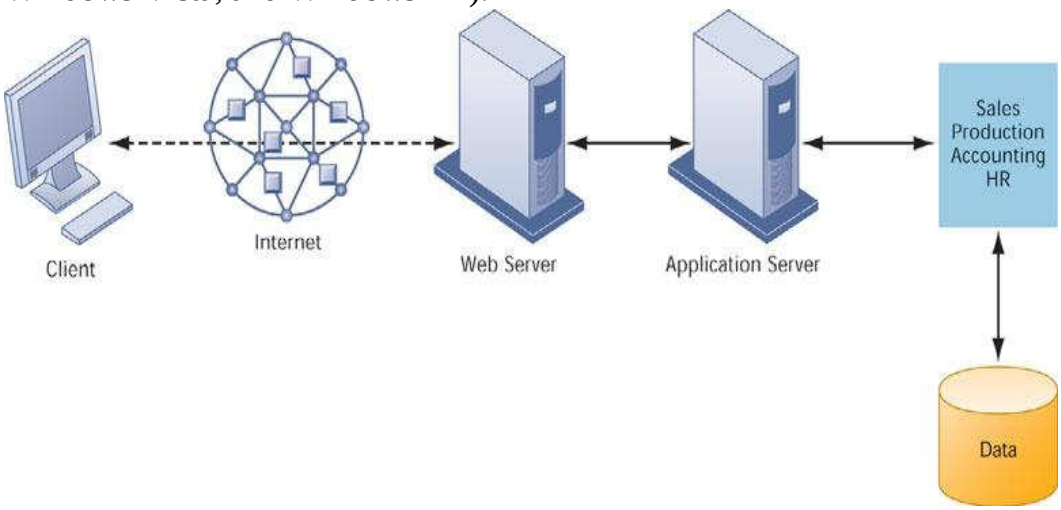

Fig. 7.1: A Multitiered Client/Server Network (n-tier)

In a multitiered client/server network, client requests for service are handled by different levels of servers.

SELF-ASSESSMENT EXERCISE

i. Find and describe three examples of client-server computing.
ii. In each case, try to explain why this approach is used (for example, the benefits it brings) and what tasks (processing, data storage, etc.) are handled by the client and by the server.
iii. Research the benefits and problems of using a commercial cloud service to provide computing resources for a medium sized business. Think in each case (both for benefits and problems) about issues

associated with cost, control, security and flexibility. Do you imagine that one day almost all computing will be provided in this way?

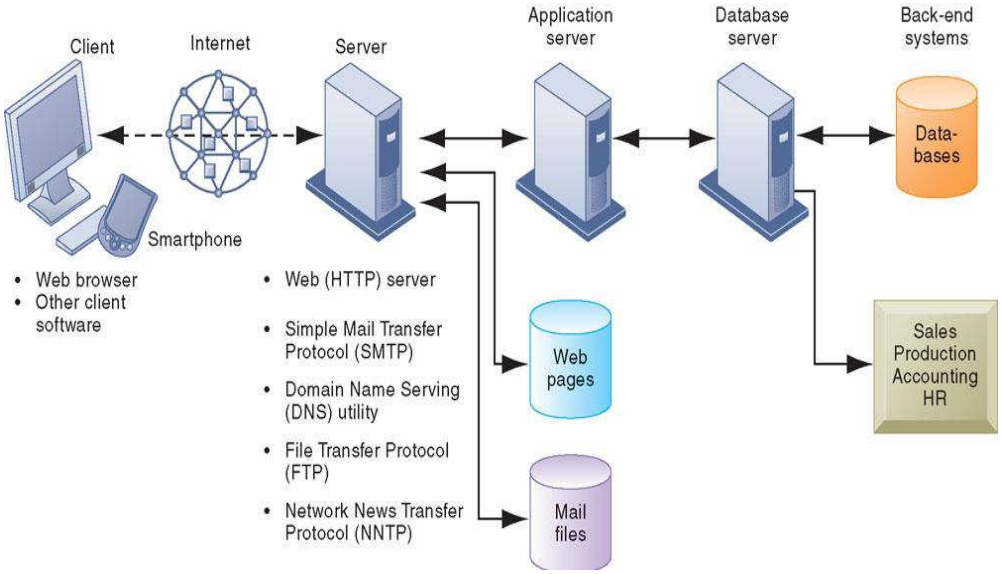

Fig. 7.2: Client/Server Computing on the Internet

Client computers running Web browser and other software can access an array of services on servers over the Internet. These services may all run on a single server or on multiple specialized servers.

3.5 Software: Operating Systems and Applications

Computers require programs (software) in order to run; the computer hardware described above can do nothing useful unless it has some instructions to follow − some software. It is usual to differentiate between systems software, which helps the machine to operate, and applications software, which directly performs some useful task for those using the computer (for example, Microsoft Windows is an operating system; Microsoft Word is an application).

The operating system is the principal item of systems software. It is described in some detail here, because studying the operating system is a useful way to understand the nature and functions of computer hardware.

The operating system manages the hardware resources of the computer and organizes the running of programs. It also provides the user with the means of controlling the computer, and a computer user communicates with the

operating system in order to get the computer to undertake any task − for example, to run a program or print a file. In most of today‘s operating systems, this user interface is based on the WIMP (window, icon, mouse, pull-down menu) concept, which combines these four features for effective communication with the user. Apple OS and Microsoft Windows are examples of operating systems that provide a common, consistent and sophisticated graphical user interface (GUI) for application programs to use. Linux is an example of an open source operating system developed by volunteers and freely available as source code, and users of Linux have a choice as to the style of interface they use.

All computers from phones to science GRIDs require an operating system of some description. One way to view the main task of an operating system is by considering how it allows the initiation and running of other application programs. When someone wishes to run a program – for example, a spreadsheet – they tell the operating system the name of the program (by pointing and clicking) and ask that it be run. In order to run the program, the operating system needs to manage and coordinate the hardware, software and network resources. We can think of these as six separate, but connected types of resource:

- memory management
- input–output management
- secondary storage management
- processor management
- program management
- network management.

3.5.1 Memory Management

The operating system allocates some memory (RAM) to programs that are to be run and may alter this allocation as they run. For example, the spreadsheet has to be allocated some memory in which to locate itself (its code) and the data it manipulates. As more data is typed into the spreadsheet, more memory may be needed.

3.5.2 Input–Output Management

The operating system will manage input and output devices to enable programs to obtain input (for example, from a keyboard) and to produce outputs (for example, on screens or printers). For example, the spreadsheet will need input from the keyboard. It will ask the operating system for some keyboard input and will wait until it gets it. When the user types on the

keyboard, it is the operating system that directly reads the keystrokes and passes them on to the spreadsheet program. The operating system may detect some special keystrokes, which it chooses to interpret and act upon itself, rather than passing on to the spreadsheet.

For example, the Caps Lock key tells the operating system to pass all characters to the spreadsheet as capital letters.

3.5.3 Secondary Storage Management

Secondary storage management is done through a file system. The operating system allocates space on a disc to contain a file, and maintains a directory of file names and locations. This means that a file can be subsequently located and read.

When the operating system is told to run the spreadsheet, it is, in effect, told to find a file of program code and load it into memory. Similarly, if when using the spreadsheet, we decide to store the work that has been done, this results in a request to the operating system to find some free space on the disc, give it a designated file name and write the contents of our spreadsheet on to the disc.

3.5.4 Processor Management

The operating system also needs to manage the other main hardware resource – the processor itself. In the simple model of a computer that we are concerned with, we assume that there is just one processor, and that it can do just one thing at a time (real computers − even microcomputers have, in reality, a number of processors dedicated to various specific tasks such as controlling main memory, doing arithmetic, manipulating graphics images, etc.).

The operating system is also a program, so it needs to use the processor in order to achieve all the tasks described above. In the case of the spreadsheet, the operating system will undertake the task of loading the program into the main memory (when the processor is being used by the operating system), and then passing control to that program (when the processor is then being used by the spreadsheet). When the spreadsheet wishes to achieve an input or output task − such as printing some information − it passes a request to the operating system.

3.5.5 Program Management

The description given above suggests that the operating system actually manages one other resource − programs. In the example, there is just one processor, but two programs − the operating system and the spreadsheet. In a modern microcomputer, there can be many programs, all wishing to share the processor. Indeed, hundreds of separate programs may be running simultaneously. In such a case, the operating system has to ensure that all the programs get an appropriate slice of processor time – using it in rotation or when they have specific needs. In general, the operating system should be able to pre-empt any other program (for example, push to the front of the queue) and use the processor immediately when it needs to. In any case it should prioritize other programs to ensure that the most important ones get more of the processor resource. This is known as pre-emptive multi-tasking.

3.5.6 Network Management

Another area for operating systems is managing a computer's connection to a network. In a local area network, for example, this may involve the operating system being able to retrieve and store files on a separate file server computer, which is shared by a number of computers connected to the network. Similarly, a network operating system may allow shared use of a print server or a communications server that gives access to wide area networks. More generally, operating systems provide basic connections to the internet and allow this to be shared among programs.

When many programs are running simultaneously in a computer, it does, of course, complicate all the other management tasks. Memory must be carefully shared between programs; input needs to be directed to the right program and output devices such as printers need careful management too. As you will gather from the above description, operating systems are complicated items of software. As hardware gets more powerful and users expect more, operating software gets more complex too, and today an operating system for a microcomputer or a mobile phone is a very substantial and sophisticated piece of software.

SELF-ASSESSMENT EXERCISE

Pull up the task manager window on a windows-based PC when it is running (for example, press CTL-Alt-Del all at the same time).

Take a look at the Applications tab to see what user applications are running.

Then look at the Processes tab, and see how many actual bits of software (modules or processes) are running on the machine. A process is roughly equivalent to a separate program and in this case will include many separate parts of the operating system software as well as ‗applications'. Then click the Performance tab and see how much physical memory the computer has, how much main memory is in use and how much of the CPU power is being used. The graphs you see will show this for the recent past. Try loading a couple of other data - heavy or processor heavy programs such as a computer game or a big spreadsheet and see if these figures change.

3.6 Interfaces with the Computer

Information systems involve people, and many computers (client computers in particular) need to be easily accessible by people. All systems will have some form of input and output device to get data in, or to get it out. These include the basics of keyboards, screens and various types of printer. The machine upon which this is being written has a keyboard and a mouse as well as a scanner as inputs. For outputs, there are two colour flat screens and a colour laser printer. Using the operating systems and other software, all these devices work together to create a consistent and easy to use interface that uses windows on the screen, icons, pull- down menus and a mix of the keyboard and the mouse for interactive input. Other forms of input device and input media might include:

- barcodes read by a scanner at a supermarket till, or QR codes read by a mobile phone
- a digital camera capturing video
- the magnetic ink character recognition (MICR) system used on bank cheques
- a smartcard used to access a bank account via an ATM (cash machine), or to identify, say, each specific doctor using a hospital computing system.

New input devices have become widely available and usable in recent years. For example, we now use voice-recognition systems, which take human speech as an input. One example of where this is used is by radiographers (specialist doctors) as they interpret and report on X-ray images and other types of digital scan. They can dictate their report while looking at the image, which makes good sense as it
allows them to concentrate on the image.

SELF-ASSESSMENT EXERCISE

You are designing an information system to be used by foreign exchange dealers of a bank as they rapidly trade currencies in a noisy dealing room, gathering information and making trades. What particular characteristics would you want of input and output devices used?

When considering input and output, it is useful to recognize that any output from a system may need to be subsequently input – data generated and output by one computer is often read into another one (the basis of client-server computing). Networks support this exchange, but technologies such as barcodes or QR codes are useful for this and can be printed by one computer and read by another. It may be appropriate, at times, to think of a USB key (pen drive/thumb drive/data stick) or CDROM as an output-input medium. The QR code here can be read by a scanner including many mobile phones.

3.7 Data Storage Devices

Main memory is volatile, but data (including software) need to be stored permanently, securely and economically. Computers therefore have forms of non- volatile storage, referred to as secondary storage or backing store.

Files and file processing

Magnetic discs, and − to a lesser degree − magnetic tapes, have historically provided the basic storage capability for computer systems. The way in which data is organized and accessed using such devices is the topic of files and databases. A file is a named unit of data stored within a computer. For example, the word- processed version of this document is stored in a file. It is held as a sequence of characters and control codes. The organization is vital – the characters must be retrieved in the same sequence they were stored; otherwise the document would be unreadable! For data-processing applications, we often think of files slightly differently – as structured in terms of records made up of fields. For example, one record per customer, with fields for name, address, phone number, etc.

Transaction processing applications (the back-office computing) may often revolve around a master file that maintains the essential data and which is updated by various types of transaction. These transactions may be stored in a transaction file. For purposes of security and integrity, copies should be made of data stored on computers; hence another type of file is a back-up file.

Example 1
The customer accounts system of Multinational Bank has a file of customer account details – a sequence of records, each containing data on individual customers. Among the fields that occur within each record are:

- name
- customer number
- date of first opening an account
- address
- telephone number
- email address.

The file is used whenever a person is contacted in any way. In practice, these records will need to be accessed in any order, depending on which customer a bank employee wishes to contact (called random access). The customer number field has a special status as the key field, because the customer number allows the correct record to be uniquely identified and retrieved. Note that the bank has 25 customers called John Smith! And most of these have more than one account at the bank. The file is stored on disc, and we can go directly to read any record if we know where on the disc it is stored. In practice we would expect some database management software to take care of most of the detail of storage and retrieval of these records. Before the creation of database software − and cheap computer power − organising files was an important technical issue. Today, with database software in common use, and with cheap computing power and fast storage devices of vast capacity, we seldom need to think in such technical detail about how exactly data is stored, accessed and retrieved for any given application.

3.8 Application Software

All programs, including operating systems, need to be written before they can be run. In general, the programming languages in which programs are written are chosen because they make it easy for people to express what they wish to achieve. Computers cannot directly understand such a language or execute the program. It is necessary therefore to translate from the language that a program is written in (say Java or C++), to the language that the computer understands (machine code). This task is undertaken by language translator programs: compilers translate the entire program, producing a new version of the program – the object code; interpreters translate and execute one statement of the source program at a time.

3.8.1 System Development Tools

Writing programs in modern programming languages, such as C++ or Java, provides great flexibility in what can be done and supports efficiency in the delivered product. It does not, however, support great productivity in the actual writing of programs. It has become increasingly common, therefore, for all types of computer application to be written using tools that provide more help to the developer and need less detail to be specified. Good examples of this are the many database packages on the market, or spreadsheets. These provide, as you should discover doing your project work, an easy route to setting up storage of data and also provide tools to allow the design of input screens, models, output reports and the logic of processing information. A database package will provide some of the flexibility of a programming language, but also high-speed and prepackaged solutions to standard problems. Examples would be the way a spreadsheet provides sorting facilities or a database package the ability to generate reports.

Programming for the web is a rather different activity to conventional programming, and has given rise to many new tools, languages and techniques. Many development tools are now available for developing web-based systems quickly; these usually generate hypertext markup language (HTML) − the language for web pages − but add newer techniques, such as extensible mark-up language (XML) and provide support for links to databases.

3.8.2 User-Written Programs and Commercial Software Packages

We can write programs if we have the skills and the time, but most computer users rely on packaged software – sometimes called packed applications, or COTSS (commercial off the shelf software). It is possible for even large organisations to perform almost all of their information handling requirements using purchased application packages, and it is even more likely that a small business will operate in this way.

Application packages exist for all standard business tasks. Payroll programs are a good example – most payrolls in any given country have to perform the same basic set of calculations in order to compute tax and insurance contributions and most organisations will want to keep similar information about their employees. The result is a strong market in such standard applications – perhaps expanded to all aspects of human resources management and known as HR (human resource) packages.

It makes good sense for most organisations – both big and small – to consider buying such packages rather than developing their own from scratch.

SELF-ASSESSMENT EXERCISE

Draw up a table showing the advantages and disadvantages for a medium-sized business of:

1. Writing their own software for managing their financial accounts.
2. Purchasing and configuring a package for this task to run on their own computers.
3. Customizing a package by adding extensive changes and extensions.
4. Outsourcing the whole information processing task to another company or contractor.

For each option, try to give an illustrative example of a type of information system need and/or circumstance that might make each choice appropriate. Do some research online to allow you to explain the difference between configuration and customization of a software package.

4.0 CONCLUSION

A computer is an electronic device which performs many management functions which include memory management.

5.0 SUMMARY

In this unit we look at computers and the various devices that enable it perform the role of information processing. With the aid of the operating system the following six separate but connected types of resource management(memory management, input–output management, secondary storage management, processor management, program management, network management) are done and this is where the computer system derives its uniqueness as far as information processing is concerned.

6.0 TUTOR-MARKED ASSIGNMENT

1 Apple, Google, IBM, Intel, Microsoft, Oracle, Samsung, Dell, Acer, Arm, Lenovo, SAS and SAP are all global IT companies.

Choose three them and briefly investigate and explain the primary expertise that each holds, and the business model (or models) that they use to generate revenues and make profits (for example, what they sell and to whom, and how).

Use the various company websites as the main basis for your research. In each case just add WWW. to the front, and .COM to the back of the name and you will probably find them!

2. A warehouse stores information on 3,000 products. Each product description comprises about 500 characters of data plus a photo of half a megabyte. How much disc space is needed to store this information? Express your answer in megabytes and kilobytes.

7.0 REFERENCES/FURTHER READING

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An excellent brief treatment of the history of computers is found in Wikipedia. Internet resources relating to the history of computing include http://ei.cs.vt.edu/~history/

UNIT 2 INFORMATION SYSTEM SOFTWARE AND HARDWARE

CONTENTS

1.0 INTRODUCTION

A typical information system comprises both computer software and hardware and this forms the basis for discussion in this unit. Here we engage on a more detailed discussion on them.

2.0 OBJECTIVES

At the end of this unit, you would be able to:

- explain the concepts of hardware and software
- enumerate classification of software
- list the functions and types of operating system.

3.0 MAIN CONTENT

3.1 What is Software?

Software is the generic term for all sorts of program that runs on the hardware system. The hardware system on its own is just a bunch of electrical gadgets which at best could deliver a fatal electric shock when powered. It is the software that drives the hardware. The software is

designed to exploit and provide the potential capabilities of the hardware to the intending user.

Although software consists of series of instructions, rather than pieces of equipment, it does of course have to be recorded on some physical medium. In principle, the programs could simply be written or printed on pieces of paper. Sometimes this is done; when we can for instance buy books on programs, which we can type into the computer for ourselves. However, for large programs or for programs, which are used frequently, it is more convenient to use a recording medium, which can be read directly by the computer. The most familiar media of this kind are magnetic discs and tapes. Pieces of software, which are used particularly often, may be stored permanently in the computer itself by means of read-only memory.

Software can therefore be embodied in a variety of physical forms, although the software itself consists of a series of instructions rather than physical objects. The tasks that may be performed by software are even more varied.

3.2 Classification of Software

The programs used on a computer can be divided into two main kinds:

i. Systems software/program
ii. Application software/program

Essentially, systems software helps us to run the computer itself, while applications programs tell the computer how to carry out the particular tasks that we want performed e.g. calculate statistics, keep accounts or whatever.

3.2.1 Systems Software

This is the collection of programs that directs the basic functions of the computer in such a way that they are for the most part transparent to the user. They refer to the sets of programs that facilitate the optimal use of the hardware systems and provide suitable environment for the writing, testing, editing, debugging and running of user programs. Usually, every computer systems come with a collection of these suites of programs which are provided by the hardware manufacturer.

They permit the programmer to concentrate on writing efficient program to solve problems, without being concerned with such things as the internal

memory, selection of memory addresses, control of input and output devices, or error detection.

The major types of systems software are:

- Operating systems (OS)
- Utilities and service programs‘
- General purpose subroutines
- Communication monitors
- Data base management systems
- Translators

Operating System (OS): The operating system is the program that controls and monitors execution of all other programs. Without an operating system, constant human intervention is required to enter a program, initiate its execution, and manually record its successful termination.

It is an organized collection of programs that acts as an interface between machine hardware and users.

Functions of an Operating System (OS)

- Executes and monitors input and output operation;
- monitors the status of hardware devices;
- It assigns priority to the users i.e. jobs award, executions are scheduled according to either a predetermined or a dynamic assignment plans.
- It handles control of multi-programming allowing the process of several jobs at the same time.
- Receive, interpret and executive commands from the human operator i.e. operator communications via the console printer or Visual Display Unit (VDU).
- Control of data transmission between terminals and the computer and computer to computer.
- Controls the database management system.
- Control of assemblers, interpreters, compilers, utility software and sub-routines so that these are immediately available when required.
- Debugging and editing new programs in conjunction with the computer, and passing error messages to the users.
- Dynamic allocation of main and backing storage including virtual storage. Virtual storage operates on the principle of holding programs on disk and transferring segments (pages) of the programs into the main store for execution.

- Allows many terminal users of the computer to use it as though it were at the disposal of each of them exclusively.
- Control of program library.
- Spooling the control of input/output peripheral in order to achieve their best utilization. For example, if the printer is unavailable the operating system spools the output onto say a margin in disk for subsequent printing.
- Implement the use of passwords.
- Format new discs.
- Maintain disc directories.
- Execute disc reading and writing operations.
- Diagnose disc errors.
- Execute disc commands relating to the deletion, copying, renaming, dumping of files, etc.
- Report on the status of disc usage and bytes available.

Examples of Operating System include:

DOS: Disc operating system

MS-DOS: Micro-soft operating system designed for 16-bit processors which are usually business oriented machines.

UNIX: It supports multi-tasking and multiple terminals connected to a single system.

XENIX : is a multi-user system based on UNIX. SCO UNIX: is a multi-user system based on UNIX.

DOS commands: Some typical DOS or MS-DOS commands are:

DIR : Lists the files in a directory with their size in bytes.

CLS : Clears the monitor/terminal screen

TYPE : Displays the contents of a text file on a screen

COPY : Duplicates one or more files to another disc

DELETE : Erases files from a disc

DISKCOPY : Makes backup copies of contents of one disc to another

Examples of Mainframe Computer Operating system are:

DME/3 - Direct Machine Environment – ICL 2950

VME/K - Virtual Machine Environment

MVS/SP - Multiple Virtual Storage/System Product – IBM system 270

VM/SP - Virtual Machine/System Product – IBM 4300 etc.

Utilities and Service Programs

These are part of the systems software, devised to carry out standard data processing operations normally supplied by manufacturers and run by the users. Examples include:

- routines for sorting files into a particular order or to merge more than 1 file together,
- routines for copying from one medium to another,
- routines for the provision of Trace and Debugging facilities,
- routines for loading/reorganizing of index sequential files,
- routine for creating of programs libraries and data dictionaries to label files,
- routine for a map of the usage of storage space of random access device.

Explanation of some routines/aids:
Debugging Aids: Some logic errors may prove difficult to find during the program testing stage; such elusive error can be traced by using Debugging Aids.

A **trace routine** prints out the contents of certain storage locations after specified instructions have been obeyed, thus allows the programmer to trace the operation of his program in an attempt to find the error.

Edit Routines: These prepare data for output, perhaps to the printer, by suppressing unwanted zeros, inserting (=N=) signs and inserting decimal points.

Dumping routines: These transfer the program and it‘s working data to the backing storage at regular interval. A dump routine is used in conjunction with a restart program, which reloads the main store with the program and working data.

Sorting: Programs for re-arranging a set of record into a certain sequence based on their key values.

Files Maintenance (amendment): This involves the straight forward insertion and deletion of records into or from sequential files.

File Copying: A program to copy the exact set of data on to another for the same type of storage medium, e.g. a replica of data records on disk is made on another disk area.

File Conversion: A program to transfer data from any medium to another e.g. magnetic tape to magnetic disk.

Sub Routines:
A certain task may occur several times in a program. Example are statistical jobs like the:

- calculation of square roots
- calculation of standard deviations
- calculation of tax

Rather than writing the routine into program each time is needed thus wasting programming time, compilation time and core store (main memory), the program includes it once only in the forms of a sub-routine.

Each time the operation needs to be carried out; the program passes control to the sub-routine. After the instructions in the sub-routine have been obeyed, control is passed back to the main program instruction immediately after the one, which caused the branch of the sub-routine.

Sub-routine is a part of program, which performs a logical section of the overall function of the program. There are two types namely:

- An Open Sub-routine which is a part of the program
- An Closed Sub-routine which is located elsewhere in store

Programmer can write sub-routines themselves for inclusion in their programs, or they can be obtained from other bodies as standard routines.

Communications Monitors
Communication monitor is an advanced software for managing input/output buffers, assign priority to messages, select communication channels, establish the corrects protocol for transmission, and handle the other support functions of computer-related communications.

Protocol is a coding pattern or set of rules that must be matched before characters can be sent from one electronic device to another.

Translation Program
These include assemblers, compilers and interpreters.
Computer written programs are coded in computer languages, which can fall broadly into three groups:

- Low level language e.g. assembly codes
- High level language, e.g. COBOL, FORTRAN, ALGOL, BASIC, etc,
- File interrogation languages.

An **assembler** is a software-program that translates assembly codes into machine language. It will also normally provide error diagnostics to aid the programmer in preparing and accurate program.

A **compiler** is a software program which is used with a high-level language. It translates high level code much more complex and more closely allied to English Language or Mathematical notation to machine language.

An **interpreter** translates each high-level language instruction and then carries it out immediately. It executes the program line by line.

Emulator: A hardware device designed as part of range of computers but used to run programs originally developed for another range of computers, e.g. emulators is used for bridging the gap difference between one generation of computers and others.

Simulator is software which enables programs written for one range of computers to be run on another range of computers. During operations, both simulator and application programs (written for old computer) in turn translates into equivalent code of new computer, which eliminates the need to immediately write new programs when a user changes his computer.

Generators: Are software packages which allow non-computer specialists to develop their own application programs and are able to generate programs which will produce a defined result from a given input, if user clearly specifies his requirements.

3.2.2 Application Software

Application programs can be divided into two main groups: programs that we buy ready-made (packages) and programs that we write for ourselves. If we write a program for ourselves then we obviously have to decide what computer language that it is to be written in. We will discuss some of the main languages later.

i. Ready-made Programs (Application Packages)
   Application packages are ready made programs or suite of programs with associated documentation, used for a particular type of problems or variety of similar problems.

The documentation should include specifications of input and output formats and file layouts. This will include user instruction manuals, hardware requirements and details of how the package may be varied to suit the user's individual needs.

Software packages are sold as complete products while user application programs are normally produced by an organisation for internal use to perform specific tasks.

Application packages may be classified into two: special or specific purpose and general purpose application packages.

(a) **Special or specific purpose**: These consist of programs designed to carry out just one specific task. Examples include:

I. Software used in wide variety of business such as:
- Payroll
- Stock Control
- Sales order processing and sales ledger
- Accounting or nominal ledger
- Purchase order processing and purchase ledger, etc.

II Software used only in specialized businesses such as:
- Transaction processing in banks and building societies
- Airline seat reservation
- Theatre set reservation
- Point of sale software etc.

III Packages are also available in education, scientific, engineering and mathematical areas. They address problems such as:
- Economic analysis
- Simulating/modelling
- Statistical analysis
- Regression analysis
- Building/machine design
- Electronic circuitry design
- Medical research aid diagnosis

Programs for each of these areas are of use only in their specific area of application and their use will be confined to a specific department of the business. A payroll program, for example, will be used for nothing but payroll and will be used only by payroll staff.

(b) **General Purposes**: These provide facilities which might be useful in a wide variety of business situations and which might therefore be used across many departments of a business. Examples include:

1. Word processing programs
2. Database programs
3. Spreadsheet programs
4. Business graphics programs
5. Integrated software packages

Each of these will be examined in a little detail later.

Reasons for application packages are:

- shortage of resources
- need to get systems installed quickly
- similarities in system requirements

Advantages of Application Packages

1. The main advantages are the saving of programming effort and expense on the part of the user. Development costs are effectively shared between the users.
2. There is reduction in systems and programming effort and cost.
3. Implementation of an application is quicker and possibly cheaper.
4. System testing is minimized since the packages should have been well tested.
5. System documentation is provided with the packages.
6. Portability from the existing computer system to any new computer adopted by the user.
7. Efficiency in terms of speed, storage requirements and accuracy.
8. Provides a standard approach to common applications.

Disadvantages

1. The package is not tailored for a particular user needs.
2. The company providing the package may cease business and leaves the user without a system.
3. Inefficiency may result from the inclusion of features not relevant to every application.
4. No one on site can help out when problem occurs.
5. Some packages are not brought up to date with such things as latest legislation as part of the standard cost e.g. economic recovery fund, deductions, tax rates.

Factors to consider when deciding whether to use a Package or not:

(i) Whether the package satisfies the user‘s requirements. A package may provide insufficient processing of data, or output may be in an unsatisfactory form.

(ii) Whether the package provides too much processing. Output may exceed the user's requirements, and this may prove irritating or even embarrassing to user.

(iii) **Cost:** This includes the cost of the software, of setting up and operating the system as well as training cost. How does the cost of the package compare with developing one‘s own system. The overall cost does not include long term maintenance and updating for changes e.g. new legislation.

(iv) **Reliability:** Package programs exist, especially payroll packages, which have been used for a considerable period of time, and should be reliable and error-free. A check should be made on this aspect with other users.

(v) **Flexibility:** The system should be capable of amendment and development.

The potential user should find out whether the provider of the software package would be willing to offer a service to make any required program changes. In other words, is the package flexible and is it parameter-driven, enabling the user to choose a number of approaches to its implementation.

(vi) **Types of processing:** What is the input medium, and are there any special costs or difficulties associated with this?

(vii) **Timing of processing:** How long does the processing take (therefore, what turnaround times must the wages department, for instance, have and what correction procedures are available?).

(viii) **Integration with other systems**: Does the user, for instance wish to integrate output from the payroll system with a nominal ledger system? Or can the package and its data be transferred to other machines?

(ix) **Hardware required:** The user may wish to obtain a package for existing computer hardware, without having to buy new equipment. The package must, therefore, require the use of this pre-determined hardware.

(x) Will the package cope with the volume of data required within the time available?

(xi) Is the documentation clearly written and easily understood by non-computer personnel?

(xii) Has the package been successfully used by others with a similar business set up?

(xiii) Will someone from the supplier be available during the first days of application use? Will help be given with file set-up?

(xiv) How easy are the backup, start-of-the-day and end-of-day procedure?

Sources of Application packages are:

(i) Specialist software house;
(ii) Computer bureau;
(iii) Computer manufacturers;
(iv) Other companies selling their own system.

Arguments for the use of packages

- Programmers are able to concentrate their efforts on applications for which no suitable package exists due to the special nature of a particular task.

- It is unnecessary to employ specialist programmers, particularly when using micro-computers.

- Applications can be up and running (operation) much more quickly than would be the case when developing one‘s own computer system, including the writing of programs.

- Expertise is _built-in when using packages.

Argument against the use of packages

- It may be necessary to modify a package as it may be incompatible with system requirements in all instances and this fact will increase the costs of the package.

- Purchased programs may cost more than internally written programs.

- Package programs may take longer to run than specially written programs, but this depends on the relative skills of programmers and whether machine code is used rather than high-level languages.

ii User written programs

In spite of the wide range of programs available, there will inevitably be occasions when there is no ready-made program, which quite suits our needs. We will then want to write our own program either by:

- **Creating the software using in-house development teams**

  In-house development is the computer industry's term for the design and programming of software by an organization's system analyst and computer programmers. These staff will be responsible for:

  - Determining what the software must do.
  - Developing the specification
  - Creating the software
  - Testing the programs prior to implementation.

- **Developing software using contract programming**

  This involves hiring independent specialist called contractors in software development to create the software needed by an organisation. The contractors may be:

- Responsible for the entire development process
  - Including formulation of specifications or
  - Creation of software using specification prepared by the organization's information system group.

3.3 Specific Purpose Application Areas

Payroll System: It is connected with the (production of a weekly wages payroll). Salary systems are similar to those encountered for wages, the

principal difference being that it is usual for the monthly salary to be generated by the computer from details held on the master files and therefore (with exception of overtime, bonus, inclusion of new staff, deletion of former staff, etc.) there is no need for any transaction input.

The main features of a simple wages system are:

- Inputs, which include: Clock card or time sheets. Details of overtime worked, amount of bonus or appropriate details of the bonus is calculated by the computer.

- Outputs, will include: Pay-slips; payroll (i.e. a copy of the pay slips); payroll analysis, including analysis of deductions (tax, NHF, etc.) and details for costing purposes, coin analysis, cheque credit transfer forms, etc.

- Files used: The master file will hold two types of data in respect of each employee – standing data, e.g. rates of pay, details of deductions, personnel details and transaction data e.g. gross pay to date, tax to-date, pension contributions, etc.

Stock Control System: The computer is able to process data quickly making available information on stock levels, slow moving items or trends in demand.

In **On-line-real-time** system it would be possible to give customers up-to-date information on stock available. By locating stock (say) in another area's warehouse and bringing it to customer, a better service could be provided. A good stock control system should reduce working capital that would otherwise be tied up in stocks.

Purchase System: The simplest purchase system is one where the computer is used to maintain the purchase ledger and produce a purchase analysis.

In more advanced system, the purchase can be integrated with other parts of the system. For example, if they are to stock control the original input might be the goods received details. The computer up-dates stock records, matches GRN's against invoices, post invoice details, and producers' accruals information. Purchase orders may be generated on the basis of predetermined maximum stock levels.

Sales System: This is based on posing invoices to the sales ledger. In more advanced system, sales systems are often linked to stock control.

Commonly, it is found that the original input is either the customer‘s order or the dispatch note.

The information from these is used to up-date stock records produce invoices and post them to the sales ledger.

A simple sales order processing and sales ledger system, for example, might comprise a suite of 5 programs as follows:

(i) A program to process customer orders and produce sales invoices;
(ii) A program to print monthly statements;
(iii) A program to process cash received and pest this to the sales ledger;
(iv) A program to print aged debtors list;
(v) A program to print a sales analysis.

Financial Application: The banks and insurance companies are the major users of commercial computer systems such as:

- Automatic cheque clearing: Banks may use a computerized system to handle cheques, which ensures that payments by cheques are cleared within three days.

- General uses: Bank customers’ accounts can be largely computerized and some details current balance may be available on line.

- Regular payments may be made automatically by banks as part of a computer system.

Cash System: Cash recording can be inter-linked with those of purchases and sales. Some companies use the computer to produce bank reconciliation by running a cash book file against a file containing details from the bank statements.

Nominal Ledger System: The production of the nominal ledger, trial balance and draft accounts will be used on inputs from all the other systems (purchases, wages, etc.), journal entries, details of accruals and pre-payments, etc.

Fixed Assets System: This maintains a complete register of the fixed assets of a company or group of companies and automatically calculates depreciation.

3.4 General Purpose Application Areas

Word processing programs are used for the preparation and editing of text. For instance, these notes were prepared using Microsoft Word. For relatively long documents of this kind, the main advantage of using a word processor rather than an ordinary typewriter is that it is possible to correct or change part of the text without the need to retype the material which is unaltered. It would, for example, be quite easy to add new sentences or paragraphs to these notes, or to remove some of those that are here at the moment. If the notes had been typed on an ordinary typewriter, such changes might mean that the whole thing had to be retyped. However, word processors can also be useful in dealing with shorter documents. For example, many organizations need to send out large numbers of letters which are essentially the same but which differ in their details. A word processing program can substantially reduce the amount of work involved in this task. In addition, other programs, handling such things as mailing lists or the checking of spelling, can sometimes be used in conjunction with word processing programs.

There are in fact two different ways of providing a word processing facility. One way is by the use of a word processing program (such as MS-Word, WordPerfect, WordStar) on a general-purpose computer. This is relatively cheap and has the additional advantage that the computer can be used to do other things when it is not being used for word processing. The other way is by means of a dedicated word processor – a machine that can be used only for word processing.

A word processing system will consist of five unions:

- A keyboard
- A Visual display unit
- A computer processor
- A computer disc storage
- A printer

Advantages of Word Processing

Cost Savings: The ability to store text and then retrieve and readily amend it means that much operator time should be saved when dealing with such items as standard letters, contracts, etc.

Increased Operator Efficiency: The fact that word processing systems readily allow for error correction and that most of them are ‗user friendly should result in a greater output per individual operator.

Improved Operator Morale: The nature of word processors is such that the operator is likely to find the job more satisfying, less tedious and also possibly quieter and neater.

Improved Quality of Output: The report layout facilities which are feature of most word processing packages should result in better quality output which will both improve the image of the company and also result in more job satisfaction for the operator.

Database programs: The simplest way of describing what a database program is to say that it is used to organize and process a database, and that a database consists of structured information. It may be more helpful to give a simple example. Suppose that we are carrying out a large-scale survey of, say, the farmers in a particular area. We might collect data on the areas they devote to different crops, the number of workers they employ and so on. If we are not using computer, then we might use filing cards to keep records of the data relating to each farmer. On each card there might be a space for the number of hectares of a particular crop grown, the number of workers employed, etc. A database is essentially the computer‘s equivalent of this set of records cards. The database program helps us to organize and update it and can analyze the data to give us such information as, say, the total number of workers employed by the farmers in our survey. The simplest database programs can handle only one kind of record at a time. More sophisticated programs can handle different but related kinds of records.

Spreadsheet Programs: These can handle calculations of the kind that might be set out in a two-dimensional table. Examples might include sets of accounts, in which the columns of the table might correspond to particular periods of time and the rows to particular kinds of income and expenditure, or certain kinds of statistical calculations such as regression analysis. A spreadsheet program allows us to set up a table of this kind, specify how rows and columns are related one another, and enter data into the table. Data can be changed, and the resulting changes to other values in the table are calculated automatically. Spreadsheet

programs have a wide variety of possible applications. They are particularly useful in planning, where their capacity to recalculate a set of related figures allows us to explore the implications of alternative sets of assumptions relatively easily.

Spreadsheets are so large (possibly upward of 250 columns wide by in excess of 1,000,,000 rows deep) that it is impossible to view the whole spreadsheet at one time. It is possible to scroll across or up and down the sheet in order to view a different range of cells. It may also be possible to go direct to a particular area of the sheet by setting up a ‗window'. Some integrated software packages currently on the market will also allow for the data contained in the spreadsheet to be displayed in a variety of graphical forms (pie chart, bar chart, line chart etc), and to be linked with database, word processing and communication facilities. Spreadsheets have grown in popularity as a result of their use in micro-computers although software packages are also available for mini-computers and mainframes. To work efficiently spreadsheets will require a fairly large internal memory with the systems software being held on disk or ROM chips or possibly a mixture of the two.

Business Graphics: There are a variety of different kinds of graphics programs available, but business graphics programs are intended for the production of diagrams such as pie charts, histograms and so on. Such diagrams can present data in a way which has a much clearer immediate impact than can be achieved by giving the same information in the form of a series of numbers. At one time the only way in which such diagrams could be produced with microcomputer was to make the diagram out of a series of characters such as letters, but in the last 15 years or so a number of programs have appeared which can produce much better quality graphics. The quality of the results that graphics programs can produce is very dependent on the details of the hardware used. The computer itself, the monitor and the printer all play an important role in determining the visual quality of the output. In considering the purchase of a business graphics package it is also important to take account of how easily data can be transferred between the graphics programs and any other programs which you are likely to use to handle the same data.

Integrated software packages: These constitute one of the newer groups of ready-made programs. What was then thought of as the first such program (Lotus 123) appeared in 1983. They combine word processing, spreadsheets, business graphics and database management in a single program. Lotus 123 is in fact an exception to this in that it does not include word processing and it is now generally regarded as a spreadsheet program

with some additional facilities rather than as a full-scale integrated package. It has however, had many successors, including among the best known Symphony, Framework, Jazz and Smart.

The integration of a number of facilities in a single program (rather than using a series of separate programs) is obviously convenient in some respects, although it should be remembered that, by and large, the difficulty of using a program tends to increase as the facilities it offers expand. In addition, the individual components of an integrated package may not be as powerful as comparable single-purpose programs. For instance, a good database program will usually offer better facilities for handling a database than will an integrated package. On the other hand, the database program will not provide the other kinds of facilities that one would expect in the integrated package.

3.5 Computer Hardware

Computer hardware refers to the physical devices such as servers, desktop computers, laptops, portable devices, networking devices, storage devices and printers, etc. Let's now look at each of these elements separately

Servers: A server is a computer with high computing power and storage space that is used to host shared resources. The server can be used as a database server that stores all of the business transaction. An email server could be used for all emails of the company. A file share could be used for storing the individual files of the organization employees, etc.

Desktop computers: These are workstation clients that usually connect to the server to post, process, and retrieve information e.g., a point of sale system installed on a desktop computer to connect to the POS database on the server to post and retrieve data.

Laptops and portable devices: Laptops have the same computing power as desktop computers but have the advantage of been portable. With the advent of the internet and virtual private networks, employees can travel with their laptops to remote locations and still be able to access the server at the head office.

Tablets are much easier to carry compared to laptops, and many organizations have business applications that run from tablets. They are also capable of connecting to the server via the internet.

Networking devices: Networking devices are used to interconnect computing resources so that they can communicate with each other. Common networking devices include networking hubs and switches, Wi-Fi routers, etc. Hubs and switches are used to provide network connectivity via a physical cable, and they are usually used to connect desktop computers. Wi-Fi routers are used to provide wireless networking capabilities. Wi-Fi routers are usually used to connect laptops and mobile devices to the corporate network.

Printers: Printers are used to print hardcopies of reports. They vary depending on the use. Some printers have networking capabilities and can be installed on a network and used by more than one person. This reduces the costs of buying individual printers for each computer. Dot-matrix printers are usually very common with the point of sale and bank tellers for printing receipts, deposit slips, etc.

Storage devices: Storage devices are used to store data. The data could be in the form of documents, audio, video, software installation packages, database backups, etc. The most common storage devices are external discs. Storage devices with networking capabilities also exist that can be used to share files on a network. The IT department usually creates file storage directories according to departments and type of data to be stored.

Computer hardware refers to the physical units or machine, which makes up the computer configuration. The software refers to the programs, which are processed by the hardware. The hardware can be divided into Unit:

- The Central processing Unit (CPU)
- The Peripheral unit or Electrical gadgets

The Central Processing Unit: This is the heart of the computer system; it consists of three hardware sections:

- The main memory of storage section
- The control Unit (CU)
- The Arithmetic and logical unit (ALU)

The main store is also called main memory or immediate access store or internal store or random store. The main store holds the program being executed and the data to be worked upon. Result of processing are also stored here prior to transfer to an output device or auxiliary storage device.

The Control unit is a hardware device, controls and coordinates the other elements of the system as directed by the program in store. It decodes and interprets the instruction and direct their implementation.

The Arithmetic Logic Unit consist of two units; the arithmetic unit which performs arithmetic operation such as addition, subtraction, multiplication, division and the Logic Unit which performs logical operations such as comparison between numbers, shifting values from one area to another.

The peripheral unit: This can be subdivided into 3 units

- Input Devices
- Output Devices
- Auxiliary Devices

The Input device allows data to be read into the CPU from the outside world by the user. Examples are keyboard devices, mouse, joystick, scanner etc.

Output devices: permits results of processing to be transferred from the CPU to the outside world examples are printers, visual Display Unit (VDU), graph plotters etc.

The auxiliary storage is also known as backing storage, external store or secondary store. Since the main store is very fast it would be ideal to store programs permanently in it. But because of its high cost, there is need to have slower and less expensive types of storage called auxiliary storage to back up the memory. Data and programs not currently required for processing are held on auxiliary storage devices until they are needed.

4.0 CONCLUSION

The understanding of the basic and detailed knowledge of computer software and hardware is good for development of an information system.

5.0 SUMMARY

Information technology as a business tool is used to efficiently archive business goals and reduce operational costs in the long run. At a minimum, an implementation of information technology requires hardware, software, and telecommunication networks.

Hardware refers to the physical devices such as servers, workstations, printers, etc. The software most used included database servers, email

servers, spreadsheet applications, word processors, etc. Local area networks and sometimes wide area networks are used to share resources among users.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss the functions of the operating system.
2. Write a detailed note on computer hardware and discuss its role in information system production.

7.0 REFERENCES/FURTHER READING

Adesola, W.A (2000). "Management Information System." Unpublished lecture Note, The Polytechnic Calabar

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UNIT 3 MANAGING DATA RESOURCES

CONTENTS

1.0 INTRODUCTION

In this unit you will learn about managing data resources in an organization.

2.0 OBJECTIVES

At the end of this unit, you would be to:

- discuss the importance of establishing an information policy in an organization
- explain database features and data management
- examine the concept of database management system
- distinguish between the terms data mining and data warehouse.

3.0 MAIN CONTENT

3.1 Data Resources

Setting up a database is only a start. In order to make sure that the data for your business remain accurate, reliable, and readily available to those who

need it, your business will need special policies and procedures for data management.

3.2 Establishing an Information Policy

Every business, large and small, needs an information policy. Your firm's data are important resource, and you don't want people doing whatever they want with them. You need to have rules on how the data are to be organized and maintained, and who is allowed to view the data or change them.

An **information policy** specifies the organization's rules for sharing, disseminating, acquiring, standardizing, classifying, and storing information. Information policy lays out specific procedures and accountabilities, identifying which users and organizational units can share information, where information can be distributed, and who is responsible for updating and maintaining the information. For example, a typical information policy would specify that only selected members of the payroll and human resources department would have the right to change and view sensitive employee data, such as an employee's salary or social security number, and that these departments are responsible for making sure that such employee data are accurate.

If you are in a small business, the information policy would be established and implemented by the owners or managers. In a large organization, managing and planning for information as a corporate resource often requires a formal data administration function. **Data administration** is responsible for the specific policies and procedures through which data can be managed as an organizational resource. These responsibilities include developing information policy, planning for data, overseeing logical database design and data dictionary development, and monitoring how information systems specialists and end-user groups use data.

You may hear the term **data governance** used to describe many of these activities. Promoted by IBM, data governance deals with the policies and processes for managing the availability, usability, integrity, and security of the data employed in an enterprise, with special emphasis on promoting privacy, security, data quality, and compliance with government regulations.

A large organization will also have a database design and management group within the corporate information systems division that is responsible for defining and organizing the structure and content of the database, and maintaining the database. In close cooperation with users, the design group

establishes the physical database, the logical relations among elements, and the access rules and security procedures. The functions it performs are called **database administration**.

3.3 Ensuring Data Quality

A well-designed database and information policy will go a long way toward ensuring that the business has the information it needs. However, additional steps must be taken to ensure that the data in organizational databases are accurate and remain reliable. What would happen if a customer‘s telephone number or account balance were incorrect? What would be the impact if the database had the wrong price for the product you sold or your sales system and inventory system showed different prices for the same product? Data that are inaccurate, untimely, or inconsistent with other sources of information lead to incorrect decisions, product recalls, and financial losses. Inaccurate data in criminal justice and national security databases might even subject you to unnecessarily surveillance or detention.

According to Forrester Research, 20 per cent of U.S. mail and commercial package deliveries were returned because of incorrect names or addresses.

Gartner Inc. reported that more than 25 per cent of the critical data in large Fortune 1000 companies’ databases are inaccurate or incomplete, including bad product codes and product descriptions, faulty inventory descriptions, erroneous financial data, incorrect supplier information, and incorrect employee data (Gartner, 2007).

Think of all the times you‘ve received several pieces of the same direct mail advertising on the same day. This is very likely the result of having your name maintained multiple times in a database. Your name may have been misspelled or you used your middle initial on one occasion and not on another or the information was initially entered onto a paper form and not scanned properly into the system. Because of these inconsistencies, the database would treat you as different people.

If a database is properly designed and enterprise-wide data standards established, duplicate or inconsistent data elements should be minimal. Most data quality problems, however, such as misspelled names, transposed numbers, or incorrect or missing codes, stem from errors during data input.

The incidence of such errors is rising as companies move their businesses to the Web and allow customers and suppliers to enter data into their Web sites that directly update internal systems.

Before a new database is in place, organizations need to identify and correct their faulty data and establish better routines for editing data once their database is in operation. Analysis of data quality often begins with a **data quality audit**, which is a structured survey of the accuracy and level of completeness of the data in an information system. Data quality audits can be performed by surveying entire data files, surveying samples from data files, or surveying end users for their perceptions of data quality. **Data cleansing,** also known as **data scrubbing**, consists of activities for detecting and correcting data in a database that are incorrect, incomplete, improperly formatted, or redundant. Data cleansing not only corrects errors but also enforces consistency among different sets of data that originated in separate information systems. Specialized data-cleansing software is available to automatically survey data files, correct errors in the data, and integrate the data in a consistent company-wide format.

Data quality problems are not just business problems. They also pose serious problems for individuals, affecting their financial condition and even their jobs.

3.4 Database Features and Data Management

A database is a collection of related data stored in one place with minimum redundancy. Most business applications record the day to day business transactions through these databases. There are various databases available for accessing and storing data like RDBMS, NoSQL, XML, etc.

i. The relational database management system (RDBMS) model uses tables to store data, and it is the most commonly used database model.
ii. The data is queried using structured query language (SQL).
iii. Records in a relational database table are uniquely identified using a primary key which should be unique for each record.
iv. A primary key that appears in another table is called a foreign key.

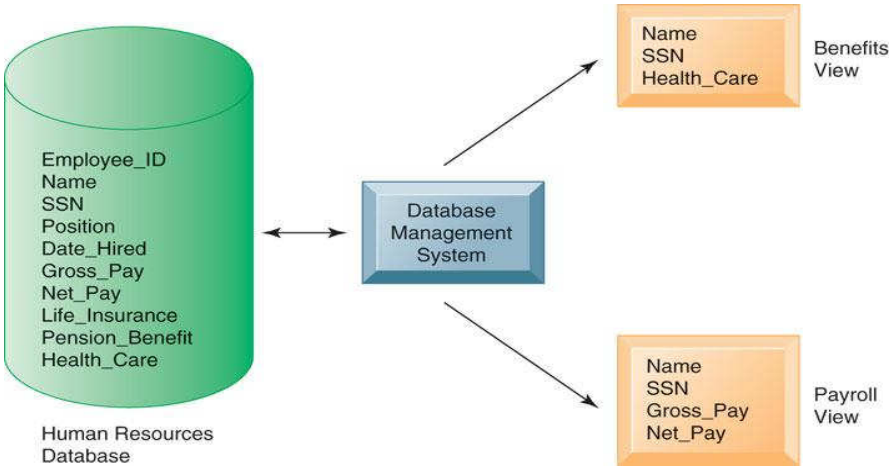


Fig 9.1: Human Resource Database with Multiple Views

A single human resources database provides many different views of data, depending on the information requirements of the user. Illustrated here are two possible views, one of interest to a benefits specialist and one of interest to a member of the company‘s payroll department.

A relational database system can either be standalone or client-server based. The **standalone database** does not support multiple users at the same time. Examples of standalone database systems include:

- Microsoft Access
- SQLIte
- Microsoft SQL Server Compact

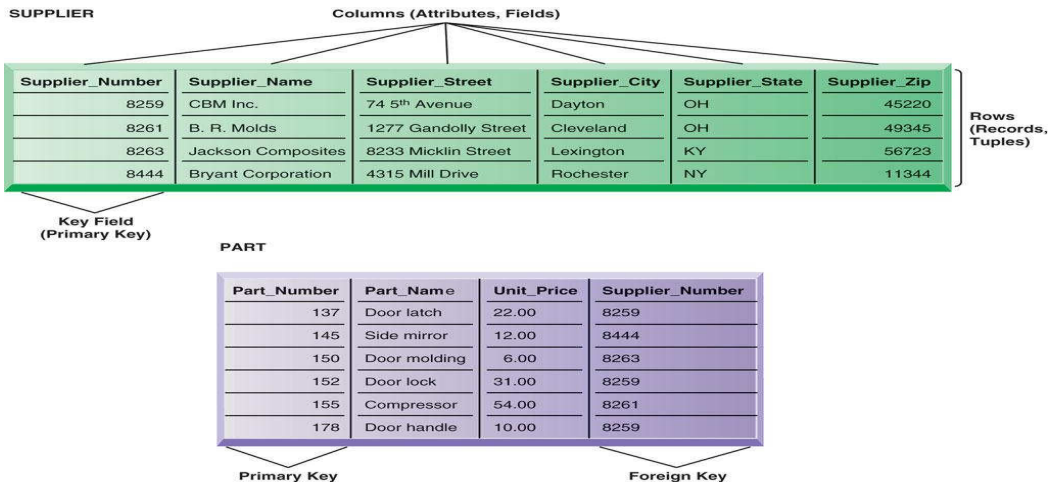


Fig.9.2: A Typical Relational Table

A relational database organizes data in the form of two-dimensional tables. Illustrated here are tables for the entities SUPPLIER and PART showing how they represent each entity and its attributes. Supplier Number is a primary key for the SUPPLIER table and a foreign key for the PART table.

A **client-server database** can support more than one user at a time. The database engine is usually installed on a server computer and users connect to it from remote workstations. Examples of client-server databases systems include

- MySQL
- Microsoft SQL Server
- Oracle
- PostgreSQL

Another type of database that is now gaining popularity is NoSQL database. They are non-relational and are used to handle large amounts of data without slowing down the performance of the system. Companies that handle large amounts of data such as Facebook, Google, Amazon, etc. use NoSQL database.

Examples of NoSQL databases include

- CouchDB
- Oracle NoSQL database
- MongoDB
- Neo4J

Database designing is concerned with understanding the data storage and retrieval requirements of an organization and developing detailed data models of the database. See unit 13 for more discussion on database design.

3.5 Data Base Management Systems (DBMS)

DBMS is a complex software system which constructs, expands and maintains the database. This is a set of programs designed to help utilize information in database.

Functions (Uses) of DBMS

i. It provides a method of organizing data in a file structure that minimizes duplication.
ii. It serves as the link between the file, the computer and the

information users.

iii. The DBMS allocate storage to data.

iv. It maintains indices so that any required data can be retrieved and so that separate items of data in the dbase can be cross- referenced.

v. DBMS establishes provisions for adding, deleting and updating the records in the database.

vi. It provides an interface with user programs. Programs may be written in a number of different programming languages. The programmer need not be familiar with the structure of the base because the data his requires is retrieved by the DBMS.

vii. DBMS provides facilities for different types of file processing.

viii. It can process a complete file; process required records, retrieve individual records, retrieve related records or related data within records.

ix. It provides security for the data in the base. This function includes protecting data against unauthorized access, safeguarding data against corruption and providing recovery and restart facilities after a hardware or software failure.

x. DBMS keeps statistics of the use made of the data in the base. This allows redundant data to be removed. It also allows data, which is frequently used to be kept in a readily accessible form so that time is saved.

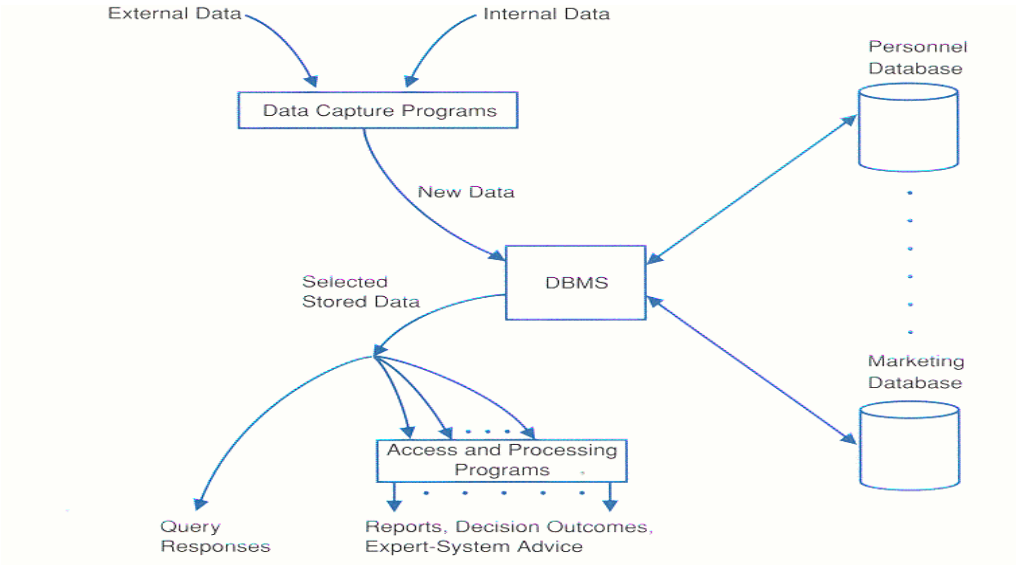


Fig. 9.3: A Typical DBMS

The DBMS here sits at the heart of the data processing set up.

Data Base Administrator (DBA)
DBA is the supervisor, librarian and custodian of a database. Database is so important that a special manager is appointed sometimes with a staff. A DBA must have a sound knowledge of the structure of the database and of the DBMS. He must be conversant with the organization, it systems, and the information needs of the managers. His functions include:

- He is responsible for ensuring that the data in the base meets the information needs of the organization.
- He ensures that the facilities for retrieving data and for structuring reports are appropriate to the needs of the organization.
- He keeps the data dictionary; and manuals for users describing the facilities the database offers and how to make use of those facilities.
- He supervises the addition of new data. He liaises with the managers who use the data and the systems analysis and programmers who develop the systems.
- Security of the database is also the responsibility of the Administrator and in future, requirements of privacy.
- The Administrator is also responsible for periodic appraisal of the data held in the base to ensure that it is complete, accurate and not duplicated.

3.6 Definition of Terms

DDL: A Data Description Language is used to create or change the database. It defines the physical characteristics of the data, such as alphabetic of numeric, and describes the relationship between the data elements and the application programs. It is used to specify the data in the base.

DML: A Data Manipulation Language lists the instructions such as DELETE or FIND. It is used by application programs to access the database. DML is used to access the data.

DD: A Data Dictionary is a centralized inventory of the data elements stored in the database. It is _data about data'. It is used to organize that data when the database is created. It is also used to maintain the database and keep track of the location of each data elements within the database.

Non-Integrated System: Implies that computer systems are developed in a piecemeal fashion, and the design team will arrange to capture separate input information for each individual application.

Integrated System: implies that two or more applications are merged into one single application, with one set of input data. The integrated system extends database to include all information flows in a business and automates as many decisions as possible to produce comprehensive management information system. There are several approaches to integrated system, some of which are explained below:

- Several separate master files might be incorporated into one computer system (e.g. sales, purchases and stock); or
- Several separate files may be draw into single master file e.g. stock record and stock valuation records; or
- Output from one or more systems may provide the input to another system e.g. a magnetic tape output from the payroll, stock, purchases and sales system may provide some of the input for the nominal ledger system.

Integrated system approach makes inefficient use of computer processing time and data preparation time.

Data Bank is designed to contain any data that may be required, just as a librarian has to keep stocks of books, some of which may never be referred to.

Control Problems in a Database

1. Concentration of functions within the data processing (DP) Department.

2. Increased concentration of data associated with the difficulty of maintaining adequate backup.

3. Problem of data definitions and data relationships from the unlimited access to files in the database system.

Control Measures

1. Physical controls at the terminals.
2. Restriction of access to the database by DBMS.
3. Restriction of access to programs by the DBMS.
4. File reconstruction techniques and facilities provided by DBMS provide details of transactions processed in journal form.

5. Restricted access to the data dictionary, which contains data definitions and data relationships.

3.7 Data Mining

Traditional database queries answer such questions as: How many units of product number 2103 were shipped in February 2010?‖ OLAP, or multidimensional analysis, supports much more complex requests for information, such as: Compare sales of product 2103 relative to plan by quarter and sales region for the past two years.‖ With OLAP and query-oriented data analysis, users need to have a good idea about the information for which they are looking.

Data mining is more discovery-driven. Data mining provides insights into corporate data that cannot be obtained with OLAP by finding hidden patterns and relationships in large databases and inferring rules from them to predict future behaviour. The patterns and rules are used to guide decision making and forecast the effect of those decisions. The types of information obtainable from data mining include associations, sequences, classifications, clusters, and forecasts.

- **Associations** are occurrences linked to a single event. For instance, a study of supermarket purchasing patterns might reveal that, when corn chips are purchased, a cola drink is purchased 65 per cent of the time, but when there is a promotion; cola is purchased 85 per cent of the time. This information helps managers make better decisions because they have learned the profitability of a promotion.

- In **sequences**, events are linked over time. We might find, for example, that if a house is purchased, a new refrigerator will be purchased within two weeks 65 percent of the time, and an oven will be bought within one month of the home purchase 45 percent of the time.

- **Classification** recognizes patterns that describe the group to which an item belongs by examining existing items that have been classified and by inferring a set of rules. For example, businesses such as credit card or telephone companies worry about the loss of steady customers. Classification helps discover the characteristics of customers who are likely to leave and can provide a model to help managers predict who those customers are so that the managers can devise special campaigns to retain such customers.

- **Clustering** works in a manner similar to classification when no groups have yet been defined. A data mining tool can discover different groupings within data such as finding affinity groups for bank cards or partitioning a database into groups of customers based on demographics and types of personal investments.

- Although these applications involve predictions, **forecasting** uses predictions in a different way. It uses a series of existing values to forecast what other values will be. For example, forecasting might find patterns in data to help managers estimate the future value of continuous variables, such as sales figures.

These systems perform high-level analyses of patterns or trends, but they can also drill down to provide more detail when needed. There are data mining

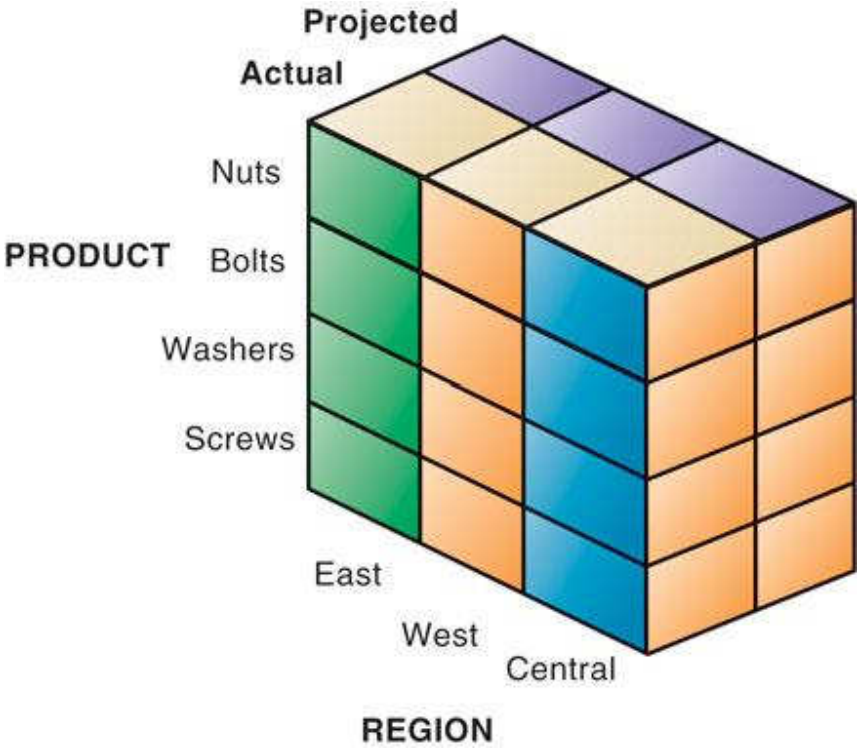


Fig. 9.1: Multidimensional Data Model

The view that is showing is product versus region. If you rotate the cube 90 degrees, the face will show product versus actual and projected sales. If you rotate the cube 90 degrees again, you will see region versus actual and projected sales. Other views are possible.

One popular use for data mining is to provide detailed analyses of patterns in customer data for one-to-one marketing campaigns or for identifying profitable customers.

Predictive analytics use data mining techniques, historical data, and assumptions about future conditions to predict outcomes of events, such as the probability a customer will respond to an offer or purchase a specific product. For example, the U.S. division of The Body Shop International Plc used predictive analytics with its database of catalog, Web, and retail store customers to identify customers who were more likely to make catalog purchases. That information helped the company build a more precise and targeted mailing list for its catalogs, improving the response rate for catalog mailings and catalog revenues.

3.8 Data Warehouses

Suppose you want concise, reliable information about current operations, trends, and changes across the entire company If you worked in a large company, obtaining this might be difficult because data are often maintained in separate systems, such as sales, manufacturing, or accounting. Some of the data you need might be found in the sales system and other pieces in the manufacturing system. Many of these systems are older legacy systems that use out-dated data management technologies or file systems where information is difficult for users to access. You might have to spend an inordinate amount of time locating and gathering the data you need, or you would be forced to make your decision based on incomplete knowledge. If you want information about trends, you might also have trouble finding data about past events because most firms only make their current data immediately available. Data warehousing addresses these problems.

What Is a Data Warehouse?

A **data warehouse** is a database that stores current and historical data of potential interest to decision makers throughout the company. The data originate in many core operational transaction systems, such as systems for sales, customer accounts, and manufacturing, and may include data from Web site transactions. The data warehouse consolidates and standardizes information from different operational databases so that the information can be used across the enterprise for management analysis and decision making.

Figure 9.2 illustrates how a data warehouse works. The data warehouse makes the data available for anyone to access as needed, but it cannot be altered. A data warehouse system also provides a range of ad hoc and

standardized query tools, analytical tools, and graphical reporting facilities.

Many firms use intranet portals to make the data warehouse information widely available throughout the firm.

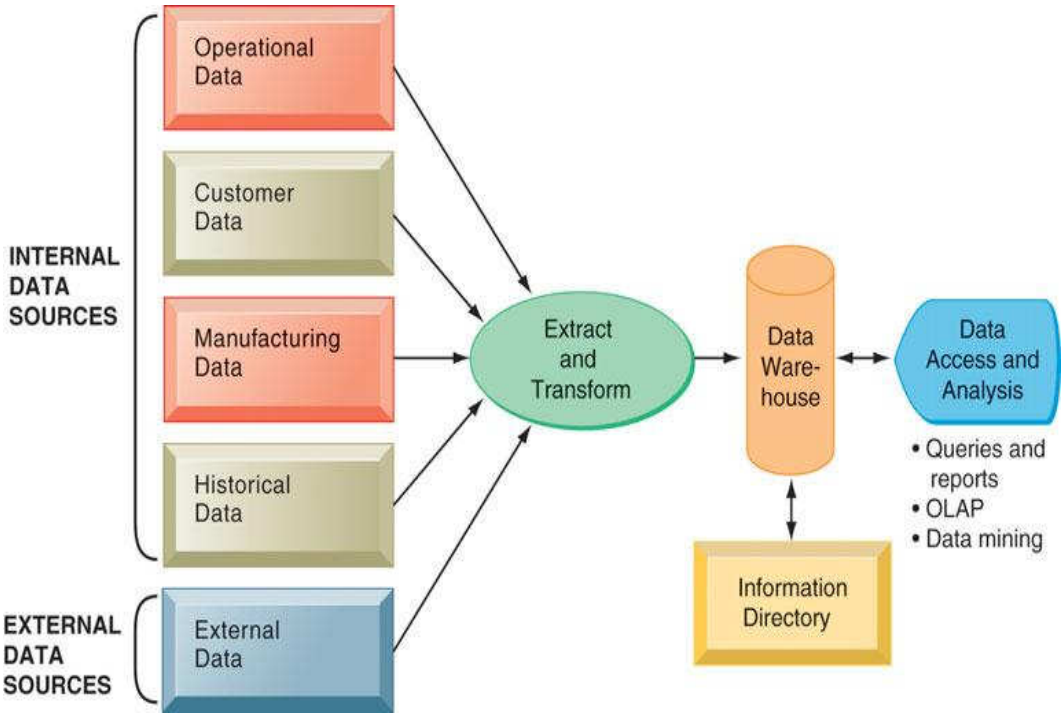


Fig. 6.12: Components of a Data warehouse

The data warehouse extracts current and historical data from multiple operational systems inside the organization. These data are combined with data from external sources and reorganized into a central database designed for management reporting and analysis. The information directory provides users with information about the data available in the warehouse.

3.9 Telecommunication Systems and Networks

Telecommunication is the exchange of information over long distances. Telecommunication uses transmitters and receivers to facilitate communication. Signals can be sent via physical cables or the sent via a wireless network.

A telecommunication network refers to multiple transmitters and receivers exchanging data. The internet is an example of a large telecommunication network. Wide Area Networks (WANs), telephone communication networks, etc. are all examples of telecommunication networks.

Networking devices are used to link computers and other telecommunication devices together. The devices used to create a network depend on the type of network work that you want. For example, a wired Local Area Networks (LANs) will require a network switch and RJ-45 cables.

A network router is used to facilitate communication between two or more networks. A wireless router is used to provide wireless access points. A wireless access point is used to connect an electronic device i.e. computer, smartphones, etc. to a computer network

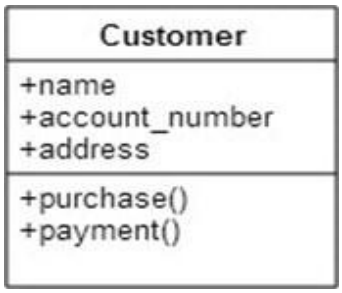
3.10 Data Structures and Algorithms

Think of a business such as Facebook. Every month billions of users submit data to Facebook. Facebook, in turn, uses this data to accurately select posts which are relevant to the user and make friends suggestions which are almost 100% accurate every time.

Data structures and algorithms are an efficient way of organizing and managing data, especially large datasets. Data structures usually refer to the way the data is stored.

For example, a class is a representation of a real-world entity. A customer class will contain properties i.e. name, account number, address, etc. and methods i.e. make a purchase, make a payment, etc.

The following image illustrates the concept of a class;



Other examples of data structures include arrays, records, sets and graphs. An algorithm refers to the operations that can be performed on the data.

Let's take Amazon as an example. If you have ever purchased an item on Amazon or browsed through the catalogues, Amazon will recommend other items that you might be interested in. Amazon uses historical data to predict other items that you might also be interested in.

SELF-ASSESSMENT EXERCISE

What are the consequences of an organization not having an information policy?

4.0 CONCLUSION

Managing data resources is an essential routine that is carried out routinely with an established policy by any organization with a viable and proactive information system in place. Data are being generated hourly, daily and monthly in volumes and hence, its management is a serious issue for the organization.

5.0 SUMMARY

This unit is a review of key concepts in data management in organizations which include the followings: importance of establishing an information policy, data mining, and use of data warehouse.

6.0 TUTOR-MARKED ASSIGNMENT

1. What are the problems of managing data resources in a traditional file environment and how are they solved by a database management system?
2. List and describe the problems of the traditional file environment.
3. Define a database and a database management system and describe how it solves the problems of a traditional file environment.
4. Why are information policy, data administration, and data quality assurance essential for managing the firm‘s data resources?
5. Describe the roles of information policy and data administration in information management.
6. Define data mining, describing how it differs from OLAP and the types of information it provides.

7.0 REFERENCES/FURTHER READING

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UNIT 4 PROGRAMMING IN COMPUTER LANGUAGES

CONTENTS

1.0 INTRODUCTION

In this unit we review computer programming languages in general but with special focus on high level programming languages.

2.0 OBJECTIVES

At the end of this unit, you should be able to: discuss computer programming languages.

3.0 MAIN CONTENT

3.1 What is Computer Programming?

Computer programming is the act of writing a program which the computer can execute to produce the desired result. A computer program is the sequence of simple instructions or statements into which a given problem is reduced and that which is in a form the computer can understand. Embedded in a program is the logic of the problem to be solved and it is in fact, this logic that is expressed in simple computer executable statement.

In effect the computer does not produce the logic rather; it follows the logic supplied by programmer. Programming demands a great deal of planning, creativity and logical reasoning. Depending on the complexity of the problem to be solved, programming can be quite challenging.

3.1.1 Computer Programming Languages

A set of notations used for communication is called a language. Spoken languages are said to be ambiguous while computer languages are said to be unambiguous because each statement has a unique meaning. The two main classes of computer languages are called low level language and high level language.

Low level language: A low level language is either a machine language or as assembly language.

Machine language: In Theory we could write our programs using machine code but this would be quite a laborious exercise. Remember that machine code is made up of ones and zeroes; getting them all right is not easy.

It is a programming language composed primarily of numeric instructions, i.e. it is defined by the operation codes and format of the machine instructions of the computer. It is a language made up of strings of binary digits specific to a particular make and model of computer. A machine instruction contains two basic parts:

i. Operations to be performed, e.g. add, subtract, multiply, etc.
ii. One or more operands and the memory address where the data to be operated upon is located.

The operation is identified by a numeric code called the operation or operands e.g. an instruction to add the contents of a memory address to a register. The operation code is the numeric code for the addition operation and the operands are simply, numbers indicating the memory, address and the address of a register.

Since the computer deals with only binary numbers, machine language instructions must be expressed numerically, using the digits 0 and 1.

Machine language cannot be changed by the programs. The interpretation of a machine language program is a direct function of the computer hardware, the circuitry of the computer determines the rules of the language.

Disadvantages of Machine Language

- Programming in machine language is a difficult and tedious task.
- It is subject to much human error
- It is machine dependent

Assembly Language

Slightly less difficult to use is assembly language. This is written by using mnemonic codes, each of which corresponds directly to a machine language instructione.g. Using a 6502 processor on a computer (such as the BBC Microcomputer or the APPLE) the instruction.

LDA #3

Means load the number 3 into the accumulator. Rather than assigning a particular memory addresses to an operand, the programmer gives a symbolic name to a location and labels the location by that name.

Assembly language instructions are translated into machine language by a program called an assembler. Writing in assembly language does have some advantages over using most of the other languages that we will be discussing below. It gives us very detailed control over precisely what the computer does. We can therefore write efficient programs which will run quickly and which occupy relatively small amounts of space in the computer‘s memory. However, assembly language programs have some disadvantages:

i. They are quite difficult to write and harder to learn (although not as difficult as machine code).

ii. They cannot easily be moved from one computer to another as different microprocessor use different assembly languages, thus the entire program must be re-written if it is to be used in another computer.

iii. An assembly language program is more difficult to modify, because it is written in a language that is hard to interpret.

iv. The logical steps to solve the problem are buried in mass of machine instructions.

For these reasons it is often more convenient to write programs in a high-level language.

High-level Languages

In general, high-level languages use words and symbols in ways which are similar to those in which they are normally used by human beings, rather than using the somewhat cryptic mnemonic codes used by assembly languages.

Advantages of High-level Languages

- The programmer is free to concentrate on problem solution instead of the internal operations of the computer.
- Less time is required for writing the program.
- Program logic is easier to trace.
- Program revision is easier
- High-level languages are much easier to learn, to understand, and to use.
- Major high-level languages are available on most computers and so it is relatively easy to move a program from one kind of machine to another.
- Because they are machine-independent, a program written on one computer can easily be run on another computer.

We now turn to a discussion of individual high-level languages. We will not attempt to describe the details of how to use them (except for FORTRAN); these can be found in the manufacturer‘s manuals or in other books on particular languages. Instead, we will simply attempt to give an idea of the purposes for which the languages are used and of their general nature. The languages we will
discuss are:

-	BASIC	PASCAL	FORTRAN
-	ALGOL	COBOL	LISP
-	LOGO	FORTH	PROLOG
-	APL	JAVA	ADA
-	C++	PHP	C_Sharp(C#)
-	C		

There are, of course, many others, some of which are designed for specialized applications. However, those listed above should give some idea of the variety of languages available.

BASIC: (an acronym for Beginner's All-purpose Symbolic Instruction Code) is a family of general-purpose, high-level programming languages whose design philosophy emphasizes ease of use. In 1964, John G. Kemeny and Thomas E. Kurtz designed the original BASIC language at Dartmouth College in New Hampshire, United States. They wanted to enable students in fields other than science and mathematics to use computers. At the time, nearly all use of computers required writing custom software, which was something only scientists and mathematicians tended to learn.

Versions of BASIC became widespread on microcomputers in the mid-1970s and 1980s. Microcomputers usually shipped with BASIC, often in the machine's firmware. Having an easy-to-learn language on these early personal computers allowed small business owners, professionals, hobbyists, and consultants to develop custom software on computers they could afford.[original research?] In the 2010s, BASIC was popular in many computing dialects and in new languages influenced by BASIC, such as Microsoft's Visual Basic.

PASCAL: is an imperative and procedural programming language, which Niklaus Wirth designed in 1968–69 and published in 1970, as a small, efficient language intended to encourage good programming practices using structured programming and data structuring.

A derivative known as Object Pascal designed for object-oriented programming was developed in 1985, later developed into Delphi. PASCAL is the main rival to BASIC as a language for those starting to learn computer programming. For once, the letters in the name do not stand for anything; the language is named after Blaise Pascal, the 17^{th} century French Mathematician whose achievements included the invention of a calculating machine. PASCAL is intended to avoid the potential untidiness of BASIC programs, and to bring out the logical structure of a program much more clearly. To take just one example, all of the variables in a PASCAL program have to be declared at the beginning of the program. In BASIC, new variables can be introduced at any point in the program. Because of this greater discipline, PASCAL programs tend to be slightly more difficult to write than BASIC programs, but there is less danger of writing a poorly organized program in PASCAL. This is particularly important when the program is a fairly long one.

FORTRAN: (/ˈfɔːrtræn/; formerly FORTRAN, derived from "Formula Translation") is a general-purpose, imperative programming language that is especially suited to numeric computation and scientific computing.

Originally developed by IBM in the 1950s for scientific and engineering applications, Fortran came to dominate this area of programming early on and has been in continuous use for over half a century in computationally intensive areas such as numerical weather prediction, finite element analysis, computational fluid dynamics, computational physics, crystallography and computational chemistry. It is a popular language for high-performance computing and is used for programs that benchmark and rank the world's fastest supercomputers.

Fortran encompasses a lineage of versions, each of which evolved to add extensions to the language while usually retaining compatibility with prior versions. Successive versions have added support for structured programming and processing of character-based data (FORTRAN 77), array programming, modular programming and generic programming (Fortran 90), high performance Fortran (Fortran 95), object-oriented programming (Fortran 2003) and concurrent programming (Fortran 2008).

ALGOL: (short for Algorithmic Language) is a family of imperative computer programming languages, originally developed in the mid-1950s, which greatly influenced many other languages and was the standard method for algorithm description used by the ACM in textbooks and academic sources for more than thirty years.

In the sense that the syntax of most modern languages is "Algol-like", it was arguably the most influential of the four high-level programming languages with which it was roughly contemporary: FORTRAN, Lisp, and COBOL. It was designed to avoid some of the perceived problems with FORTRAN and eventually gave rise to many other programming languages, including PL/I, Simula, BCPL, B, Pascal, and C.

ALGOL introduced code blocks and the begin…end pairs for delimiting them. It was also the first language implementing nested function definitions with lexical scope. Moreover, it was the first programming language which gave detailed attention to formal language definition and through the Algol 60 Report introduced Backus–Naur form, a principal formal grammar notation for language design.

There were three major specifications, named after the year they were first published:

- ALGOL 58 – originally proposed to be called IAL, for International Algebraic Language.
- ALGOL 60 – first implemented as X1 ALGOL 60 in mid-1960. Revised 1963.[5][6]
- ALGOL 68 – introduced new elements including flexible arrays, slices, parallelism, operator identification. Revised 1973.[7]

Niklaus Wirth based his own ALGOL-W on ALGOL 60 before developing Pascal. ALGOL-W was based on the proposal for the next generation ALGOL, but the ALGOL 68 committee decided on a design that was more complex and advanced, rather than a cleaned, simplified ALGOL 60.

ALGOL 68 is substantially different from ALGOL 60 and was not well received, so that in general "Algol" means ALGOL 60 and dialects thereof.

COBOL: (/ˈkoʊbɒl/, an acronym for common business-oriented language) is a compiled English-like computer programming language designed for business use. It is imperative, procedural and, since 2002, object-oriented. COBOL is primarily used in business, finance, and administrative systems for companies and governments. COBOL is still widely used in legacy applications deployed on mainframe computers, such as large-scale batch and transaction processing jobs. But due to its declining popularity and the retirement of experienced COBOL programmers, programs are being migrated to new platforms, rewritten in modern languages or replaced with software packages. Most programming in COBOL is now purely to maintain existing applications.

COBOL was designed in 1959 by CODASYL and was partly based on previous programming language design work by Grace Hopper, commonly referred to as "the (grand)mother of COBOL". It was created as part of a US Department of Defense effort to create a portable programming language for data processing. Intended as a stopgap, the Department of Defense promptly forced computer manufacturers to provide it, resulting in its widespread adoption. It was standardized in 1968 and has since been revised four times. Expansions include support for structured and object-oriented programming. The current standard is ISO/IEC 1989:2014.

COBOL has an English-like syntax, which was designed to be self-documenting and highly readable. However, it is verbose and uses over 300 reserved words. In contrast with modern, succinct syntax like y = x;, COBOL has a more English-like

syntax (in this case, MOVE x TO y). COBOL code is split into four divisions (identification, environment, data and procedure) containing a rigid hierarchy of sections, paragraphs and sentences. Lacking a large standard library, the standard specifies 43 statements, 87 functions and just one class.

Academic computer scientists were generally uninterested in business applications when COBOL was created and were not involved in its design; it was (effectively) designed from the ground up as a computer language for business, with an emphasis on inputs and outputs, whose only data types were numbers and strings of text. COBOL has been criticized throughout its life, however, for its verbosity, design process and poor support for structured programming, which resulted in monolithic and incomprehensible programs.

LISP: (historically, LISP) is a family of computer programming languages with a long history and a distinctive, fully parenthesized prefix notation. Originally specified in 1958, Lisp is the second-oldest high-level programming language in widespread use today. Only FORTRAN is older by one year. Lisp has changed since its early days, and many dialects have existed over its history. Today, the best known general-purpose Lisp dialects are Common Lisp and Scheme.

Lisp was originally created as a practical mathematical notation for computer programs, influenced by the notation of Alonzo Church's lambda calculus. It quickly became the favoured programming language for artificial intelligence (AI) research. As one of the earliest programming languages, Lisp pioneered many ideas in computer science, including tree data structures, automatic storage management, dynamic typing, conditionals, higher-order functions, recursion, the self-hosting compiler, and the read–eval–print loop.

The name LISP derives from "LISt Processor". Linked lists are one of Lisp's major data structures, and Lisp source code is made of lists. Thus, Lisp programs can manipulate source code as a data structure, giving rise to the macro systems that allow programmers to create new syntax or new domain-specific languages embedded in Lisp.

The interchangeability of code and data gives Lisp its instantly recognizable syntax. All program code is written as s-expressions, or parenthesized lists. A function call or syntactic form is written as a list with the function or operator's name first, and the arguments following; for instance, a function f that takes three arguments would be called as (f arg1 arg2 arg3).

LOGO: is an educational programming language, designed in 1967 by Wally Feurzeig, Seymour Papert and Cynthia Solomon. "Logo" is not an acronym. It was derived from the Greek logos meaning word or "thought" by Feurzeig, to distinguish itself from other programming languages that were primarily numbers, not graphics or logic, oriented.

A general-purpose language, Logo is widely known for its use of turtle graphics, in which commands for movement and drawing produced line graphics either on screen or with a small robot called a turtle. The language was conceived to teach concepts of programming related to Lisp and only later to enable what Papert called "body-syntonic reasoning", where students could understand, predict and reason about the turtle's motion by imagining what they would do if they were the turtle. There are substantial differences among the many dialects of Logo, and the situation is confused by the regular appearance of turtle-graphics programs that call themselves Logo.

Logo is a multi-paradigm adaptation and dialect of Lisp, a functional programming language. There is no standard Logo, but UCBLogo has the best facilities for handling lists, files, I/O, and recursion in scripts, and can be used to teach all computer science concepts, as UC Berkeley lecturer Brian Harvey did in his Computer Science Logo Style trilogy.

Logo is usually an interpreted language, although there have been developed compiled Logo dialects (such as Lhogho and Liogo). Logo is not case-sensitive but retains the case used for formatting.

FORTH: Forth is an imperative stack-based computer programming language and environment originally designed by Charles "Chuck" Moore. Language features include structured programming, reflection (the ability to modify the program structure during program execution), concatenative programming (functions are composed with juxtaposition) and extensibility (the programmer can create new commands). Although not an acronym, the language's name is sometimes spelled with all capital letters as FORTH, following the customary usage during its earlier years. A procedural programming language without type checking, Forth features both interactive execution of commands (making it suitable as a shell for systems that lack a more formal operating system) and the ability to compile sequences of commands for later execution. Some Forth implementations (usually early versions or those written to be extremely portable) compile threaded code, but many implementations today generate optimized machine code like other language compilers.

Forth is used in the Open Firmware boot loader, in space applications, such as the Philae spacecraft and other embedded systems which involve interaction with hardware. The bestselling 1986 DOS game Starflight, from Electronic Arts, was written with a custom Forth. The free software Gforth implementation is actively maintained, as are several commercially supported systems.

PROLOG: is a general-purpose logic programming language associated with artificial intelligence and computational linguistics.

Prolog has its roots in first-order logic, a formal logic, and unlike many other programming languages, Prolog is declarative: the program logic is expressed in terms of relations, represented as facts and rules. A computation is initiated by running a query over these relations.

The language was first conceived by a group around Alain Colmerauer in Marseille, France, in the early 1970s and the first Prolog system was developed in 1972 by Colmerauer with Philippe Roussel.

Prolog was one of the first logic programming languages, and remains the most popular among such languages today, with several free and commercial implementations available. The language has been used for theorem proving, expert systems, term rewriting, type inference, and automated planning, as well as its original intended field of use, natural language processing. Modern Prolog environments support the creation of graphical user interfaces, as well as administrative and networked applications.

Prolog is well-suited for specific tasks that benefit from rule-based logical queries such as searching databases, voice control systems, and filling templates.

APL: (named after the book A Programming Language) is a programming language developed in the 1960s by Kenneth E. Iverson. Its central data type is the multidimensional array. It uses a large range of special graphic symbols to represent most functions and operators, leading to very concise code. It has been an important influence on the development of concept modelling, spreadsheets, functional programming, and computer math packages. It has also inspired several other programming languages. It is still used today for certain applications.

ADA: is a structured, statically typed, imperative, wide-spectrum, and object- oriented high-level computer programming language, extended from

Pascal and other languages. It has built-in language support for design-by-contract, extremely strong typing, explicit concurrency, offering tasks, synchronous message passing, protected objects, and non-determinism. Ada improves code safety and maintainability by using the compiler to find errors in favor of runtime errors. Ada is an international standard; the current version (known as Ada 2012) is defined by ISO/IEC 8652:2012.

Ada was originally designed by a team led by Jean Ichbiah of CII Honeywell Bull under contract to the United States Department of Defense (DoD) from 1977 to
1983 to supersede over 450 programming languages used by the DoD at that time. Ada was named after Ada Lovelace (1815–1852), who has been credited with being the first computer programmer.

C: (/ˈsiː/, as in the letter c) is a general-purpose, imperative computer programming language, supporting structured programming, lexical variable scope and recursion, while a static type system prevents many unintended operations. By design, C provides constructs that map efficiently to typical machine instructions, and therefore it has found lasting use in applications that had formerly been coded in assembly language, including operating systems, as well as various application software for computers ranging from supercomputers to embedded systems.

C was originally developed by Dennis Ritchie between 1969 and 1973 at Bell Labs, and used to re-implement the Unix operating system. It has since become one of the most widely used programming languages of all time, with C compilers from various vendors available for the majority of existing computer architectures and operating systems. C has been standardized by the American National Standards Institute (ANSI) since 1989 (see ANSI C) and subsequently by the International Organization for Standardization (ISO).

C is an imperative procedural language. It was designed to be compiled using a relatively straightforward compiler, to provide low-level access to memory, to provide language constructs that map efficiently to machine instructions, and to require minimal run-time support. Despite its low-level capabilities, the language was designed to encourage cross-platform programming. A standards-compliant and portably written C program can be compiled for a very wide variety of computer platforms and operating systems with few changes to its source code. The language has become available on a very wide range of platforms, from embedded microcontrollers to supercomputers.

(C-Sharp) C#: (pronounced as see sharp) is a multi-paradigm programming language encompassing strong typing, imperative, declarative, functional, generic, object-oriented (class-based), and component-oriented programming disciplines. It was developed by Microsoft within its .NET initiative and later approved as a standard by Ecma (ECMA-334) and ISO (ISO/IEC 23270:2006). C# is one of the programming languages designed for the Common Language Infrastructure.

C# is a general-purpose, object-oriented programming language. Its development team is led by Anders Hejlsberg. The most recent version is C# 7.0, which was released in 2017 along with Visual Studio 2017.

JAVA: is a general-purpose computer programming language that is concurrent, class-based, object-oriented, and specifically designed to have as few implementation dependencies as possible. It is intended to let application developers "write once, run anywhere" (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of computer architecture. As of 2016, Java is one of the most popular programming languages in use, particularly for client-server web applications, with a reported 9 million developers. Java was originally developed by James Gosling at Sun Microsystems (which has since been acquired by Oracle Corporation) and released in 1995 as a core component of Sun Microsystems' Java platform. The language derives much of its syntax from C and C++, but it has fewer low-level facilities than either of them.

The original and reference implementation Java compilers, virtual machines, and class libraries were originally released by Sun under proprietary licenses. As of May 2007, in compliance with the specifications of the Java Community Process, Sun relicensed most of its Java technologies under the GNU General Public License. Others have also developed alternative implementations of these Sun technologies, such as the GNU Compiler for Java (bytecode compiler), GNU Classpath (standard libraries), and IcedTea-Web (browser plugin for applets).

The latest version is Java 9, released on September 21, 2017, and is one of the two versions currently supported for free by Oracle. Versions earlier than Java 8 are supported both by Oracle and other companies on a commercial basis.

PHP: is a server-side scripting language designed primarily for web development but also used as a general-purpose programming language. Originally created by Rasmus Lerdorf in 1994, the PHP reference implementation is now produced by The PHP Development Team. PHP originally stood for Personal Home Page, but it now stands for the recursive acronym PHP: Hypertext Preprocessor.

PHP code may be embedded into HTML or HTML5 markup, or it can be used in combination with various web template systems, web content management systems and web frameworks. PHP code is usually processed by a PHP interpreter implemented as a module in the web server or as a Common Gateway Interface (CGI) executable. The web server software combines the results of the interpreted and executed PHP code, which may be any type of data, including images, with the generated web page. PHP code may also be executed with a command-line interface (CLI) and can be used to implement standalone graphical applications.

The standard PHP interpreter, powered by the Zend Engine, is free software released under the PHP License. PHP has been widely ported and can be deployed on most web servers on almost every operating system and platform, free of charge.

The PHP language evolved without a written formal specification or standard until 2014, leaving the canonical PHP interpreter as a de facto standard. Since 2014 work has gone on to create a formal PHP specification.

PL/1: (Programming Language One, pronounced /piː ɛl wʌn/) is a procedural, imperative computer programming language designed for scientific, engineering, business and system programming uses. It has been used by various academic, commercial and industrial organizations since it was introduced in the 1960s, and continues to be actively used.

PL/I's main domains are data processing, numerical computation, scientific computing, and system programming; it supports recursion, structured programming, linked data structure handling, fixed-point, floating-point, complex, character string handling, and bit string handling. The language syntax is English- like and suited for describing complex data formats, with a wide set of functions available to verify and manipulate them.

(C-plus plus) C++: (pronounced cee plus plus /ˈsiː plʌs plʌs/) is a general-purpose programming language. It has imperative, object-oriented and generic programming features, while also providing facilities for low-level memory manipulation.

It was designed with a bias toward system programming and embedded, resource- constrained and large systems, with performance, efficiency and flexibility of use as its design highlights. C++ has also been found useful in many other contexts, with key strengths being software infrastructure and resource-constrained applications, including desktop applications, servers (e.g. e-commerce, web search or SQL servers), and performance-critical applications (e.g. telephone switches or space probes). C++ is a compiled language, with implementations of it available on many platforms. Many vendors provide C++ compilers, including the Free Software Foundation, Microsoft, Intel, and IBM.

C++ is standardized by the International Organization for Standardization (ISO), with the latest standard version ratified and published by ISO in December 2014 as ISO/IEC 14882:2014 (informally known as C++14). The C++ programming language was initially standardized in 1998 as ISO/IEC 14882:1998, which was then amended by the C++03, ISO/IEC 14882:2003, standard. The current C++14 standard supersedes these and C++11, with new features and an enlarged standard library. Before the initial standardization in 1998, C++ was developed by Bjarne Stroustrup at Bell Labs since 1979, as an extension of the C language as he wanted an efficient and flexible language similar to C, which also provided high-level features for program organization. The C++17 standard is due in July 2017, with the draft largely implemented by some compilers already, and C++20 is the next planned standard thereafter.

Many other programming languages have been influenced by C++, including C#, D, Java, and newer versions of C.

3.2 A Sample Program in FORTRAN 77

Here below is a sample FORTRAN program to compute the average of any three numbers supplied through the keyboard using nine lines of codes. The explanation of each line is as stated below.

```
C234567
PROGRAM AVE
REAL A,B,C,SUM,AVE READ(*,*) A,B,C
SUM = A+B+C AVE = SUM/3.0
WRITE(*,*) –AVERAGE OF A,B AND C =‖, AVE
STOP END
```

Line 1: This is a non-executable statement. It is used to enforce FORTRAN coding format which says that all program must start on Column 7

Line 2: This line is used to give the program a name

Line 3: This line is used to declare all the 5 variables used in the program as a REAL variable. This helps to avoid datatype mismatch.

Line 4: This line is used to read the three values to be stored in the three variables names in the program (A, B, and C).

Line 5: This line computes the sum of the three values stored in the variable names A, B and C; and store the result in the variable name SUM

Line 6: This line is used to compute the average of the three values whose sum had already been computed and stored in variable SUM previously.

Line 7: This line is used to instruct the FORTRAN compiler to display the average result on the computer screen.

Line 8: This line is used to temporarily terminate the program

Line 9: This line permanently ends the program.

4.0 CONCLUSION

Here, we carry out a brief review of sixteen popular computer high level programming languages that are used for developing information system.

5.0 SUMMARY

This unit is a review of computer programming languages

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss on the following computer programming language by highlighting their strengths and weaknesses.
   i) COBOL
   ii) FORTRAN

7.0 REFERENCES/FURTHER READING

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MODULE 3

UNIT 1 INFORMATION SYSTEMS DEVELOPMENT

CONTENTS

1.0 INTRODUCTION

The software is one of the major components of a management information system. Some of the software used in a MIS system is off the shelf. These include packages such as spreadsheet programs, database applications, etc. However, they are times when off the shelf, software does not meet the business requirements. The solution to this problem is custom made software.

This unit will focus on the methodologies, analysis and design used to develop custom software.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- discuss Information Systems Development Stakeholder
- explain MIS Systems Analysis and Design
  - analyse MIS Object oriented analysis and design
  - describe MIS Systems Development Life Cycle (SDLC)
  - discuss Waterfall Model, Agile Development and Prototyping
  - enumerate stages in system development

3.0 MAIN CONTENT

3.1 Information Systems Development Stakeholder

A typical information systems development usually has three (3) stakeholders namely:

- **Users** – Users are the ones who use the system after it has been developed to perform their day to day tasks.

- **Project sponsors** - this category of the stakeholders is responsible for the financial aspect of the project and ensuring that the project is completed.

- **Developers** – this category is usually made up of systems analysts and programmers. The system analysts are responsible for collecting the user requirements and writing system requirements.

The programmers develop the required system based on the system requirements that is developed by the system analysts.

The most important stakeholders in a project are users. For a project to be accepted as being completed, the users must accept it and use it. If the users do not accept the system, then the project is a failure.

3.1.1 MIS Systems Analysis and Design

Systems analysis and design refers to two closely related disciplines **system analysis** and **system design.**

- **System analysis** is concerned with understanding the business

objectives, goals and developing business processes. The end product of systems analysis is systems specifications.

- **System design** uses the output from system analysis as its input. The main objective of system design is to interpret the system requirements into architectural, logical and physical designs of how the information system to be implemented.

3.1.2 MIS Object Oriented Analysis and Design

Object-oriented analysis and design (OOAD) is closely related to systems analysis and design. The main difference between object-oriented analysis and design (OOAD) and systems analysis and design is that OOAD uses objects to represent real-world entities.

Object oriented analysis and design uses visual modelling to improve communication among all stakeholders and produce high-quality products.

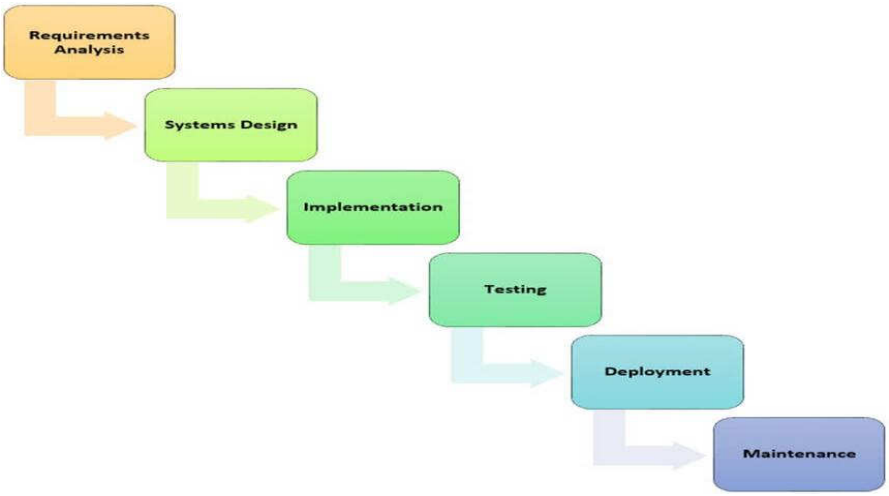
An object is a representation of a real-world entity such as a customer, a product, an employee, etc. Unified Modelling Language (UML) is a general-purpose language used to create visual designs for a system (see section on UML).

3.1.3 MIS Systems Development Life Cycle (SDLC)

The system development life cycle refers to the processing of planning, creating, testing, and deploying an information system. The main objective of system development life cycle is to produce high-quality information systems that meet or exceed the expectations of the users within the stipulated budget and time frame.

SDLC uses a number of development methodologies to achieve this objective. The next sections will discuss some of the most popular development methodologies.

Waterfall Model
The waterfall model uses a sequential design model. The next stage starts only after the completion of the previous stage. The first stage is usually drawn on the top and the subsequent stages below and to the left bottom. This forms a waterfall like structure, and it's where the name came from.



The main objective of the waterfall model is

- Planning
- Time scheduling
- Budgeting and
- Implementing an entire system at once

The waterfall model is ideal when the user requirements are clearly understood and are not expected to change radically during the development of the information system. The waterfall model is ideal in situations where a project has a fixed- scope, fixed time frame, and fixed price.

The biggest challenge of the waterfall model is adoption to change. It is not easy to incorporate new user requirements.

Agile Development

Agile development is an alternative methodology to traditional project management which promotes adaptive planning, evolutionary development, early delivery, continuous improvement, and encourages rapid and flexible response to change.

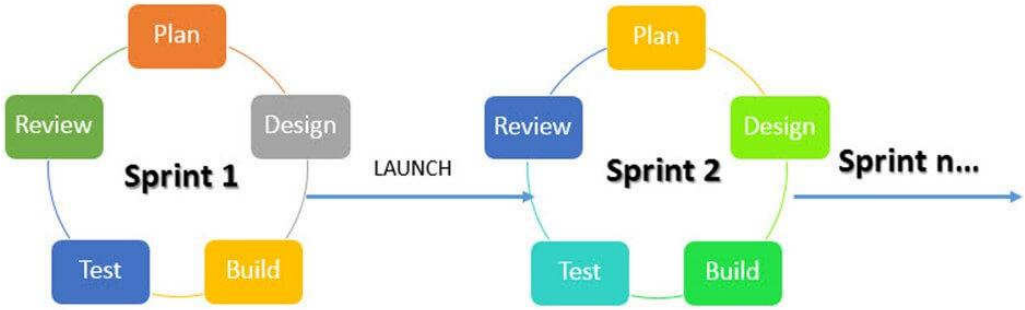
A sprint in agile terms is a well-defined task to be accomplished within a given time. Sprint goals and durations are set by the customers and development team.

All stakeholders must meet in person to get the feedback on the sprint before they can move on to the next sprint if any.

Agile methodologies usually follow the agile manifesto. The agile manifesto is based on the following twelve (12) principles

1. Customer satisfaction through early and continues delivery of software
2. Welcoming changes in requirements any time of the project
3. Frequent releases of working software usually on a weekly basis
4. Collaboration between business people and developers when working on a project
5. Projects built around motivated and trusted individuals
6. Efficient and effective Face-to-face meetings
7. Progress is measured based on working software
8. Sustainable development, sponsors, users, and developers should be able to maintain a constant pace indefinitely
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity
11. Self-organizing teams
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly.

The following diagram illustrates how agile development methodologies are implemented.



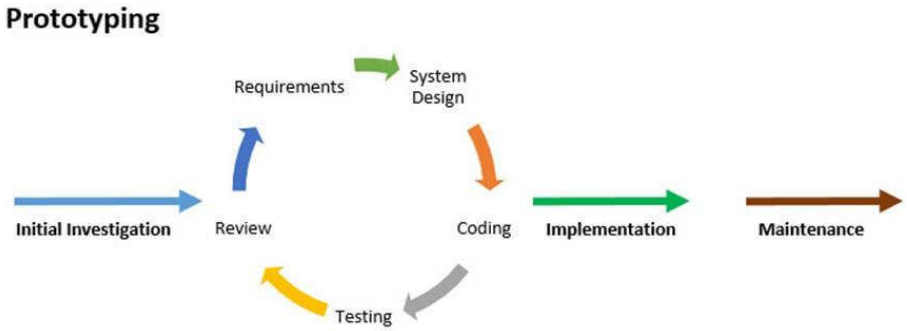
Prototyping

A prototype is a semi-functional simulation model of the actual system to be developed. Prototyping development methodologies make use of prototypes. Prototypes allow both developers and users to get feedback early.

Prototyping makes it easy for users to specify their requirements and developers understanding the requirements of the users because of the prototypes. A prototyping methodology stands with identifying the basics system requirements especially the input and output from the system. These requirements are then used to create a simulation model that users can interact with and provide feedback. The user feedback is used to enhance

the prototype and make other important decisions such as project costing and feasible time schedules.

The following diagram illustrate the stages of prototyping



3.2 Stages in Systems Development

Introducing computers to organizations involves either replacing existing manual system with automation or replacing existing computer systems with better and more efficient systems. Generally, introducing computers can be likened to construction of an edifice, whereby expert opinion will be sought from land surveyor and soil engineer as to fitness of the land area for the purpose intended, architect would be contacted for suitable design that suits the owner and conducive to the area; the services of building engineers or quantity surveyors will be required to estimate the costs of the project. After the necessary survey plans and architectural designed are approved and costs estimates ascertained, then construction work can commence.

During construction, plans are constantly referred to ensure that the objectives are still being met by the quantity surveyor. When construction is completed the quantity surveyor satisfies that the set objectives have been achieved. The various stages involved in construction of an edifice can be stages and each one with appropriate term.

Similarly introducing computers in an organisation must follow a definite pattern for the desired results to be achieved. The stages involved in development of a new information systems is referred as System Life Cycle. Information systems development involves analyzing the entire organisation which may comprise the organization structure, procedures and computer systems. It is not likely that a computer expert or consultant would randomly recommend a new system without going through the System Life Cycle. However, his efforts may not be distinctively categorized into stages.

The computer expert efforts would involve:

- investigation and recording of the existing system
- analysis of the recorded facts
- design of the new system
- implementation and review of the new system

The System Life Cycle
Traditionally, stages involved in System Life Cycle can be categorized and in the following order:

- Preliminary survey or initial study
- Feasibility study
- Investigation and fact recording
- Analysis
- Design
- Implementation
- Review and maintenance

The start of a new system life cycle is normally as result of some problems such as failures or limitations of the existing system causing dissatisfaction or awareness of modern developments. Whatever the reason it is management who will initiate the selection of a project for preliminary study or investigation.

Although the detailed study will be done, it is sufficient to know briefly the concept involved in each of the stages as set out below:

Preliminary Survey: The purpose of this study is to establish whether there is a need for a new system and if so specify the objectives of the system. This study is usually carried out by Steering Committee which comprises of the Analyst and/or the data processing (DP) manager with the managers of all the departments concerned.

Feasibility study: The aim of feasibility study is to investigate the project in sufficient depth to be able to provide information which either justifies the development of the new system or shows why the project should not continue. The questions, which this study addresses, include:

(a) What are the likely problem areas, which will need special attention?
(b) What are the likely computer configurations, which would be suitable?

(c) What are these configurations likely to cost in terms of money, staff and time to design, to install, to test, and to run?

The findings of the feasibility study are presented to management in the form of a report, which will make appropriate recommendation. If the report findings are in favour of the project then senior management may decide to move to the next stage.

Investigation and Fact Recording: Detailed study is done in this stage. This study is more detailed and comprehensive than the feasibility study. The purpose of this study is to fully understand the existing system and to identify the basic information requirements.

Analysis: Full description of the existing system and the objectives of the proposed system should be analyzed to produce specification of the users' requirements. The Requirements Specification should be presented to the management for approval before system design is embarked upon. Greater emphasis is placed upon this stage to avoid more expensive and frustrating errors, which failed to meet requirements at the design stage.

Design: If management concludes that it should go ahead with a particular system, or further explore several alternatives, the systems analyst will then prepare several proposals which must be complete in every probable and possible detail. The analysis may lead to many possible alternative designs. E.g. combinations of manual and computerized elements may be considered. Once an alternative is selected the purpose of the design stage is to work from the requirements specification to produce System Specification. The system specification will be a detailed set of documents, which provide details of all features of the system.

Implementation: Implementation involves executing the detail set out in the system specification. Two particularly important tasks are programming and staff training. Most computer systems are implemented on a modular basis, i.e. the overall design system will be broken down into a series of sub-units (modules), each one being thoroughly tested before becoming operational. As each module proves to be satisfactory it will be integrated into developing overall system.

Maintenance and Review: Once a system is implemented and in full operation it is examined to see if it has met the objectives set out in the original specification. Unforeseen problems may need to be overcome and that may involve returning to earlier stages in the cycle to take corrective action.

Documentation
Some documentation must accompany all stages in the cycle. The most important are:

(a) Feasibility Study Report
(b) Requirements Specification
(c) System Specification

Initial Study
The analyst establishes the need for a new system and its objectives in this stage. He begins his tasks by choosing a particular area of study. The selection process may be carried out by a team of departmental representatives headed by an experienced manager, e.g. Chief Accountant (Steering Committee). The initial study report may recommend that there is no need to have further and costly investigation. Computerization may not be suitable and existing systems may be strengthened or improved possibly after an O & M (Organisation and Method) Study.

Steering Committee
Factors which may lead to the Board or Top Management to set up a Steering Committee and commission a feasibly study is:

- shortcoming or bottlenecks with the existing system
- obsolescence of current data processing equipment
- requirements for increased speed of processing and reduction in costs
- need for an improved information systems

The Steering Committee will normally include representatives of top management from each department affected by the project and the committee will be directly responsible to the Board of Directors.

A typical constitution of the steering committee consists of:

- A Senior Manager as Chairman
- Managers of the user departments
- The Senior member of the DP department
- A representative from any organisation (external) involved, e.g. consultants.

Functions of the Steering Committee would include:

- giving approval to individual DP projects or approval for the next stage of a project to go ahead
- making recommendations to the Board on acquisition of the computer
- monitoring and controlling individual projects e.g. monitoring progress, and actual costs compared with budget
- ensuring that projects are worth their cost i.e. that their benefits (financial or otherwise) outweigh their costs
- appointment of the Feasibility Study Group
- selecting the systems development staff
- negotiating with supplies of hardware and software
- assessing the contribution of each project to the long term corporate objectives of the organisation
- ranking projects in order of priority and assigning resources to the most important projects first
- taking decisions to deter projects when insufficient resources are available

Since steering committee has a responsibility for the costs and benefits of new projects, a senior accountant should ideally be a regular committee.

Feasibility Study

The main objective of a feasibility study is to assess the data processing requirements of the organisation, to investigate and recommend possible solutions and to provide management with information on which a decision can be based.

Composition of Feasibility Study Team

i. Some members of the team should be drawn from the affected departments.
ii. One person with a detailed knowledge of computers and systems design
iii. At least one person with a detailed knowledge of the organisation
iv. Consultants might be hired to assist the feasibility study team.

Objectives (Terms of Reference) of Feasibility Study

The objectives of feasibility study must be established by the steering committee with the Board approval for the System Analyst and his team to

work upon. These may include to:

- reduce staffing/administrative costs
- improve accounting procedures
- provide a better service for customers/clients
- improve cash flows by producing invoices and statements of account early
- improve the flow of information for management
- improve stock control, better credit control
- improve the accuracy of information and data on business documents

In order to achieve the designated objectives, it is necessary to select the areas of the business most likely to achieve them which have several of the following characteristics:

- Large volumes of data to be processed
- High proportion of repetitive operations
- Need for speed (to get information fast)
- Need for accurate information
- Complex processing problems

Contents of Feasibility Study Report

- Outline of present system, listing its procedures, input, output file, security features, controls/constraints.
- The basis for reporting back to the steering committee of Board
- The responsibilities of the members of the feasibility study team
- The budget, in respect of time, cost and resources allocated to the study
- The method of working and contacts within affected user departments
- Outline of proposed system with alternatives considered and proposed preferred solutions

Cost Contribution of Using a computer – Some of the elements of costs which must be considered include:

- Equipment costs (capital costs/leasing costs) of computer and peripherals
- Initial system supplies (e.g. tapes, diskettes, ribbon, papers, etc.).
- Installation costs – new building if (necessary)
- The computer room (lighting, air-conditioning) etc.

Fact Finding Techniques: the main techniques for gathering facts about a current system include:

Interviewing: This technique is most widely used and it is the most productive. During interview facts about what is happening come to light, together with the opinions of the interviewee regarding weaknesses in the system. The personal contacts are important in getting the co-operation of the people involved, and in giving them the feeling of having made a substantial contribution towards the design of the new system. It is vital to gain the confidence of the individuals concerned at this stage in order for all the facts to be gathered.

Questionnaire: It serves the time of the interviewer but are difficult to design and are generally considered difficult to complete. It is particularly useful when a little information is required from a great number of people. Moreover, when the study involves many different geographical locations they may be the only practicable method of gathering facts.

Observation: This is best employed in conjunction with other techniques and carried out after the observer has an understanding of the procedures involved. He will be able to spot irregularities. Observation takes into account details relating to the movement of personnel and forms, the speed of operation, working conditions, idle time, number of staff, bottlenecks and delays etc.

Inspection: This involves the examination and inspection of documents regarding number of entries made, their general state, how they are filed and the effectiveness of the filling system. The study of organisation charts, procedure manuals and statistics, can reveal much useful information about a procedure. However, a close study of the forms currently being used should give the best guide to current practice which may, or may not, accord with the original requirements.

Fact Recording: The most useful charting techniques for recording organizational structures, activities, procedures and flow of data are:

Organizational Chart: This indicates the formal grouping of people into departments and showing the line functions and people involved.

Activity Chart: It describes the breakdown of the structure of a department by specifying what each person does.

Procedure Flowchart: It shows the flow of information through a specific procedure of projects. It enables the analyst to be reasonably sure that he has covered all aspects of the system. It provides the basis for writing a clear and logical report. It is a means of establishing communication with the people who will eventually operate the system.

3.3 System Analysis

This is an important intermediate stage between investigation (feasibility study) and system design. The analyst must examine all the facts he has gathered in order to make a proper assessment of the existing system. He must not include ideas in the new system. The aim of this stage is to ensure that all feasible alternatives are eventually produced.

Requirement Specification is an important report produced at analysis stage. The analyst is expected to discuss the requirement specification with the user. He must use the specification to bridge the gap between business user and the technical designer. At the end of these discussions the requirements specification should be in an accepted form, estimates for alternative designs should be prepared, and the decision to proceed with a particular design can be made.

The present system may be criticized against the following principles of procedures, after which the strengths and weaknesses of the system should be apparent.

Purpose; Are the purposes being satisfied? Are they still necessary? Could they be achieved in any other way?

Economical: Is it economical? Benefits should be related to the cost of producing them. Are there more economical methods?

Work flow: Are the work flows satisfactory?

Specialization/Simplification/Standardization: Are the three S‘s being practiced? Is the work capable of being carried out by machine? Can the complex procedures be simplified? Are standard practices observed?

Flexibility: Is the system flexible? What will be the effect on the system of a big increase or decrease in the volumes to be processes?

Exception principle: Is the principle of exception being observed? Factors requiring action should be highlighted and not submerged in a mass of routine detail.

Reliability: How reliable is the procedure? What provision is there for such events as staff sickness, machine breakdown? Could more up to date equipment be justified?

Form: Is the information being produced in the form best suited to the recipient? Is there a need for a hard copy?

Existing: If a change is made, what equipment and other facilities currently being used could be incorporated in the new procedure?

Continuous Control: What types of errors are occurring? Are the controls satisfactory? What other types of controls could be used?

Time: Is the information being produced in time for meaningful action to be taken?

3.3.1 Analysis Tools

Tools required for the analysis stage include decision tables, decision trees (i.e. traditional methods) Data flow Diagram (DFD), Data Dictionary (DD), Entity Attributes Relationship (EAR) models, Structured English (i.e. modern methodologies), Unified Modelling language (UML).

Modern Structured Methods
The modern techniques useful in fact finding and fact recording are Data Models and Data Flow Diagrams (DFD).

Data Models is a representation of the properties of the data within an existing or proposed system. The entity attribute relationship (EAR or ER) model is one of the most common and successful types of data model. Its basic elements are: Entities, Attributes and Relationships, hence the name EAR model. Its constructs are:

Entity: An entity is anything about which data is to be stored. For example, if the system needs to store data about customers or products then the model would have customer or product entities.

Attributes: The attributes of an entity are those facts which need to be stored about the entity. For examples, the attributes of a customer might include, the account numbers, name, address, credit limit.

Relationships: These exist between various entities within a system. For example, there may be a relationship between the customer and an order.

Normalized Data Model: A valid data model is one which is normalized and the process of converting an invalid model into a valid one is called Normalization.

The aim of normalization is to ensure that each fact is only recorded in one place so that facts cannot be inconsistent. It will also ensure that the performance of updates cannot produce anomalies by updating one copy of the fact but not another.

Each occurrence of an entity, for example, each individual customer, must be uniquely identifiable by means of a key comprising one or more attributes. The customer‘s full name or account number might serve as a key, for example, other attributes (non-key attributes) may be regarded as facts about what key stands for (e.g. facts about the customer). So, given the key other facts relating to the key can be obtained. The process of normalization ensures that in each entity of the final model every non-key attribute is a fact about the key, the whole key and nothing but the key(see unit 13 on data modelling for detailed discussion on this).

Unified Modeling Language (UML)

The Unified Modelling Language (UML) is a general-purpose, developmental, modelling language in the field of software engineering, that is intended to provide a standard way to visualize the design of a system.

UML was originally motivated by the desire to standardize the disparate notational systems and approaches to software design developed by Grady Booch, Ivar Jacobson and James Rumbaugh at Rational Software in 1994–1995, with further development led by them through 1996.

In 1997 UML was adopted as a standard by the Object Management Group (OMG), and has been managed by this organization ever since. In 2005 UML was also published by the International Organization for Standardization (ISO) as an approved ISO standard. Since then the standard has been periodically revised to cover the latest revision of UML.

UML Design

UML offers a way to visualize a system's architectural blueprints in a diagram (see image), including elements such as:

- any activities (jobs);

- individual components of the system;
- and how they can interact with other software components;
- how the system will run;
- how entities interact with others (components and interfaces);
- external user interface.

Although originally intended for object-oriented design documentation, UML has been extended to a larger set of design documentation (as listed above), and been found useful in many contexts.

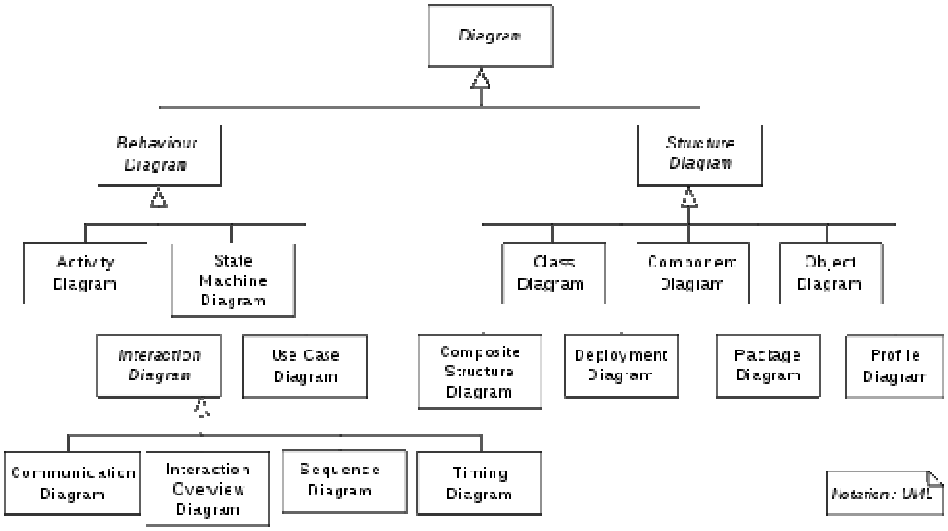


Fig. 11.1: Hierarchy of UML 2.2 Diagrams, shown as a class diagram

The following image shows samples of UML diagram that are used for modelling (see figure 11.1,11.2, 11.3, 11.4 and 11.5)

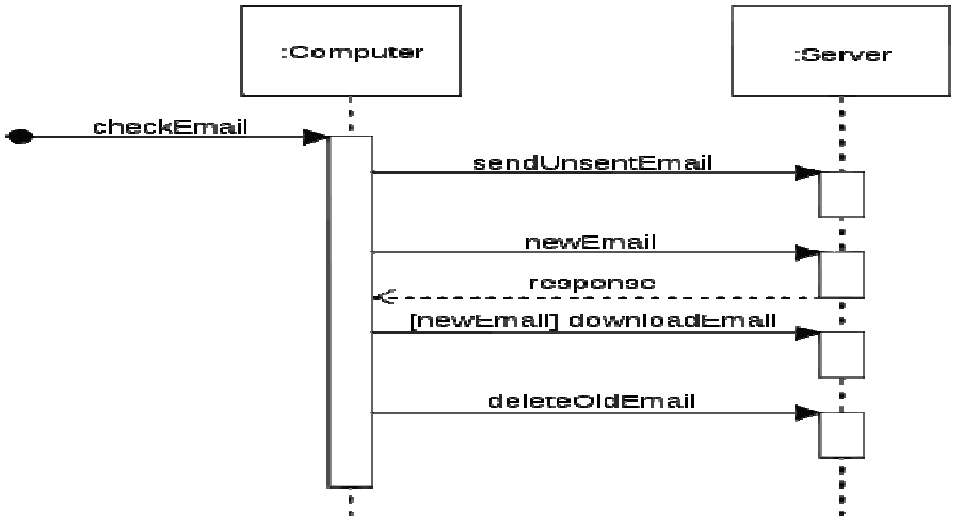


Fig. 11.2: Sequence Diagram

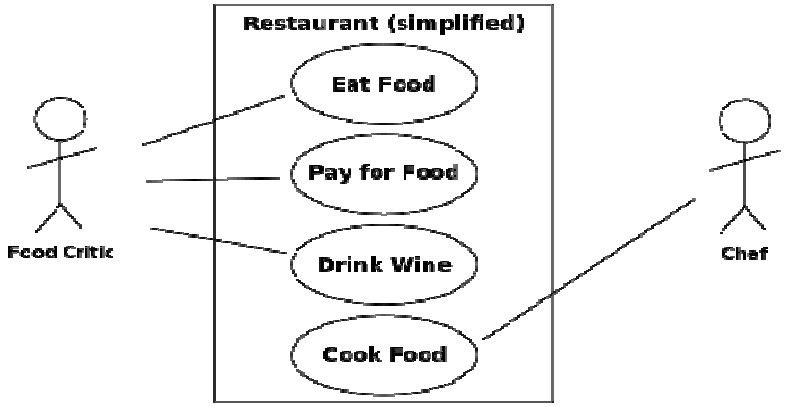


Fig. 11.3: Use Case Diagram

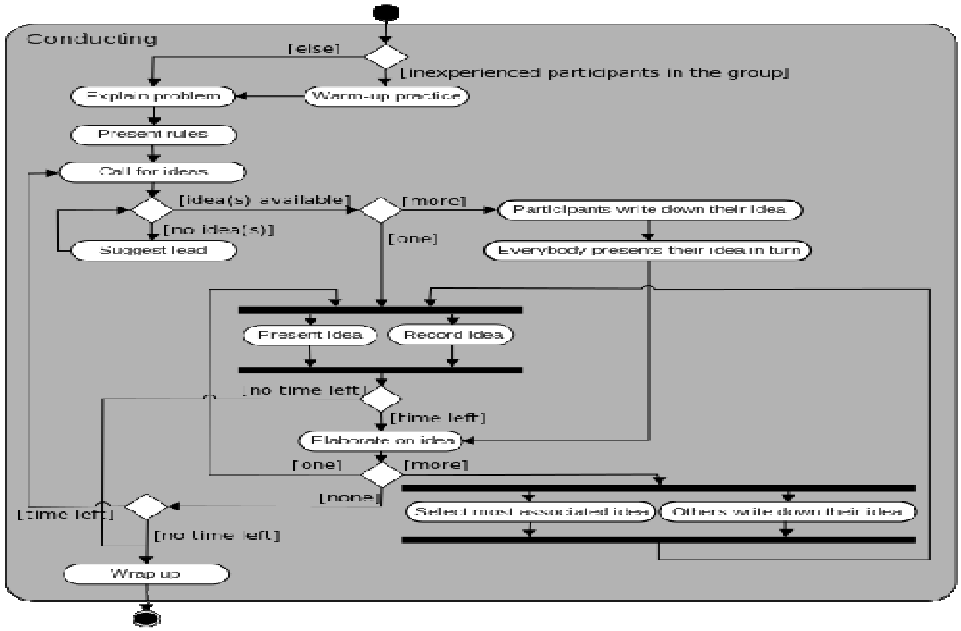


Fig. 11.4: Activity Diagram

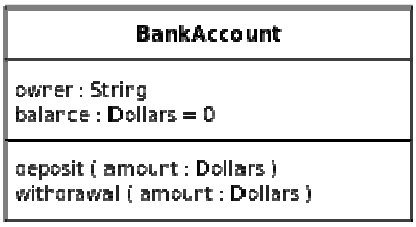


Fig. 11.5 Class Diagram

3.4 System Design

The design of the new system will result in the preparation of a System Specification. This stage would involve a team of analysts and programmers, with the approved feasibility report.

Elements of the Design

The design of a new system can be categorized into the following elements:

- Outputs
- Inputs
- Files
- Procedures

Outputs: It is necessary to consider what is required from the system before deciding how to set about producing it. The analyst will need to consider form, types, volumes, and frequencies of reports and documents. Choice of output media will also have to be made.

Inputs: Consideration of input will be influence greatly by the needs of output, e.g. the necessity for quick response from the system would determine the need for an on-line type of input. Consideration would be given to:

- Data collection methods and validation
- Types of input media available
- Volumes of input documents
- Design of input layouts

Files: File design is linked to input and output. Input is processed against the files to produce the necessary output. Considerations involved in designing files are:

- Storage media
- Method of file organisation and access
- File security
- Record layouts

Procedures are the steps which unify the whole process, which link everything together to produce the desired output. These will involve both computer and clerical procedures. They will start with the origination of the source document and end with the output document being distributed. The design of the computer programs will constitute a major task in itself.

Design Factors

The purpose is to meet the set objectives in the Requirements Specification as agreed at the beginning of the project. In the absence of requirements specification then the objectives are as contained in the system specification.

Following are criteria or issues to be considered in designing a new system:

Economical: The cost and benefits of the new system should be compared with those of the existing system.

Work Flows: The best work flows must be attained. This includes methods of transmitting data to and from the computer, the number of runs required, file organisation, the requirements of internal check, and the link with clerical procedures.

Specialization, Simplification and Standardization: The analyst should have the benefits to be derived from the practice of the 3 Ss in mind throughout the design stage.

Flexibility: This should cover integration of procedures, modularity of hardware, peak periods and treatment of exceptions.

Integration of procedures is important as the centralized nature of computer processing makes possible the integration of many procedures carried out independently under conventional methods.

Modularity of hardware implies that it is important when choosing the hardware to ensure that it is capable of being expanded (units added) when the need arises.

The system can be designed to cope with peak period processing or consider the use of bureau service for the unusually high loads. Similarly, exceptional items (i.e. those not recurring frequently) could be designed into the system.

Exception principle should be incorporated in the design of the new system, so that only deviations from plan are reported for management‘s attention. E.g. warnings should be given of slow moving stocks, in a stock control system.

Reliability of all the hardware and software must be considered. The analyst must ensure that facilities required for the new system have a proven record of reliability. Maintenance requirements, the expected life of the hardware, and the backup facilities must be considered.

Form: Data must be presented to the computer in a machine sensible form. The analyst must consider all the methods of input and try to reduce the steps necessary between origination of data and its input. If output from one run is used as the input to another, the ideal medium for the subsequent input should be used. When output is required in a humanly legible form, choice of method presentation is important. Methods available are visual display, printed copy, graphical, etc., and the needs of the person receiving the output will determine which one is appropriate.

Existing system: Consideration must be given to the existing staff, procedures, equipment, forms, etc., in the design of any new system.

Continuous control: As the majority of steps are carried out automatically, there is need for care in internal check. Audit trails must be laid to the satisfaction of the auditors.

Time: The time requirements of the new system are important. Speeds of equipment, modes of access and processing methods must be considered. The length of the processing cycle, i.e. the period between presentation of source data to the computer and the production of output documents will be subject to strict time constraints.

Systems Specification (or Definition or Description) is a complete documentation of the new system which must be updated continuously whenever system changes. It is the documentation of a computerized system prepared by analysts which set out computer features.

Purpose of Systems Specification
Communication: It provides a means of communication the system requirement to:

- Management or Steering Committee for review and approval
- Programmers who will write programs for implementation
- Operators who will operate the system
- Users who will originate input and use output

Record: It provides a record of the system for future reference. A permanent record of the system in detail is necessary for control. It will be used for evaluations, modification, and training purposes. It is of particular importance to have the system well documented as those analysts who took part in its design of on to other projects, or perhaps change employment.

Contents of System Specification

- Introduction, showing the name of system, date prepared, department involved, statement of acceptance etc.

- Objectives with respect to expected benefits i.e. tangible and intangible.

- Systems description including procedure charts, narratives, flow charts, decision table, coding, auditing procedures etc.

- Input specification indicating documents name, source/origination, frequency of preparation, layout of document/screen.

- Output specification showing report name, no of print lines, report destination draft layout etc.

- File indicating name, medium (i.e. disc, tape), size of records, record type, security, password etc.

- Equipment with respect to types, classification, peripherals, terminal utilization, computer utilization etc.

- System testing including disc checking or dry run, testing programs with test data, with live data and comparing results.

- Systems changeover or including file conversion and methods of changeover such as parallel run, direct changeover.

- Program specification including name, purpose, start procedures, processing requirements, error condition, operator messages, validation checks etc.

3.5 System Implementation

The implementation activities could be divided into:

- Selection of computer
- Installation planning
- Selection and training of staff
- Installation
- Programming
- System testing
- File conversion
- System changeover

Selection of computer: At this stage, vendors will be invited to tender for recommended equipment. The feasibility report and system specification would contain recommendation of equipment to be acquired and whether the equipment will be bought or leased.

Installation Planning: What should be done and when should it be documented in form of implementation plan or program specifically depicting activities chart which illustrate what should be done, budgeted duration, when, by whom, and remarks. As the development and implementation of a computer project may take a long period of time, there is need for proper plan and time schedule of the various activities.

In planning, all known facts as regards the organisation, personnel need, accommodation, the computer vendors, the software etc. must be taken into account and analyzed.

The planning tools include network analysis, Gantt chart, Pie Chart, Histogram, etc. Planning helps to control the project implementation as progress will be monitored at each stage to see variation, its cause and find remedies.

Selection and training of staff: At implementation level, the management must estimate the staffing need of the different activities involved. Some of the existing staff may have to be retrained to cope with the new system. New staff might be recruited and trained to complement the existing staff. In-house training and/or external training programmes (including overseas) may be organized for staff. The management should ensure that all persons involved with the new system are capable of operating it.

Installation: Issues to be resolved before installation of computer hardware and software include:

- planned choice of site
- choice of building must provide adequate space for computer and peripherals
- there must be rooms for expansion
- restriction of access to the principal users of computer
- provision of special electricity
- ensuring conducive temperature
- protection from fire

Programming: Decision to acquire packages or develop programmes in-house would have been made at design stage. If packages will be acquired efforts to get vendors to bid should be in place, otherwise proper procedures for program development should be followed and the program should be adequately documented.

System Testing: A new system must be thoroughly tested so as to avoid loss of time and money during live running. Testing strategy may include:

- Develop Test Plan, Test Data, Expected Result, etc. for each of the programs.
- Carry out test on each program module and compare result with the expected result.
- Carry out system testing i.e. testing of the complete system from first module to the last for all programs in the new system as well as the procedures required.
- Error should be corrected for another round of test and comparison of results.

A program trial log must be maintained by the programmer to record the results and progress of each program during testing.

File Conversion: Involves transferring the data in one file to another filling mode. The activities require for file conversion include –

- ensuring that the original record files are accurate and up to date
- recording the old file data on specially designed input document usually done by user department staff
- transferring the completed input media into the computer media, that is usually done by the computer staff
- using special programs to read the transcribed data and produce the required files

System Changeover: The methods of changeover include: -

Parallel Running: This involves the processing of the current data on both the old and new systems at the same time and then cross-checking the results to verify the accuracy of the new system.

The main attraction of a parallel changeover is that the old system is kept alive until the new system has been sufficiently proved for at least one system cycle using full data in the real environment.

Its main disadvantages include the extra cost and the difficulty or impracticability of user staff having to carry out their different clerical operations for two systems

in the time available for one and then cross-checking the results. The use of extra staff may not be possible or desirable, and it is very hard to decide if any extra staff should be put to work on the old system or the new.

The choice of parallel changeover should never be used as an excuse for bad system testing. The system should have undergone rigorous testing before the changeover commences.

Direct changeover: Involves a complete replacement of the old system by the new system in one swift move. This implies an over-night switch from one system to the other which may result in catastrophic results.

It is by its very nature a very hold move and pre-supposes a well-organized and supervised implementation. It also assumes thorough system testing and user training.

This method is normally adopted only when there is insufficient similarity between the systems to make a safe method impossible or sometimes when the extra staff required to supervise parallel runs are not available.

Before adopting a changeover procedure, the experts must have established complete confidence in the new system and it is wise to effect the changeover at a time when work is slack.

Pilot Operation: Involves the changing over of part of the system, either in parallel or direct. The parallel pilot can be described as introducing the new system in piecemeal fashion by phasing different areas of work gradually. It may be difficult to do this with an integrated system as a separate entity.

The direct pilot changeover can be described as phase out parallel run i.e. not so much parallel as consecutive. The new system is first run on data from a previous period and the results checked against the known figures from the original system. This is easier to control than parallel running.

3.6 System Review and Maintenance

After the new system has been installed, it is important to review and maintain periodically to see that:

i. It has met and will continue to meet the set objectives, otherwise to take action necessary
ii. Any unforeseen problems may be resolved
iii. The system is able to cope with the changing requirements of business

In appraising operation of a new system comparison should be made between actual and predicted performance. The appraisal should include:

- Computer department staff and organisation
- Suitability of equipment and software
- Cost/benefit analysis
- Internal control

3.7 Organisation and Method (O&M)

This can be defined as the systematic analysis of selected procedural problems in order to produce alternatives which will be more suitable, technically and economically. It can also be described as systematic attempt at increasing the efficiency of an organisation by improving procedures, methods and systems communication and controls, and organisation structure.

The types of problem which an O & M investigation will be concerned with are:

- Getting a job done more efficiency and so more cheap
- Rationalizing work i.e. questioning whether work needs to be done at all, whether it can at least be done more simply and with less effort, alternatively trying to establish whether better use can be made of existing idle time, by spreading employee‘s workloads more evenly their working time.

An O & M study consists of the following stages:
- Investigation
- Analysis
- Design
- Implementation and review

Investigation stage include:
- Confirmation of the terms of reference
- Obtaining all the relevant facts
- Recording

Terms of Reference: The objectives of the assignment must be clearly established by management as well as any constraints with regards to areas of investigation.

The objectives will depend on the length of study and the number of people involved.

If it is the responsibility of management, not of the O & M team, to define the objectives of a study. These may include:

- Investigate the need for and the best method of checking purchase invoices.
- Find the most economically method of producing sales invoices.
- Suggest alternatives to present stock control/materials procurement/accounts payable procedures.

Fact Finding: Aims at finding out exactly, who does the work, in what manner, where, and at what time.

Fact Recording: The investigator must formulate a plan for keeping of notes of facts in order to avoid having a mass of notes on all areas, which will be difficult to examine. Notes should be divided into areas of investigation or by type of information. Tools for fact recording include:

- Procedure flow chart
- Work or operation chart
- Process chart
- Movement chart

Analysis stage aim is to make sure that every aspect is critically examined and that all feasible alternatives are eventually produced.

Design: This is the stage of an O & M expert to use his creative abilities to produce all feasible alternatives. Ideas will already have been formed in his mind during the analysis stage and these could now be exhaustively formalized.

The design stage of O & M is similar of those of system analysis. The difference lies in interpreting the needs of a system using conventional methods rather than computer methods.

Duration: O & M assignments tend to take much less time to conduct since they are concerned with manually executed procedures leaving out minor steps to the discretion of the clerk or supervisor. However, system analysis takes much time since it involves details built into the systems specification from which the final programs will be prepared, and this can be a very lengthy process.

O & M is involved merely with a step in a procedure while system analysis involves a complete system.

Organizational Changes: Systems analysis results in more organisation changes to gain full benefits from the introduction of computers. Organisation disruption is normally on a far less scale as a result of O & M assignments.

Technical Knowledge: Systems analysis specializes in electronic data processing techniques (i.e. capabilities and limitations of computer). While O & M personnel specialize in conventional methods of data processing (such as adding machines, calculating machines, electronic calculators, accounting machines (combination of typewriters/adding machines).

Effect of Mistake: Error in systems, which involved using of computer, can be far reaching than with O & M using conventional methods.

Business Knowledge: Systems analyst need a good knowledge of the many application areas in which they become involved to be able to recognize and aid the re-definition of management information requirements.

4.0 CONCLUSION

Here we review information system development methodologies as well as the stages in system development.

5.0 SUMMARY

Information systems development refers to methodologies and steps involved in developing a new information system or upgrading an existing system to meet the evolving user requirements. In a nutshell, a development methodology has to first identify and understand the problem with the existing system and find a solution that solves the problem.

The methodology chosen depends on the nature of the project and user requirements.

- The waterfall model is ideal when the project is not expected to change much
- While methodologies such as Agile, Prototyping, etc. are ideal when the project is expected to change during the course of development and the changes have to be incorporated.

6.0 TUTOR-MARKED ASSIGNMENT

Write short explanatory note on the following:

1. Stages in system development
2. System analysis and design
3. Organization and methods

7.0 REFERENCES/FURTHER READING

Adesola, W.A. (2000). "Management Information System**.''** Unpublished lecture Note, The Polytechnic Calabar.

Laudon, K.C. & Laudon, J.P. (2012). *Management Information Systems: Managing the Digital Firm*. (12th ed.). Boston; London: Pearson.

http://en.wikipedia.org/wiki/Unified_Modeling_Language

UNIT 2 TELECOMMUNICATION AND NETWORK SYSTEMS

CONTENTS

1.0 INTRODUCTION

This unit deal more with the general principles of telecommunication and internet technologies.

2.0 OBJECTIVES

At the end of this unit, you would be able to:

- discuss data communication systems
- discuss Physical and wireless media
- explain the global Internet concept
- d i s c u s s Internet Addressing and Architecture
- expain Domain Name System.
- e x p l a i n Internet Architecture and Governance.

3.0 MAIN CONTENT

3.1 Data Communication Systems

If we are stating that a system is "online" it means that a computer contains the correct hardware and software and access to a telephone line so that communication can occur between it and other computer users, electronic mail and on-line databases.

The purpose of data communication (transmission) is the transfer of data between CPUs and physically remote devices or terminals. To accomplish this movement of data, hardware and software components of both computer and telecommunications technology are used. Telecommunication is the technology, primary hardware, used to establish a communication link between two or more locations.

Data communication is becoming a feature of more and more computer systems, regardless of their configuration. Distributed data processing, for example, depends upon the use of data communications facilities in order to function. Even centralized and decentralized system frequently use input and output devices positioned at locations remote from their CPUs and consequently use data communication facilities to connect these remote devices to the computer.

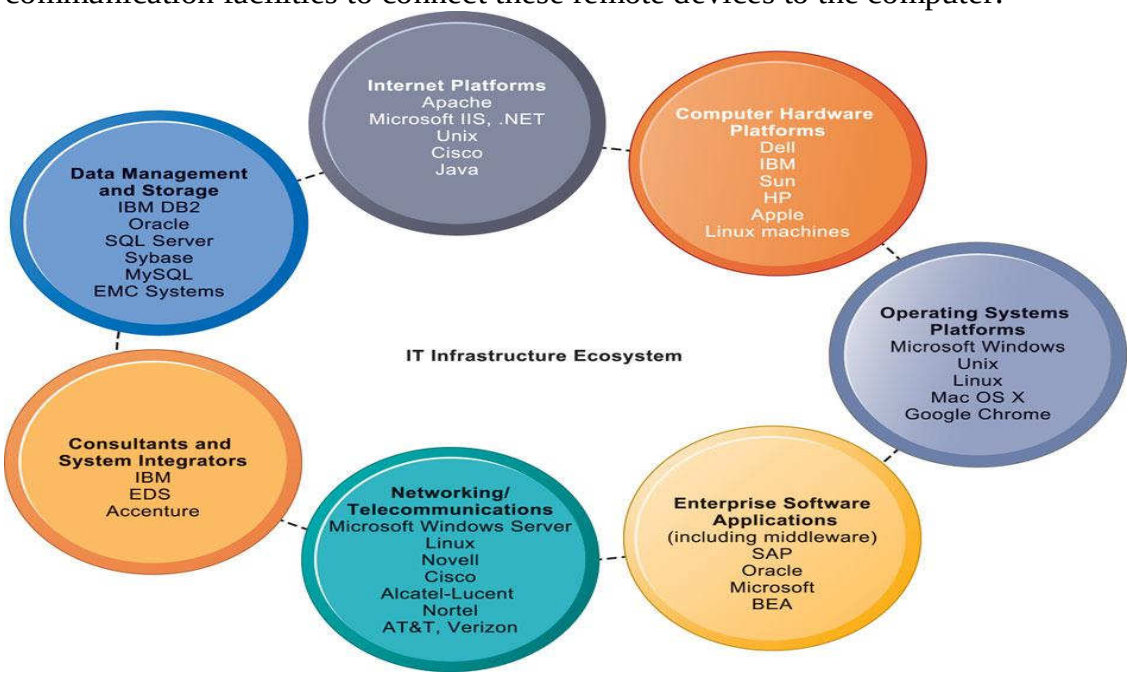


Fig. 12.1: The IT Infrastructure Ecosystem

There are seven major components that must be coordinated to provide the firm with a coherent IT infrastructure. Listed here are major technologies and suppliers for each component.

3.1.1 On-Line and Off-Line Data Communication

On-line data communication indicates that communication lines are connected directly to the computer. Off-line data communication, on the other hand, means that the communication lines are not connected directly to the computer. For instance, terminal can be linked to say, a key-to-diskette or even magnetic tape unit which is not itself linked to the computer. Data is transmitted via the data link to the device at the other end. Such data is led to the computer eventually. Such a data transmission system is called an off-line system.

3.1.2 Data Communication Hardware and Software

A typical communications system consists of hardware, terminals, line multiplexors, modems, communication channels, communication processors, and one or more computers (one of which may be known as the host).

A modem card for the computer or an acoustic coupler:

1. A modem card is a card containing microchips which can be plugged into the back of the computer. This will act as the interface between the computer and the local telephone system. The card has to plug into the telephone socket. Communication is made by typing in the telephone number you require on your computer. For this you need some communications software. Examples include Data Talk and Cross Talk.

   The term ‗modem is derived from ‘modulator’ and ‘demodulator’. As telephone line use analog signals and data terminals transmit signals in digital form, a modem is necessary for converting digital signals to analog and vice versa.

2. An acoustic coupler is rather like a telephone receiver. It plugs into the computer and sits next to computer. The telephone receiver is then placed on top of it. To make contact you then dial the number of the service you require.

If this was all there was to using electronic systems we would all be doing it. However, there are other technical factors to keep in mind such as:

(a) **Emulation**: This term refers to the computer emulating a terminal. That is to say, to be on-line the computer is no longer just a microcomputer it is also an output and input terminal to the communications system. It must be sympathetic to the communications system and must therefore emulate the correct protocols for the system to use it.

(b) **Baud rate**: Part of emulation is the speed with which a message can be received and sent. Speed is measured as Baud.

(c) **Multiplexor**: This is a device which enables a number of data channels to be accommodated on a single communication line, for the purpose of transferring data from the computer.

A multiplexor received data from a number of terminals in the communication system which transmit and receive a data at low speed. The multiplexor batches terminal messages and transmits them at high speed to the computer. A number of terminals may share a multiplexor located at a regional office as in time sharing operations. All transmissions are then communicated to the computer by a single communication line via a multiplexor at the central location. This arrangement reduces the number of lines required and saves the cost of leasing telephone lines.

(d) **Communication Channels**: Data channels refer to the equipment and cable that inter-connect computers and peripheral devices. They act as a supervisor of the flow of information between the CPU and the peripheral devices to compensate for differences in the speed with which the CPU and peripheral devices move information. Communication channels serve only as a communication medium.

Communications channels are classified according to the volume of data they are capable of transporting. Narrowband (also known as baseband), voiceband, and broadband channels, respectively, carry increasing volumes of data. Small coaxial cables and telegraph lines are examples of narrowband channels. While telephone lines are good example of……. While telephone lines are good example of voiceband channels, example of broadband

channels include larger co-axial cables, microwave circuits and communication satellite channels.

At present, the telephone line is the most commonly used medium for transporting data.

(e) **Communication Processors:** Between the modem and the CPU there is usually a device called a communication processor, normally, a mini- computer dedicated solely to managing data communications. They support the operations of a mainframe computer by performing functions which it would otherwise be required to perform itself. The functions include code conversions, editing and verification of data, terminal recognition and control of transmission lines. The mainframe computer is then able to devote its time to data processing rather than data transmission.

Non-programmable communications processors are known as communications controllers. They are used in simple applications where there is relatively low volume and little variety among messages.

Programmable communications processors are called front-end processors. It takes care of such functions as message routing, parity checking, editing etc.

3.1.3 Transmission Modes

There are three transmission modes, they include:

(a) Simplex
(b) Full Duplex or Duplex
(c) Half Duplex

A **Simplex** link only carries data in a single direction, for example we can only listen to news on a radio but we cannot reply to it. A **Full Duplex** link carries data in both ways to and fro simultaneously, an example is a telephone. While a **Half Duplex** link allows data transmission in both ways to and fro but not simultaneously. In this link, one could only talk or listen but cannot do both at the same time; an example is a radio message.

3.1.4 Classifying Carriers

Carriers are also classified into two namely: Synchronous and Asynchronous transmissions.

Synchronous transmissions are associated with high speed transmissions. In this mode the activities of the source and destination devices are coordinated.

With **Asynchronous** transmission the devices at the source and destination are not coordinated. As a result, extra bits are sent along the transmission to signify the beginning and end of a message transmitted. These extra bits are called start/stop bits. This mode is more popular and it is less expensive.

3.2 Network Systems

There are many different kinds of networks and ways of classifying them. One way of looking at networks is in terms of their geographic scope (see Table 12.1).

Table 12.1: Types of Networks

TYPE	AREA
Local area network (LAN)	Up to 500 meters (half a mile); an office or floor of a building
Campus area network (CAN)	Up to 1,000 meters (a mile); a college campus or corporate facility
Metropolitan area network (MAN)	A city or metropolitan area
Wide area network (WAN)	A transcontinental or global area

Local Area Networks

If you work in a business that uses networking, you are probably connecting to other employees and groups via a local area network. A **local area network (LAN)** is designed to connect personal computers and other digital devices within a half-mile or 500-meter radius. LANs typically connect a

few computers in a small office, all the computers in one building, or all the computers in several buildings in close proximity. LANs also are used to link to long-distance wide area networks (WANs, described later in this section) and other networks around the world using the Internet.

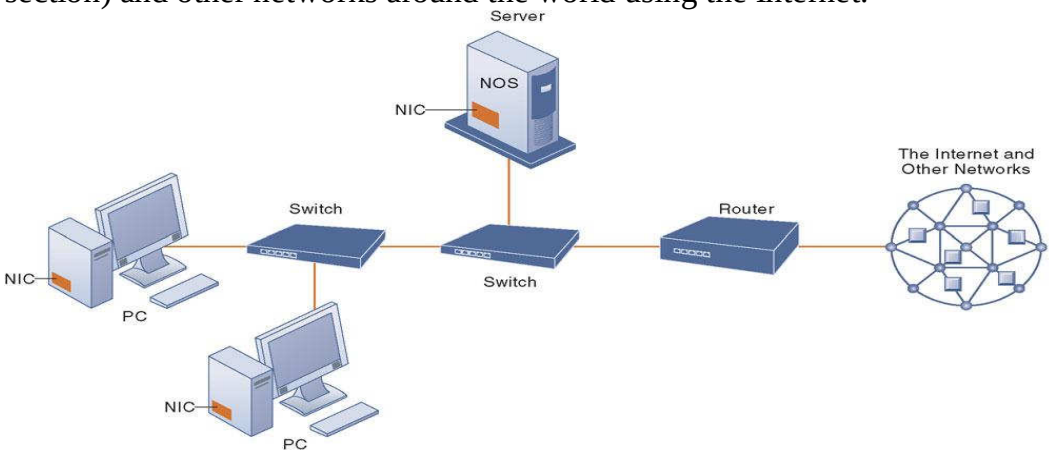


Fig. 12.1: Components of a simple computer network

Illustrated here is a very simple computer network, consisting of computers, a network operating system residing on a dedicated server computer, cable (wiring) connecting the devices, network interface cards (NICs), switches, and a router

Review Fig. 12.1, which could serve as a model for a small LAN that might be used in an office. One computer is a dedicated network file server, providing users with access to shared computing resources in the network, including software programs and data files.

The server determines who gets access to what and in which sequence. The router connects the LAN to other networks, which could be the Internet or another corporate network, so that the LAN can exchange information with networks external to it. The most common LAN operating systems are Windows, Linux, and Novell. Each of these network operating systems supports TCP/IP as their default networking protocol.

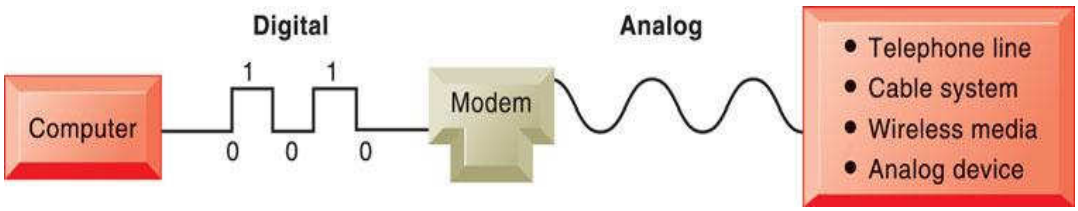


Fig. 12.2 functions of the modem

A modem is a device that translates digital signals into analog form (and vice versa) so that computers can transmit data over analog networks such as telephone and cable networks(as previously discussed).

Ethernet is the dominant LAN standard at the physical network level, specifying the physical medium to carry signals between computers, access control rules, and a standardized set of bits used to carry data over the system. Originally, Ethernet supported a data transfer rate of 10 megabits per second (Mbps). Newer versions, such as Fast Ethernet and Gigabit Ethernet, support data transfer rates of 100 Mbps and 1 gigabits per second (Gbps), respectively, and are used in network backbones.

The LAN illustrated in Fig. 12.1 uses a client/server architecture where the network operating system resides primarily on a single file server, and the server provides much of the control and resources for the network.

Alternatively, LANs may use a peer-to-peer architecture. A **peer-to-peer** network treats all processors equally and is used primarily in small networks with 10 or fewer users. The various computers on the network can exchange data by direct access and can share peripheral devices without going through a separate server.

In LANs using the Windows Server family of operating systems, the peer-to-peer architecture is called the *workgroup network model,* in which a small group of computers can share resources, such as files, folders, and printers, over the network without a dedicated server. The Windows *domain network model*, in contrast, uses a dedicated server to manage the computers in the network.

Larger LANs have many clients and multiple servers, with separate servers for specific services, such as storing and managing files and databases (file servers or database servers), managing printers (print servers), storing and managing e-mail (mail servers), or storing and managing Web pages (Web servers).

Sometimes LANs are described in terms of the way their components are connected together, or their **topology**. There are three major LAN topologies: star, bus, and ring (see Fig 12.3).

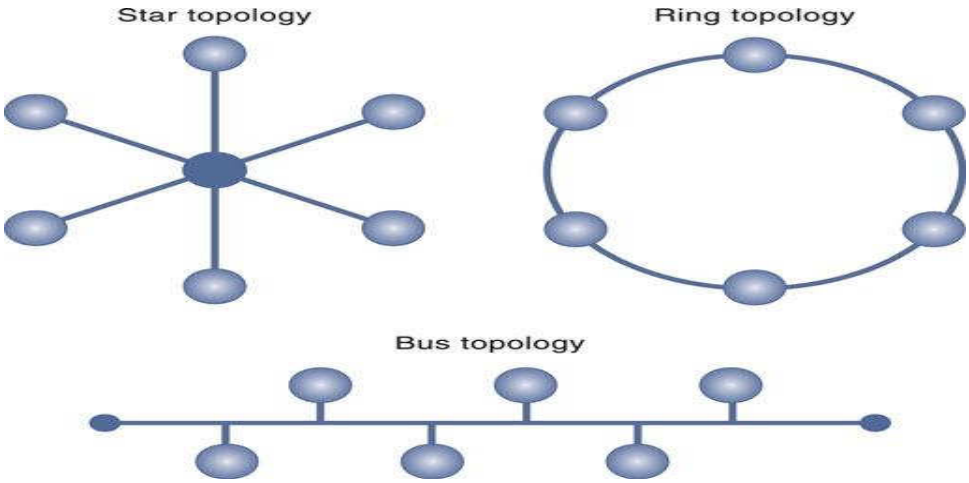


Fig.12.3 Network Topologies

The three basic network topologies are the star, bus, and ring.

In a **star topology**, all devices on the network connect to a single hub. Figure 12.3 illustrates a simple star topology in which all network traffic flows through the hub. In an *extended star network*, multiple layers of hubs are organized into a hierarchy.

In a **bus topology**, one station transmits signals, which travel in both directions along a single transmission segment. All of the signals are broadcast in both directions to the entire network. All machines on the network receive the same signals, and software installed on the client computers enables each client to listen for messages addressed specifically to it. The bus topology is the most common Ethernet topology.

A **ring topology** connects network components in a closed loop. Messages pass from computer to computer in only one direction around the loop, and only one station at a time may transmit. The ring topology is primarily found in older LANs using Token Ring networking software.

Metropolitan and Wide Area Networks

Wide area networks (WANs) span broad geographical distances—entire regions, states, continents, or the entire globe. The most universal and powerful WAN is the Internet. Computers connect to a WAN through public networks, such as the telephone system or private cable systems, or through leased lines or satellites. A **metropolitan area network (MAN)** is a network that spans a metropolitan area, usually a city and its major suburbs. Its geographic scope falls between a WAN and a LAN.

3.3 Physical Transmission Media

Networks use different kinds of physical transmission media, including twisted wire, coaxial cable, fiber optics, and media for wireless transmission. Each has advantages and limitations. A wide range of speeds is possible for any given medium depending on the software and hardware configuration.

Twisted Wire

Twisted wire consists of strands of copper wire twisted in pairs and is an older type of transmission medium. Many of the telephone systems in buildings had twisted wires installed for analog communication, but they can be used for digital communication as well. Although an older physical transmission medium, the twisted wires used in today‘s LANs, such as CAT5, can obtain speeds up to 1 Gbps. Twisted-pair cabling is limited to a maximum recommended run of 100 meters (328 feet).

Coaxial Cable

Coaxial cable, similar to that used for cable television, consists of thickly insulated copper wire that can transmit a larger volume of data than twisted wire. Cable was used in early LANs and is still used today for longer (more than 100 meters) runs in large buildings. Coaxial has speeds up to 1 Gbps.

Fiber Optics and Optical Networks

Fiber-optic cable consists of bound strands of clear glass fiber, each the thickness of a human hair. Data are transformed into pulses of light, which are sent through the fiber-optic cable by a laser device at rates varying from 500 kilobits to several trillion bits per second in experimental settings. Fiber-optic cable is considerably faster, lighter, and more durable than wire media, and is well suited to systems requiring transfers of large volumes of data. However, fiber-optic cable is more expensive than other physical transmission media and harder to install.

Until recently, fiber-optic cable had been used primarily for the high-speed network backbone, which handles the major traffic. Now cellular phone companies such as Verizon are starting to bring fiber lines into the home for new types of services, such as Verizon‘s Fiber Optic Services (FiOS) Internet service that provides up 50 Mbps download speeds.

3.4 Wireless Transmission Media

Wireless transmission is based on radio signals of various frequencies. There are three kinds of wireless networks used by computers: microwave,

cellular, and Wi-Fi. **Microwave** systems, both terrestrial and celestial, transmit high frequency radio signals through the atmosphere and are widely used for high-volume, long-distance, point-to-point communication. Microwave signals follow a straight line and do not bend with the curvature of the earth. Therefore, long-distance terrestrial transmission systems require that transmission stations be positioned about 37 miles apart. Long-distance transmission is also possible by using communication satellites as relay stations for microwave signals transmitted from terrestrial stations.

Communication satellites use microwave transmission and are typically used for transmission in large, geographically dispersed organizations that would be difficult to network using cabling media or terrestrial microwave, as well as for home Internet service, especially in rural areas.

Cellular systems also use radio waves and a variety of different protocols to communicate with radio antennas (towers) placed within adjacent geographic areas called cells. Communications transmitted from a **cell phone** to a local cell pass from antenna to antenna—cell to cell—until they reach their final destination.

Wireless networks are supplanting traditional wired networks for many applications and creating new applications, services, and business models.

3.5 Transmission Speed

The total amount of digital information that can be transmitted through any telecommunications medium is measured in bits per second (bps). One signal change, or cycle, is required to transmit one or several bits; therefore, the transmission capacity of each type of telecommunications medium is a function of its frequency. The number of cycles per second that can be sent through that medium is measured in **hertz**—one hertz is equal to one cycle of the medium.

The range of frequencies that can be accommodated on a particular telecommunications channel is called its **bandwidth**. The bandwidth is the difference between the highest and lowest frequencies that can be accommodated on a single channel. The greater the range of frequencies, the greater the bandwidth and the greater the channel‘s transmission capacity.

3.6 The Global Internet

We all use the Internet, and many of us can‘t do without it. It‘s become an indispensable personal and business tool. But what exactly is the Internet? How does it work, and what does Internet technology has to offer for business? Let‘s look at the most important Internet features.

What is the Internet?

The Internet has become the world‘s most extensive, public communication system that now rivals the global telephone system in reach and range. It‘s also the world‘s largest implementation of client/server computing and internetworking, linking millions of individual networks all over the world. This global network of networks began in the early 1970s as a U.S. Department of Defense network to link scientists and university professors around the world.

Most homes and small businesses connect to the Internet by subscribing to an Internet service provider. An **Internet service provider (ISP)** is a commercial organization with a permanent connection to the Internet that sells temporary connections to retail subscribers. EarthLink, NetZero, AT&T, and Time Warner are ISPs. Individuals also connect to the Internet through their business firms, universities, or research centres that have designated Internet domains.

There are a variety of services for ISP Internet connections. Connecting via a traditional telephone line and modem, at a speed of 56.6 kilobits per second (Kbps) used to be the most common form of connection worldwide, but it has been largely replaced by broadband connections. Digital subscriber line (DSL), cable, satellite Internet connections, and T lines provide these broadband services.

Digital subscriber line (DSL) technologies operate over existing telephone lines to carry voice, data, and video at transmission rates ranging from 385 Kbps all the way up to 9 Mbps. **Cable Internet connections** provided by cable television vendors use digital cable coaxial lines to deliver high-speed Internet access to homes and businesses. They can provide high-speed access to the Internet of up to 15 Mbps. In areas where DSL and cable services are unavailable, it is possible to access the Internet via satellite, although some satellite Internet connections have slower upload speeds than other broadband services.

T1 and T3 are international telephone standards for digital communication. They are leased, dedicated lines suitable for businesses or government agencies requiring high-speed guaranteed service levels. **T1 lines** offer guaranteed delivery at 1.54 Mbps, and T3 lines offer delivery at 45 Mbps. The Internet does not provide similar guaranteed service levels, but simply ‑best effort.‖

3.7 Internet Addressing and Architecture

The Internet is based on the TCP/IP networking protocol suite described earlier in this chapter. Every computer on the Internet is assigned a unique **Internet Protocol (IP) address**, which currently is a 32-bit number represented by four strings of numbers ranging from 0 to 255 separated by periods.

For instance, the IP address of www.microsoft.com is 207.46.250.119. When a user sends a message to another user on the Internet, the message is first decomposed into packets using the TCP protocol. Each packet contains its destination address. The packets are then sent from the client to the network server and from there on to as many other servers as necessary to arrive at a specific computer with a known address. At the destination address, the packets are reassembled into the original message.

3.7.1 The Domain Name System

Because it would be incredibly difficult for Internet users to remember strings of 12 numbers, the **Domain Name System (DNS)** converts domain names to IP addresses. The **domain name** is the English-like name that corresponds to the unique 32-bit numeric IP address for each computer connected to the Internet. DNS servers maintain a database containing IP addresses mapped to their corresponding domain names. To access a computer on the Internet, users need only specify its domain name.

DNS has a hierarchical structure (see Fig. 12.3). At the top of the DNS hierarchy is the root domain. The child domain of the root is called a top-level domain, and the child domain of a top-level domain is called is a second-level domain. Top-level domains are two- and three-character names you are familiar with from surfing the Web, for example, .com, .edu, .gov, and the various country codes such as .ca for Canada or .it for Italy. Second-level domains have two parts, designating a top- level name and a second-level name—such as buy.com, nyu.edu, or amazon.ca. A host name at the bottom of the hierarchy designates a specific computer on either the Internet or a private network.

The most common domain extensions currently available and officially approved are shown in the following list. Countries also have domain names such as .uk, .au, and .fr (United Kingdom, Australia, and France, respectively), and there is a new class of ―internationalized‖ top level domains that use non-English characters (ICANN, 2010). In the future, this list will expand to include many more types of organizations and industries.

.com Commercial organizations/businesses
.edu Educational institutions
.gov U.S. government agencies
.mil U.S. military
.net Network computers
.org Nonprofit organizations and foundations
.biz Business firms
.info Information providers

3.7.2 Internet Architecture and Governance

Internet data traffic is carried over transcontinental high-speed backbone networks that generally operate today in the range of 45 Mbps to 2.5 Gbps. These trunk lines are typically owned by long-distance telephone companies (called *network service providers*) or by national governments. Local connection lines are owned by regional telephone and cable television companies in the United States that connect retail users in homes and businesses to the Internet. The regional networks lease access to ISPs, private companies, and government institutions.

Each organization pays for its own networks and its own local Internet connection services, a part of which is paid to the long-distance trunk line owners. Individual Internet users pay ISPs for using their service, and they generally pay a flat subscription fee, no matter how much or how little they use the Internet.

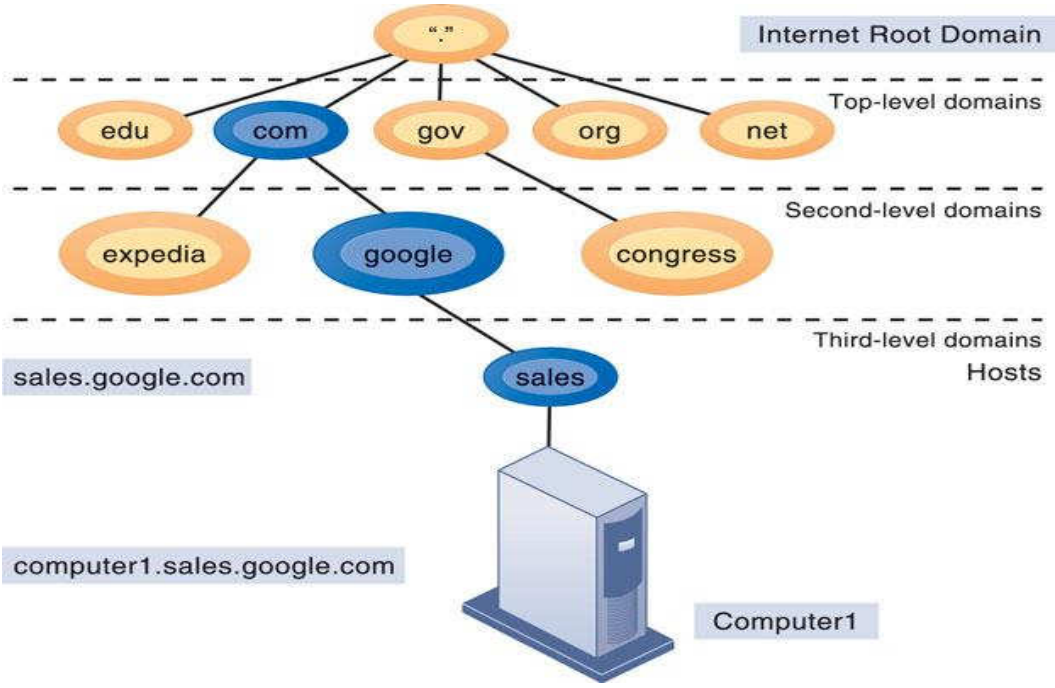


Fig. 12.3: The domain name system

Domain Name System is a hierarchical system with a root domain, top-level domains, second-level domains, and host computers at the third level.

No one –owns‖ the Internet, and it has no formal management. However, worldwide Internet policies are established by a number of professional organizations and government bodies, including the Internet Architecture Board (IAB), which helps define the overall structure of the Internet; the Internet Corporation for Assigned Names and Numbers (ICANN), which assigns IP addresses; and the World Wide Web Consortium (W3C), which sets Hypertext Markup Language and other programming standards for the Web.

These organizations influence government agencies, network owners, ISPs, and software developers with the goal of keeping the Internet operating as efficiently as possible. The Internet must also conform to the laws of the sovereign nation-states in which it operates, as well as the technical infrastructures that exist within the nation-states. Although in the early years of the Internet and the Web there was very little legislative or executive interference, this situation is changing as the Internet plays a growing role in the distribution of information and knowledge, including content that some find objectionable.

Computer Service Bureaux

Computer service bureau are third party service organisation who provide electronic data processing (EDP) facilities to their customers claims.

Types of bureau

- Independent companies formed to provide specialist computing services
- Computer manufacturers and computer vendors
- Computer users with spare capacity who hire out computer time when it is not required for their own purposes.

Types of Services provided by Bureau

(a) Data Preparation: Transcribing data from source documents into a machine readable form.

(b) Hiring of Computer Time: The bureau will process the clients' data on its computer. The client may provide the programmes but most bureau offer software packages.

(c) Time Sharing: The client has access to the bureau computer via telephone lines.

(d) Training: Computer bureau provide all aspects of EDP training

(e) Complete Service: Bureau provides comprehensive service covering system analysis, design, programming and implementation. Standard packages may be provided.

(f) Consultancy: Bureau company provides advice and assistance on all types of data processing problems as opposed to doing everything. Some bureau hire their specialist staff e.g. analysts, programmers, to customers.

(g) Software: Designing and developing software packages for clients.

Reasons for using computer service bureau

- To acquire computer experience. Client staff can familiarize themselves with the type of computer systems to be acquired.
- Some companies cannot afford the cost of outright purchase of their own computer systems. Also, it may be uneconomical for seasonal computer users to procure computer systems.

- Bureau service provides opportunity to evaluate hardware and software, a client is considering to acquire.
- Clients can use bureau service to assist with peak period loads which its system cannot cope with.
- Clients could test software purchased or prepared on bureau‘s machine while awaiting delivery of own computer.
- The services of bureau company may be sought for purpose of file conversion either from manual system or from old computerized system to a new system.
- Clients may require advice on how to go about with setting up EDP project.
- Clients may enter into contract with bureau company to provide processing time or facilities in the event of the failure of its systems i.e. bureau machine to serve as back-up or stand-by.

Advantages of computer service bureau

- Low capital outlay is required.
- Bureau’s analysis and programmers provide specialized skills.
- New users might acquire the initial computer skills via a bureau.
- Bureau‘s service can be used as standby in case of failure of in-house computer.
- Client can use an up-to-date technology which is expected to be available with Bureau Company.

Disadvantages of computer service bureaux

i. Loss of control over work scheduling
ii. Movement of data to and from Bureau Company may create some problems.
iii. Problem of security and confidentiality of data may arise.
iv. Services provided by Bureau Company are not reliable. Bureau may close down leaving the customer without any DP facilities.
v. Problems of adequate documentation controls and loss of audit traits.

Practice Exercise

a. Name the different types of physical transmission media and compare them in terms of speed and cost.

b. Define a LAN, and describe its components and the functions of each component.
c. Name and describe the principal network topologies.
d. How do the Internet and Internet technology work, and how do they support communication and e-business?
e. Define the Internet, describe how it works, and explain how it provides business value.
f. Explain how the Domain Name System (DNS) and IP addressing system work.
g. List and describe the principal Internet services.

4.0 CONCLUSION

The understanding of the basic telecommunication technologies is an essential ingredient in the appreciation of the technical underpinnings involved in the development of information system infrastructures.

5.0 SUMMARY

in this unit we discussed in detail on the following telecommunication concepts

- data communication systems
- wireless media
- internet
- Internet Addressing and Architecture
- The Domain Name System
- Internet Architecture and Governance

6.0 TUTOR-MARKED ASSIGNMENT

1. What are the principal components of telecommunications networks and key networking technologies?
2. Describe the features of a simple network and the network infrastructure for a large company.
3. Name and describe the principal technologies and trends that have shaped contemporary telecommunications systems.
4. What are the main telecommunications transmission media and types of networks?

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UNIT 3 DATA MODELING

CONTENTS

1.0 INTRODUCTION

Data modelling is an important part of database design. The data model focuses on what data should be stored in the database, exploring the relation between data entities. The goal of the data model is to ensure that all data object required by the database is accurately represented. It provides the over-all logical structure (the (“blueprint") of the database. In this unit we take a look at relational data modeling techniques and SQL, a commonly used data manipulation language.

2.0 OBJECTIVES

At the end of this unit, you would be able to:

- differentiate between physical and conceptual models in database design
- explain entities, instances, attributes and identifiers
- identify relationships in data model
- a n a l y s e Speaking ERDish and drawing relationships
- discuss Structured Query Language(SQL).

3.0 MAIN CONTENT

3.1 Database Design

Databases are now ubiquitous in any areas where information has to be stored and processed. Their importance comes from the value of information they store. The most important criteria for them can be described by two keywords reliability (covering many subareas from robustness to issues related to concurrency and security) and efficiency (covering not only data manipulation speed but also its flexibility towards new requirements or the degree to which database supports application software development).

Data modelling is the process of capturing the important concepts and rules that shape a business and depicting them visually on a diagram

Data models are collections of conceptual tools to describe data, data relations, data constraints and data semantics. There are object-based, record-based and physical data models.

When you are able to recognize and analyze information, you can better understand how things work and potentially make them better. Also, recognizing and analyzing information helps prevent mistakes and misunderstanding. For a business, this is important because it saves time and money. Hence, this explains the importance of clearly communicating and accurately capturing information requirements for designing a database.

In database design what you have in mind to design is called –conceptual model‖ while the final design is termed –physical model‖.

Business use data to increase sales and/or reduce cost. In order to accurately collect this data, a business must create a conceptual model of the data it consider important.

What is a Conceptual Model?
A conceptual model:

i. Captures the functional and informational needs of a business
ii. Is based on current needs but it may reflect future needs
iii. Addresses the needs of a business (what is conceptually ideal), but does not address its implementation (what is physically possible)
iv. Is called an –Entity Relationship Model‖
v. Is illustrated using an –Entity Relationship Diagram‖ (ERD)
vi. Is the result of completing the Data Modelling process

A conceptual model is important to a business because it:

- Describes exactly the information needs of the business
- Facilitates discussion
- Prevents mistakes and misunderstandings
- Forms important –ideal system‖ documentation
- Forms a sound basis for physical database design
- Documents the processes (also known as the –business rules‖) of the business
- Takes into account regulations and laws governing this industry
  The client‘s dream (conceptual model) will become a physical reality (physical model).

3.2 Entities, Instances, Attributes, and Identifiers

Knowing how to organize and classify data makes it possible to draw useful conclusions about seemingly random facts. Our technology-rich world produces vast quantities of facts in need of structure and order.

It is important to learn about entities because they are the things about which we store data. For example: A school needs to store data about (as a minimum): STUDENTs, TEACHERs, COURSEs, ROOMs, GRADEs.

It is important to learn about attributes because they provide more specific information about an entity.

Attributes help you distinguish between one instance and another by providing greater detail for the entity.

For example:

- In a restaurant, you need to list the individual items on a customer‘s order so that you can calculate his bill.

- When building several sales reports, you must be able to identify a specific report from the list of reports.

What about unique identifiers? It is important to learn about unique identifiers because they distinguish one instance of an entity from another.

For example:

- In a classroom, you need to distinguish between one student and another.

- When classifying your CD collection, you need to distinguish between one CD and another.

- When listing transactions on a financial statement, you need to distinguish between one transaction and another.

Entity Defined
An entity is:

- –Something‖ of significance to the business about which data must be known
- A name for a set of similar things that you can list
- Usually a noun

Examples: objects, events, people Entities have instances. An instance is a single occurrence of an entity.

Entities can be tangible e.g. PERSON, intangible e.g. SKILL LEVEL or an event e.g. CONCERT.

What is an Attribute?
Like an entity, an attribute represents something of significance to the business. An attribute is a specific piece of information that helps:

- Describe an entity, Quantify an entity, Qualify an entity, Classify an entity and Specify an entity.

An attribute has a single value.

Entities	**Attributes**
CUSTOMER	family name, age, shoe size, town of residence, email
CAR	model, weight, catalog price
ORDER	order date, ship date
JOB	title, description
TRANSACTION	amount, transaction date
EMPLOYMENT CONTRACT	start date, salary

Some attributes (such as age) have values that constantly change. These are called volatile attributes. Other attributes (such as order date) will rarely change, if ever. These are non-volatile attributes.

If given a choice, select the non-volatile attribute. For example, use birth date instead of age.

Some attributes must contain a value—these are mandatory attributes. For example: in most businesses that track personal information, name is required. Others attributes may either contain a value or be left null—these are optional attributes. Example: Email address could be a mandatory attribute for EMPLOYEE in an email application, but an optional attribute for CUSTOMER in an online catalog.

Identifiers
A SONG has a unique identifier (UID).
A UID is either a single attribute or a combination of multiple attributes that distinguishes one song from another.

How do you find a specific song in the collection? What information uniquely identifies one SONG?

Think about all the students in the classroom. Each student is described by several traits or attributes. Which attribute or attributes allow you to pick a single student from the rest of the class?
That is the student‘s UID.

The unique identifier (UID) is very important in relational databases. It is the value or combination of values that enables the user to find that one unique item among all the rest. Identifying just the right attribute, or combination of attributes and relationships, is a skill that any database designer must master. The unique identifier enables you to find your record in a file, a particular card in a deck of cards, your package in a warehouse, or a specific piece of data in a database.

Simple UIDs vs. Composite UIDs
A UID that is a single attribute is a simple UID. However, sometimes a single attribute is not enough to uniquely identify an instance of an entity. If the UID is a combination of attributes, it is called a composite UID.

Artificial UIDs
Artificial UIDs are those that don‘t occur in the natural world but are created for purposes of identification in a system. People are not born with ―numbers,‖ but a lot of systems assign unique numbers to identify people: student numbers, customer IDs, etc. A shoe has a colour, a size, a style, but no truly descriptive ―number.‖ However, a shoe store will assign unique numbers to each pair of shoes so they can be uniquely identified.

Artificial UID Example
How can we uniquely identify a STUDENT? Could we use a combination of first name and last name? Only if we are sure that the combination is unique.

Often, it is simpler and more straightforward to create an artificial attribute and make it the unique identifier. A UID can be both artificial and composite.

UIDs from Barred Relationships
Sometimes the UID is a combination of an attribute and a relationship. What is the UID of ACCOUNT? Is it artificial? Is it composite? Two people could have the same bank account number, but at different banks. Bank to bank transfers always need the bank routing number in addition to the bank account number.

Identification: Database vs. Real World
Unique identifiers make it possible for us to distinguish one instance of an entity from another. As you will see later, these become primary keys in the database. A primary key allows you to access a specific record in a database. In the real world, however, it is sometimes not so easy to distinguish one thing from another.

What is an Entity Relationship Model?
An Entity Relationship Model:

i. Is a list of all entities and attributes as well as all relationships between the entities that are of importance.
ii. Provides background information such as entity descriptions, data types, and constraints.
iii. The ER model views the real world as the set of entities and relationships between them. This modelling technique maps well to the relational model (the constructs of the ER model can easily be turned into corresponding tables)

Note: The model does not require a diagram, but the diagram is typically a very useful tool.

Goals of ER Modelling
There are four goals of ER modelling:

- Capture all required information
- Ensure that information appears only once

- Model no information that is derivable from other information already modelled
- Locate information in a predictable, logical place

Imagine your school record—from your earliest days in school, data about you was captured. Your absences, discipline history, classes taken, and grades earned are probably part of your record.

Entity Relationship Diagram (ERD)
An entity relationship diagram (ERD) is a consistent tool that can be used to represent the data requirements of a business regardless of the type of database that is used, and even in the absence of one.

3.3 Identifying Relationship

Being able to identify the relationships between entities makes it easier to understand the connections between different pieces of data.

Relationships help you see how different parts of a system affect each other. For example, the entities STUDENT and COURSE are related to each other.

To accurately model the business, the relationships between entities are as important as the entities themselves.

3.3.1 Relationships in Data Models

Relationships:
- Represent something of significance or importance to the business
- Show how entities are related to each other
- Exist only between entities (or one entity and itself)
- Are bi-directional
- Are named at both ends
- Have optionality
- Have cardinality

What is Optionality in a Relationship?
Relationships are either mandatory or optional. Consider the two entities EMPLOYEE and JOB. Based on what you know about instances of the entities, you can determine optionality by answering two questions:

- Must every employee have a job? In other words, is this a mandatory

or optional relationship for an employee?

- Must every job be done by an employee? In other words, is this a mandatory or optional relationship for a job?

What is Cardinality in a Relationship?

Cardinality measures the quantity of something. In a relationship, it determines the degree to which one entity is related to another by answering the question, How many?

For example:

- How many jobs can one employee hold? One job only? Or more than one job?

- How many employees can hold one specific job? One employee only? Or more than one employee?

Note: The cardinality of relationship only answers whether the number is singular or plural; it does not answer with a specific plural number.

Optionality and Cardinality

Examples:
Each **EMPLOYEE** must hold one and only one **JOB**
Each **JOB** may be held by one or more **EMPLOYEEs**
Each **PRODUCT** must be classified by one and only one **PRODUCT TYPE**
Each **PRODUCT TYPE** may classify one or more **PRODUCTs**

ER Drawing Conventions

Entities are represented by softboxes.
Entity names go in the softboxes.
Entity names are always singular and written with all capital letters.
Attributes are listed under the entity names.
Mandatory attributes are marked with an asterisk: –*‖
Optional attributes are marked with a circle: –o‖
Unique identifiers are marked with a hash sign: –#‖

Relationships are lines that connect entities. These lines are either solid or dashed. These lines terminate in either a –single toe‖ or a –crow‘s foot‖ at the end of each entity.

3.4 Speaking ERDish and Drawing Relationships

Most businesses use industry-specific terminology (words which have a special meaning within that business) in order to communicate information.

Data modelling uses industry-specific terminology as well, which we will call ERDish for the purposes of this class. ERDish—the vocabulary used to clearly communicate the business rules that are captured on an ERD—will give you a common language both when collecting the business rules from your client and communicating them to the Database Administrators who will implement your design.

ERD Language
ERDish is the language we use to state relationships between entities in an ERD.

You have already been speaking and writing it, when you identified relationships and specified optionality and cardinality. We are simply breaking down each ERDish sentence into its components.

The Components of ERDish
1. EACH
2. Entity A
3. OPTIONALITY (must be/may be)
4. RELATIONSHIP NAME
5. CARDINALITY (one and only one/one or more)
6. Entity B

Since each relationship has two sides, we read the first relationship from left to right (or top to bottom, depending on the ERD layout).

1. EACH
2. Entity A
3. OPTIONALITY (must be/may be)
4. RELATIONSHIP NAME
5. CARDINALITY (one and only one/one or more)
6. Entity B

Now bring it together. Speaking ERDish and Drawing Relationships using Entity EMPLOYEE and Entity DEPARTMENT as case study For example, reading from the left we have
1. EACH
2. **EMPLOYEE** (entity A)

3. **MUST BE** (optionality, solid line)
4. **WORKING IN** (relationship name)
5. **ONE AND ONLY ONE** (cardinality, single toe)
6. **DEPARTMENT** (entity B)

While reading from the right we have….

1. EACH
2. **DEPARTMENT** (entity B)
3. **MAY BE** (optionality, dotted line)
4. **THE COST CENTER FOR** (relationship name)
5. **ONE OR MORE** (cardinality, crow‘s foot)
6. **EMPLOYEE** (entity B)

Documenting business rules

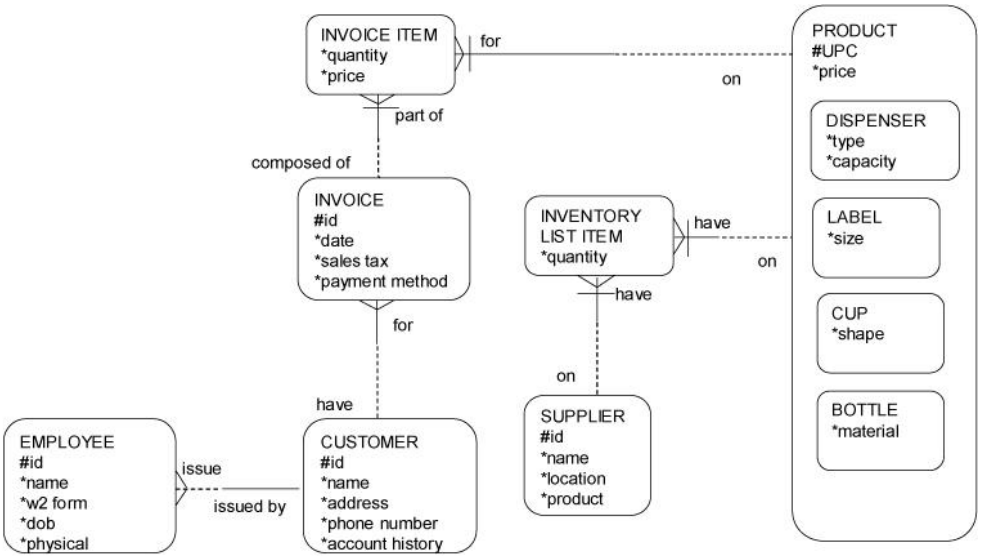
One of the primary goals of data modelling is to ensure that all pieces of information that are required to run a business are recognized.

Identifying and documenting business rules are keys to checking your data model for accuracy and completeness.

It is important to recognize that not all business rules can be represented in the ERD. Some business rules must be implemented by programming.

Exercise 1

Identify this business of the ERD below.



3.5 Structural and Procedural Business Rules

Structural business rules indicate the types of information to be stored and how the information elements interrelate.

Procedural rules deal with the prerequisites, steps, processes, or workflow requirements of a business. Many procedural business rules are related to time: event A must happen before event B.

Structural business rules can nearly always be diagrammed in the ERD. Some procedural business rules cannot be diagrammed, but must still be documented so that they can be programmed later.

Structural business rules indicate the types of information to be stored and how the information elements interrelate.

Structural Rule Example
All orders at a restaurant must be handled by a staff member (specifically, an order taker). There is no self-service ordering system. All teachers at our school must possess a valid teaching certificate.

Procedural Rule Example
Procedural business rules are workflow or process related. Here are some examples of the processes that must be followed in DJs on Demand: Initial contact with the client must be made by the project manager to confirm the event. The project manager assigns an event manager and a DJ to the event. Approval for all travel requests to an event must be signed by the project manager for that event.

SELF-ASSESSMENT EXERCISE

Students must have studied algebra and geometry in order to sign up for trigonometry. Could you represent this in the ERD? How would you implement this with programming? If the student had taken the subjects, can you think of an additional business rule that a school may want in this scenario?

3.6 Classification of Relationships

The degree of a relationship is the number of entity sets it associates to each other.

The (mapping) cardinality of a relationship expresses the number of entities that can be associated via it. The cardinality of a binary relationship between entity sets A and B can be

One-to-One (1:1) An entity in A is associated with at most one entity in B, and an entity in B is associated with at most one entity in A.

One-to-Many (1:M) An entity in A is associated with any number of entities in B. An entity in B is associated with at most one entity in A.

Many-to-Many (M:M) Entities in A and B are associated with any number from each other.

A typical One-to-Many relationship would be the one between members and books of a library: A member can borrow many books but a book (which means here an instance) can be borrowed by only one person at a time.

A typical Many-to-Many relationship would be the one between students and courses: A student can take many courses and a course can be attended by many students.

Understanding CRUD Requirements

From the business scenarios that you develop and the list of business rules that you identify during client interviews, you will build the ERD. The ERD is the conversation tool between the consultant and the client, and it is also the blueprint for the DBA who will eventually build the database.

You need a way to check that you haven‘t missed any entities or relationships in your data model. You also want to make sure that you haven‘t modeled anything that the business does not require. CRUD analysis will help you do this.

CRUD Analysis

A good way to validate an ERD is to do a CRUD analysis on it. CRUD is an acronym for create, retrieve, update, delete. These are the four basic functions (or operations) that a database allows. Part of checking a data model for completeness and accuracy is making sure that all the CRUD functions specified by the business scenario and the business rules are represented in the ERD.

CRUD Analysis—Create Function

During the client interview, and while writing the business scenarios and

rules, look for keywords like: INPUT, ENTER, LOAD, IMPORT, RECORD, & CREATE. These all indicate that a record is created in the database at this time. Review the requirements for these keywords. Does your data model account for all of these functions?

CRUD Analysis—Retrieve Function
During the client interview, and while writing the business scenarios and rules, look for keywords like: VIEW, REPORT, BRING UP, PRINT, FIND, READ, & LOOK UP. These all point to retrieving information from the database. Review the requirements for these keywords. Does your data model account for all these
functions?

CRUD Analysis—Update Function
During the client interview, and while writing the business scenarios and rules, look for keywords like: CHANGE, MODIFY, ALTER, & UPDATE
These all point to updating information that is already in the database. Review the requirements for these keywords. Does your data model account for all these functions?

CRUD Analysis—Delete Function
During the client interview, and while writing the business scenarios and rules, look for keywords like: DISCARD, REMOVE, TRASH, PURGE, & DELETE These all point to deleting information that is already in the database. Review the requirements for these keywords. Does your data model account for all these functions?

CRUD Validation
Performing a CRUD analysis on your data model helps you check for scope and completeness. If you have a business rule that has no entity to CRUD against, then your data model may be incomplete. Similarly, if you have entities in your ERD that are not touched by any CRUD function (no business rule creates, retrieves, updates, or deletes from it), then you may not need that entity in your model.

A database conforming to an ER diagram can be represented by a collection of tables. For each entity set corresponds a table with as many columns as many attributes the entity set is described with. A row of the table will represent an entity, containing the corresponding attribute values. For weak entity sets we attach to the columns of the primary key of the strong entity set on which it depends. Relationship sets can also be described this way.

Tables will contain only a subset of all possible rows: the ones which represent entities in the system we describe. As the system changes in time, we may add, delete or modify rows.

3.7 Introduction to Relational Database Concepts

The conceptual data model will be transformed into a relational database design. This means that our entities, attributes, relationships, and unique identifiers will be translated into objects in a relational database. Compare this to a clothing designer who is taking his design from paper and implementing it with fabric. The designer needs to understand how to sew the designs just like you will need to understand the structure of relational database objects.

The relational model was formally introduced by E. F. Codd in 1970 and became the dominant modeling technique in the IT sector. The relational model represents data in the form of two-dimensional tables, and a relational database is a collection of such tables each having a unique name. A relational database is a database that is seen by the user as a collection of two-dimensional tables, each containing rows and columns.

Primary Key
A primary key (PK) is a column or set of columns that uniquely identifies each row in a table.

Foreign Key
A foreign key (FK) is a column, or combination of columns, in one table that contains values that match the primary key value in another table.

Summary of Data-Integrity Rules
Data-integrity rules (also known as constraints) define the relationally correct state for a database. Data-integrity rules ensure that users can perform only those operations that leave the database in a correct, consistent state.

Constraint	Explanation	Example
Entity Integrity	A primary key must be unique, and no part of the primary key can be null	The column emp_no in the EMPLOYEES table cannot be null

Referential Integrity	A foreign key must match an existing primary key value (or else be null if nulls are allowed)	The value in the dept_no column of the EMPLOYEES table must match a value in the dept_no column in the DEPARTMENTS table
Column Integrity	A column must contain only values consistent with the defined data format of the column	The value in the balance column of the ACCOUNTS table must be numeric
User-Defined Integrity	The data stored in a database must comply with the rules of the business	If the value in the balance column of the ACCOUNTS table is below 1.00, we must send a letter to the account owner (this will need

Basic Mapping: The Transformation Process

When you design a house, you eventually would like to see the house built. Even if you don‘t do the actual construction, you will need to understand the terms used by the builders in order to help them take your conceptual design and make it a physical reality. The initial database design can be used for further discussion between designers, database administrators, and application developers.

The conceptual model (ER diagram) is transformed into a physical model. The physical implementation will be a relational database.

Terminology Mapping

Changing from analysis (conceptual model) to implementation (physical model) also means changing terminology:

- An entity becomes a table.
- An instance becomes a row.
- An attribute becomes a column.
- A primary unique identifier becomes a primary key.
- A secondary unique identifier becomes a unique key.
- A relationship is transformed into a foreign-key column and a foreign key constraint.

3.8 Language to Access Data

SQL (Structured Query Language) originally developed by IBM Research. It is a standard, and its current version is SQL 2003. The full specification of SQL is more than 2000 pages and covers features which we will not even

mention here. Our goal is to introduce only some basic constructions of the language.

SQL specifies a data definition language (DDL), a data manipulation language (DML), and embedded SQL (to make relational databases accessible in other programming languages, like C, Pascal, PL/I). It also supports basic integrity enforcing, user authorization and transaction management.

In SQL terminology a relation is a table, and attribute is a column and a tuple is a row. We will adopt this terminology in this section. We denote keywords of the language capitalized, and we use the EBNF notation specify the structure of statements.

Structured query language (SQL) allows us to access data in relational databases in an efficient way. Instead of manually searching through each row to find the record for employee number 21444, we use the following SQL statement:

```
SELECT last_name, department_id
FROM employees
WHERE employee_id = 21444
```

To find all the employees in department number 120, we write a different SQL statement:

```
SELECT * FROM employees WHERE department_id = 120
```

SQL (sequel):

- Is a declarative query language
- Is a small language focused on working with relational database
- Not a general purpose language
- Not a procedural or imperative language

We use SQL to describe what we want and allow the DBMS to handle how that is actually done. You don‘t have to manually lay out the procedure as is done in other programming languages.

SQL can be used to Create, Read, Update, Delete. Most DBMS have their own slightly different implementation of the core SQL language. Oracle uses PL_SQL(PLsequel) while Microsoft SQLserver use T_SQL(T sequel). SQL is case insensitive.

SQL Keywords (Main) are: SELECT, FROM, WHERE, ORDER BY, GROUP BY, JOIN, INSERT INTO, UPDATE, DELETE, HAVING. Other keywords are IN, LIKE, NULL, IS, IS NULL, IS NOT NULL, ASC, DESC

The most common is SELECT; used when we want to select or read one of the tables in one of the databases. We use it to ask the database a question/query and we expect a reply.

The general format of SELECT statement is : SELECT Columns
FROM tables;

Columns and tables are user defined. Examples are

SELECT firstname, lastname
FROM Employee;

SELECT *
FROM Employee;

Writing a WHERE clause is like writing the IF statement in other programming language while ORDER BY clause is used for sorting records in a database table. By default ORDER BY is in ascending order

SQL Operators: The major operators in SQL are the following:

- Relational Operators: >, <, <=, >=, <>
- Logical Operators: AND, OR, NOT

SQL Wild Card

- % (percentage sign) represents any number of character.
- _ (underscore) represents a single character.

SQL Aggregate functions
These are grouping functions that return a single value. GROUP BY clause can only be used with aggregate functions. Some common ones are COUNT(X),MAX(X), AVG(X), SUM(X), MIN(X).

SQL sample statements

- SELECT * FROM Employee WHERE lastname = ‗Modupe‘;
- SELECT * FROM Employee WHERE Salary > 5000 AND Department = ‗Sales‘;
- SELECT * FROM Employee WHERE Department IN (‗Marketing‘, ‗Sales)‘;

- SELECT * FROM Employee WHERE lastname LIKE _Modupe%';
- SELECT * FROM Employee WHERE lastname LIKE _Gr_ce';
- SELECT * FROM Employee WHERE Middlename IS NULL;
- SELECT * FROM Employee WHERE Middlename IS NOT NULL';
- SELECT * FROM Employee WHERE Salary > 5000

ORDER BY lastname, firstname;

- SELECT COUNT(*) FROM Employee'; To know how many rows in a table.
- SELECT MAX(Price) FROM Product'; To maximum value of Price in a table
- SELECT SUM(TotalDue) FROM Order WHERE CustomerID = 854;

4.0 CONCLUSION

Knowledge of data modelling is a sine qua non for database design and prerequisite for implementation of an information system.

5.0 SUMMARY

In this unit you learn about:

- database design, entities, instances, attributes and identifiers.
- Identification and classifying of relationships
- How to speak ERDish and drawing relationships
- Structural and procedural business rules
- Structure query languages

6.0 TUTOR-MARKED ASSIGNMENT

Construct ER diagram components that represent entities and attributes according to diagramming conventions

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UNIT 4 PRACTICAL INFORMATION SYSTEM: DEMO POS FOR A RETAIL STORE

CONTENTS

1.0 INTRODUCTION

In this unit, we will create a simple point of sale system for a fictitious retail store. The system will be used by the operational staff to record the day to day business transactions; the tactical staff will also use the system to monitor the retail store's current performance.

The system will have the ability to export data to excel. Excel will be used as a **decision support system** tool to analyze the data. The data in Excel can also be combined with data from other sources.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain how a typical information system is developed
- discuss data modelling.

3.0 MAIN CONTENT

3.1 Retail store MIS components

3.1.1 Business Procedures

Business procedures define how the day to day business transactions must be conducted. The point of sale system will be used to record daily sales.

The following list outlines the activities to be done when a customer buys an item

1. Customer presents items to be purchased to the cash till
2. Cashier searches the system for the presented item in the system to retrieve the price
3. Cashier enters the quantity of the purchased item, and the system computes the total cost. This process is repeated for all the purchased items
4. If a cashier wrongly adds an item or item quantity into the system, they should be able to remove it if the payment hasn't yet been posted. If the payment has been posted, the cashier should not be able to remove anything.
5. After verifying the total customer bill, the system should allow the cashier to post the customer payment and print a receipt for the customer.

3.1.2 People

The users who will be using the system will be cashiers, accountants and inventory control users. All the users must be computer literally and be trained on how to use the point of sale system.

3.1.3 Hardware

Microsoft access is a standalone database engine and as such, the system will be run on a single computer. The computer used will need to have the following specifications:

- A minimum of 1GB RAM
- A minimum of 10GB free storage space on the local drive where the database will be
- The computer should run a windows based operating with at least windows XP and above
- The processor speed should have a minimum of 1GHz

3.1.4 Software

The computer that will be used with the system should have the following minimum specifications:

- Microsoft based operating system
- Microsoft Office Suite (Specifically Microsoft Word and Microsoft Access)

3.1.5 Data

The day to day business transactions will be stored in a Microsoft Access database.

Point of Sale Database Dictionary
A database dictionary describes the database fields, what they do and the data type. The following describes the tables that we will have in our database. For the sake of simplicity, we will keep the number of tables to only four (4).

Products Table

S/N	Field Name	Data Type	Description
1	id	Numeric	Record primary
2	Product_name	String	Name of the product
3	Price	Numeric	The price of the product
4	Quantity_at_hand	Numeric	Available quantity at hand on any given
5	Recommended_supplier_i	Numeric	Foreign key that links to suppliers table

Customers Table

S/N	Field Name	Data	Description
1	id	Numeric	Record primary key
2	Customer_nam	String	Name of the customer
3	Total_purchase	Numeric	Accumulated value of the total sales to the particul

Suppliers Table

S/N	Field Name	Data	Description
1	id	Numeric	Record primary key
2	Supplier_name	String	Name of the customer
3	Contact_numbe	Numeric	Contact number for the
4	Email_address	String	Email address for the supplier

Sales Table

S/N	Field Name	Data	Description
1	id	Numeric	Record primary key
2	Customer_id	Numeric	Customer unique identifier
3	Transaction_dat	Date	The date that the transaction was recorded
4	Amount_paid	Numeric	Total purchase amount
5	Paid	Boolean	Boolean field that shows whether a customer has paid or

Sales Details Table

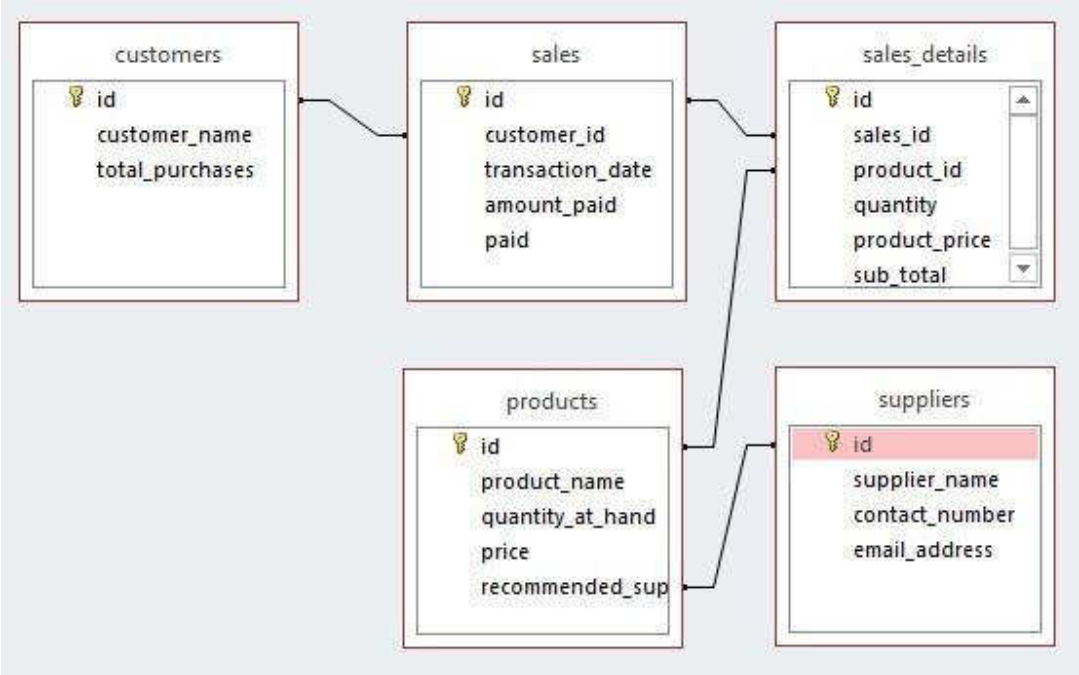
S/N	Field	Data	Description
1	id	Numeric	Record primary key
2	sales_id	Numeric	Customer unique identifier
3	Product_id	Date	The date that the transaction was recorded
4	quantity	Numeric	Total purchase amount
5	Paid	Boolean	Boolean field that shows whether a customer has paid or

Point of Sale database entity relationship diagram

The entity relationship diagram shows the relationship between tables in the database. The following table describes the relationships between the database tables

S/N	Relationship	Primary	Foreign key	Relationship nature
1	Products to Sales	Id in products	Product_id in sales	1 to Many
2	Sales tocustomers	Id in	Customer_id in sales	Many to Many
3	Products to suppliers	Id in suppliers	Recommended_supplier_id in products	Many to 1

The following image shows the relationships among the tables in our database.



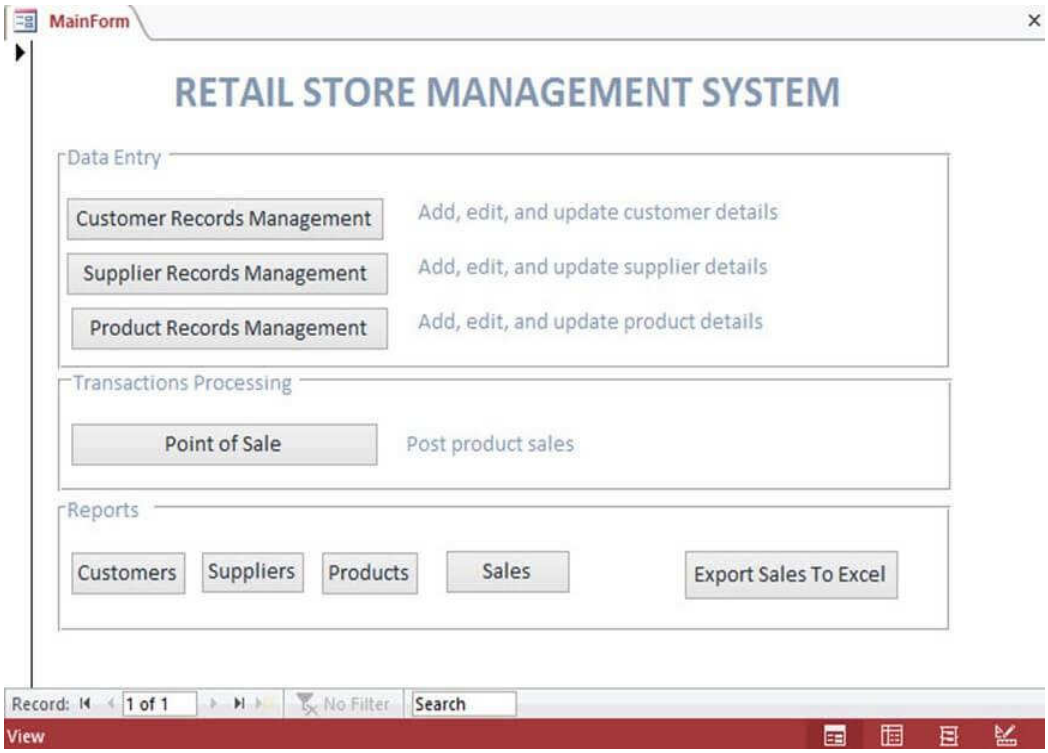
3.2 How a Transaction is Processed in the System

1. The system retrieves all customer records from the customers table and populates the drop down combo
2. The cashier clicks on new transaction button. This creates a new record in the sales table and generates a transaction id.
3. The system retrieves all products from the products table and populates the drop down combo
4. The cashier selects a product from the drop-down list. The system keeps the product id and price for the current item.
5. The cashier enters the quantity purchased. The system calculates the subtotal based on the stored price and entered quantity. This process is repeated until all products have been posted into the system.
6. The cashier enters the amount that the customer has paid. The system calculates the change if the customer pays more than the price.
7. Cashier clicks on post payment button. The system updates the;
   i. product quantity at hand in products table
   ii. updates the amount paid field and marks the transaction as paid in the sales table
   iii. updates the total purchases field in customers table

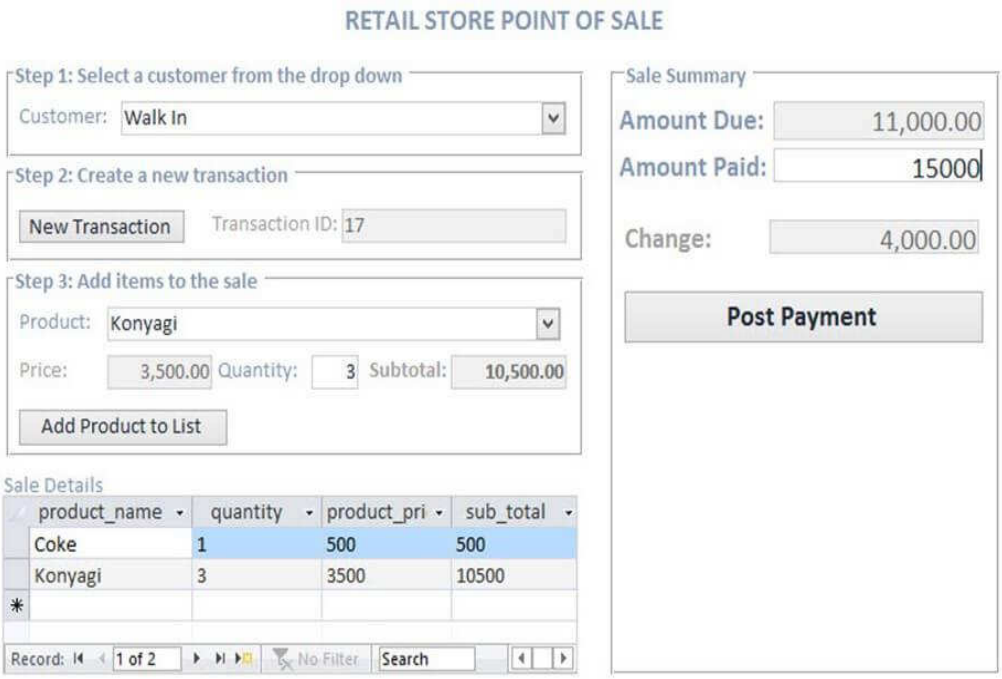
Point of Sale Graphical User Interface Screenshots

System main window – this is the entry point into the system. It allows the users to enter data, process transactions, print reports and export sales data to Excel for further analysis.

Here we have demonstrated various data entry window used during POS, to give an overview of the field that is filled while performing the transaction.

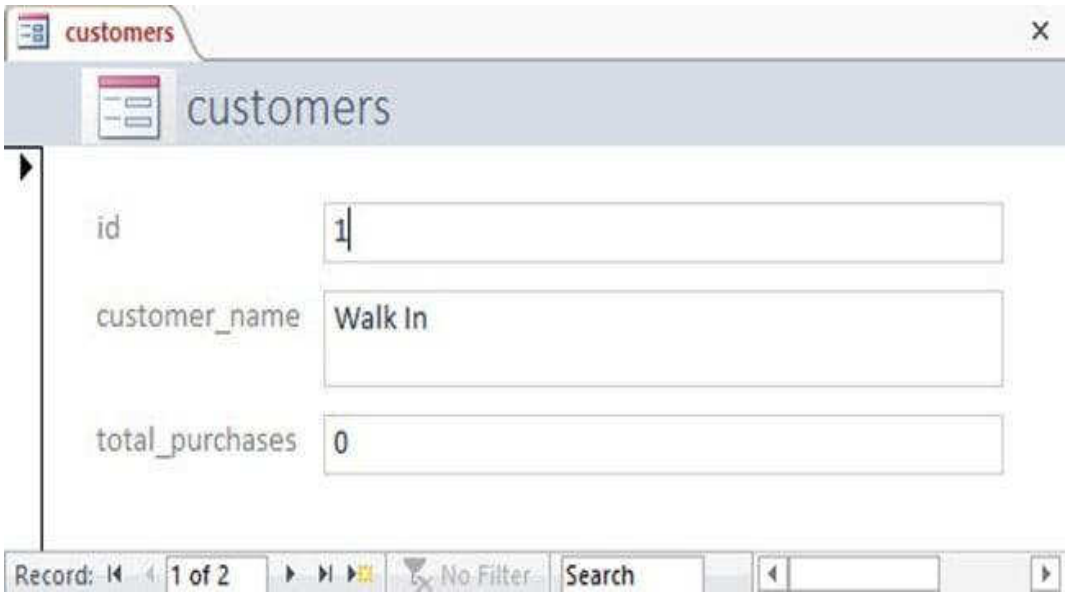


Point of Sale Window used by cashiers at the cash point

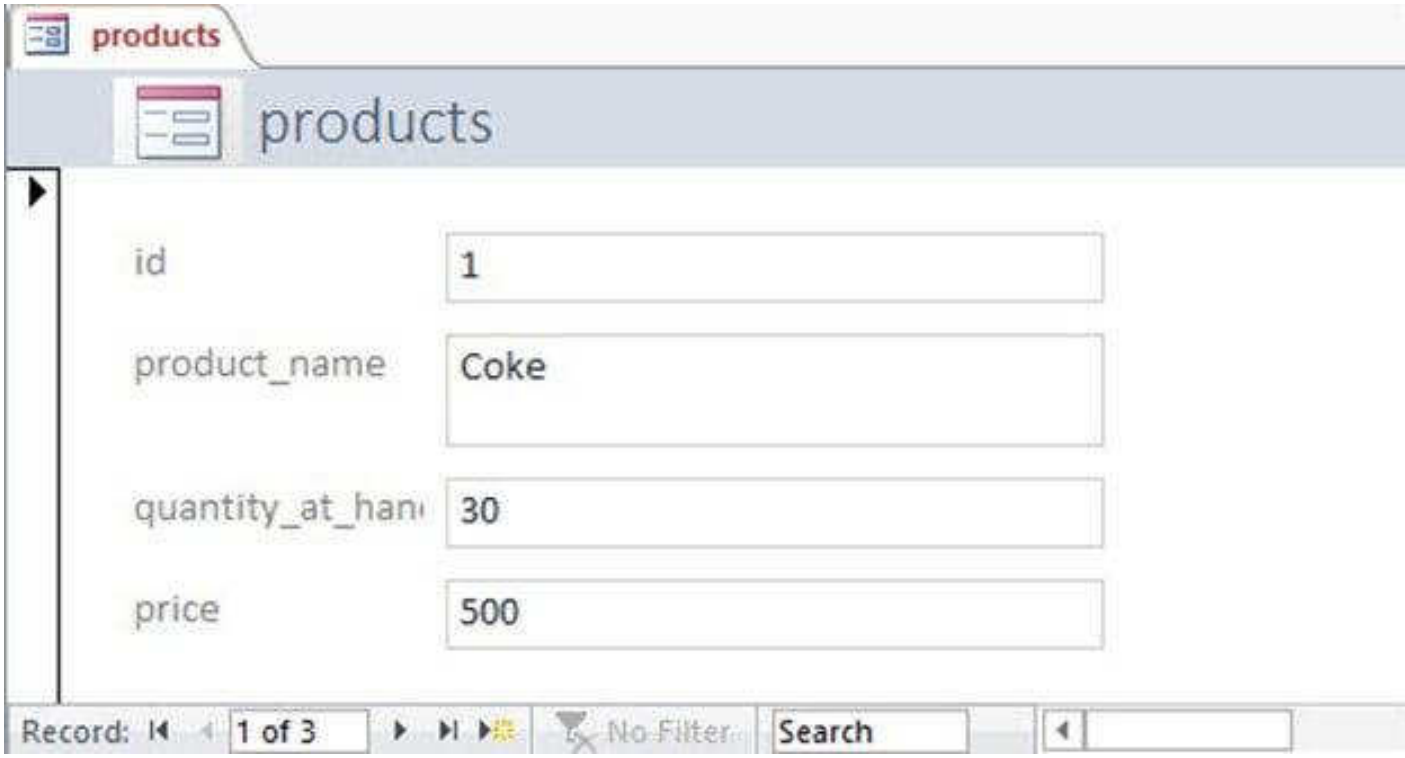


The user interface is designed in such a way that it guides the cashier through the steps involved in posting a successful purchase transaction.

Customer data entry window



Products data entry window



3.3 Information System illustrated

The Calabar branch of Guaranty Trust Bank has 20,000 customers, many of whom are staff and students of the University of Calabar. Inside the bank are positions for 10 cashiers; each position has a computer terminal. All of the terminals are linked to a computer in the assistant manager‘s office. The computer runs a number of programs that control the various terminals, and it has computer discs that store information about the various transactions that take place.

Customers can use the cash dispenser (ATM) in the outside wall, which is also part of the local system. All of these machines in the bank are linked through a computer network to the head office in Lagos where records is held.

The bank‘s operations are based round the computer record kept for each customer and their transactions. This record consists of:

- the name and address of the account holder
- the balance of the account (positive or negative)
- a record of any allowed overdraft
- a record of all transactions for the past 10 years.

Taken overall, this arrangement can be seen as an information system – the customer accounts information system. In other words, it collects, processes and stores various items of data as individual transactions take place, and it allows various types of information to be provided for various classes of people.

If I am interested in the balance on my account and whether my salary has been paid in, I can go to the cash dispenser and ask for a mini-statement, which is printed while I wait. Alternatively, I can go inside to a cashier and ask a person for the same information or I can log on to the bank‘s website to access this information.

The manager of the branch may want to see some details of my account as well. They are more likely to be interested in an overall summary of information on all accounts – perhaps the sum of the balances in all accounts in order to compare it with the same figure for last year, and a graph, may be the best way to do this. The manager may also want a list of all the people who have exceeded their overdraft limit, so that a friendly letter can be sent to them. Well, once upon a time it worked like that, but today this is probably a task that is programmed and requires no human intervention.

Both the manager and I need some information – we are each looking for particular items stored on the computer or a summary of items. We both want the information to be displayed in an appropriate format. On the basis of the information we receive, we will be able to take some actions or make some decisions. The raw material of this process is the stored records on the computer – which we refer to as data – but what both the manager and I require is information.

Remember: computers hold data. People seek and use information. When we talk about information technology rather than computers, we are acknowledging that people are central to the overall task we seek to accomplish by using this technology.

3.4 Further Illustration of Information System

Are informal information systems purposive?
In the example of the Guaranty Trust Bank, the computer system was described as an information system, and it can be seen to satisfy the general requirements of a system:

- It is made up of a number of interconnected components.
- It is an open system, with inputs coming in the form of cheques to pay, deposits to credit and requests for information.
- The information is stored and processed within the system.
- Outputs will include various forms of report for customers and managers.
- Control will be exercised within the system by a combination of the logic of the computer programs and the actions of the bank staff.

If I write a cheque for ₦10 more than my overdraft allowance, the computer alone may decide to let it through. If I write a cheque for ₦1,000,000 I do not really expect to get away with it, and the programs running on the computer should trap the transaction and probably pass it to a bank official for a decision (to suspend my account I imagine).

This last point is important. An information system is more than computers and their programs – that is just a computer system. Information systems include people, and when information systems are studied or designed,

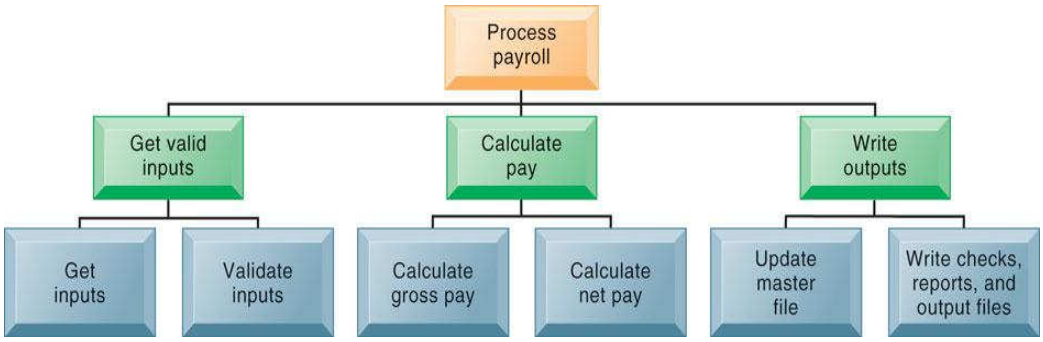


Fig. 14.9 High level structure chart for a Payroll System

This structure chart shows the highest or most abstract level of design for a payroll system, providing an overview of the entire system.

SELF-ASSESSMENT EXERCISES

Test your knowledge and understanding

1. Why do people sometimes pay for information – for example, when they buy a textbook, novel, map or daily newspaper? What may be the consequences when information that was once sold is now available freely – think of newspapers or music (is it really free?). Is there any information that you believe should always be available free to all people, or perhaps to citizens of a particular country?

2. The quotation below is taken from a publication of the Institute of Chartered Accountants in Nigeria and Ghana. Management needs timely, high-quality information in order to run their businesses effectively and to facilitate compliance with statutory and regulatory requirements. Control of the quality of information is therefore a major function of management.
   a. What sorts of control do you think are appropriate in order to ensure the quality of information?

4.0 CONCLUSION

The practical understanding of the modelling of the data concepts in an information system determines the skill set requirements of how management information system evolves.

5.0 SUMMARY

This unit shows you the practical steps involved in developing an information system and explained a prototype of a POS (point of sale) system. The system has been developed using Visual Basic for Applications (VBA) in Microsoft Access.

6.0 TUTOR-MARKED ASSIGNMENT

1. Airlines maintain large computer systems and computer networks to allow travel agents, tour operators and individual customers around the world to check on the availability of flights, to make bookings and to print tickets or download them. Considering this as an information system, identify the main components in the system, the technology used, the various people and organizations involved, and the types of information that they require (their information requirements).

2. When you use the Google search engine or Facebook you are presented with adverts that are targeted at your interests as they have been revealed in your recent uses of these systems. Investigate how this is done and how these companies collect data about you and make money from it.

Do you have any concerns about your activities online being monitored and mined for data, and this data being used to select specific adverts to show you? Is there any data that you may reveal as you go about your life online that you think should never be captured and used by other businesses?

7.0 REFERENCES/FURTHER READING

Adesola, W.A. (2000). "Management Information System**.**" Unpublished lecture Note, The Polytechnic Calabar

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UNIT 5 ETHICAL AND SECURITY ISSUES IN INFORMATION SYSTEM

CONTENTS

1.0 INTRODUCTION

Information systems have made many businesses successful today. Some companies such as Google, Facebook, eBay, etc. would not exist without information technology. However, improper use of information technology can create problems for the organization and employees.

Criminals gaining access to credit card information can lead to financial loss to the owners of the cards or financial institute. Using organization information systems i.e. posting inappropriate content on Facebook or Twitter using a company account can lead to lawsuits and loss of business.

This unit will address such challenges that are posed by information systems and what can be done to minimize or eliminate the risks.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

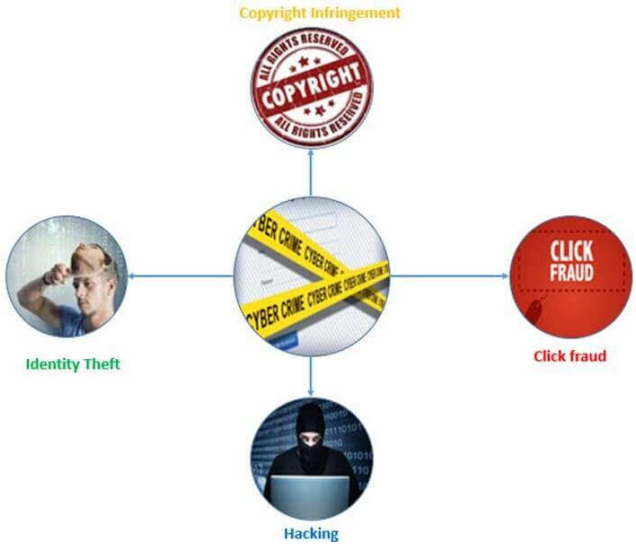
- d e f i n e cyber-crime
- e x p l a i n information system security
- d i s c u s s information system ethics
- e x a m i n e Information Communication Technology (ICT) policy.

3.0 MAIN CONTENT

3.1 Challenges Posed by Information System and Information Technology

3.1.1 Cyber-crime

Cyber-crime refers to the use of information technology to commit crimes. Cyber- crimes can range from simply annoying computer users to huge financial losses and even the loss of human life. The growth of smartphones and other high-end Mobile devices that have access to the internet have also contributed to the growth of cyber-crime.



Types of Cyber-Crime

i) Identity theft

Identity theft occurs when a cyber-criminal impersonates someone else identity to practice malfunction. This is usually done by accessing personal details of someone else. The details used in such crimes include social security numbers, date of birth, credit and debit card numbers, passport numbers, etc.

Once the information has been acquired by the cyber-criminal, it can be used to make purchases online while impersonating someone else. One of the ways that cyber-criminals use to obtain such personal details is phishing.

Phishing involves creating fake websites that look like legitimate business websites or emails.

For example, an email that appears to come from YAHOO may ask the user to confirm their personal details including contact numbers and email password. If the user falls for the trick and updates the details and provides the password, the attacker will have access to personal details and the email of the victim.

If the victim uses services such as PayPal, then the attacker can use the account to make purchases online or transfer funds.

Other phishing techniques involve the use of fake Wi-Fi hotspots that look like legitimate ones. This is common in public places such as restaurants and airports. If an unsuspecting user logon into the network, then the cyber-criminal may try to gain access to sensitive information such as usernames, passwords, credit card numbers, etc.

According to the US Department of Justice, a former state department employee used email phishing to gain access to email and social media accounts of hundreds of women and accessed explicit photos. He was able to use the photos to extort the women and threatened to make the photos public if they did not give in to his demands.

ii) Copyright infringement

Piracy is one of the biggest problems with digital products. Websites such as the pirate bay are used to distribute copyrighted materials such as audio, video, software, etc. Copyright infringement refers to the unauthorized use of copyrighted materials.

Fast internet access and reducing costs of storage have also contributed to the growth of copyright infringement crimes.

iii) Click fraud

Advertising companies such as Google AdSense offer pay per click advertising services. Click fraud occurs when a person clicks such a link with no intention of knowing more about the click but to make more money. This can also be accomplished by using automated software that makes the clicks.

iv) Advance Fee Fraud

An email is sent to the target victim that promises them a lot of money in favour of helping them to claim their inheritance money.

In such cases, the criminal usually pretends to be a close relative of a very rich well-known person who died. He/she claims to have inherited the wealth of the late rich person and needs help to claim the inheritance. He/she will ask for financial assistance and promise to reward later. If the victim sends the money to the scammer, the scammer vanishes and the victim loses the money.

v) Hacking

Hacking is used to by-pass security controls to gain unauthorized access to a system. Once the attacker has gained access to the system, they can do whatever they want. Some of the common activities done when system is hacked are:

- Install programs that allow the attackers to spy on the user or control their system remotely
- Deface websites
- Steal sensitive information. This can be done using techniques such as *SQL* Injection, exploiting vulnerabilities in the database software to gain access, social engineering techniques that trick users into submitting ids and passwords, etc.

3.1.2 Computer Virus

Viruses are unauthorized programs that can annoy users, steal sensitive data or be used to control equipment that is controlled by computers.

3.2 Information System Security

MIS security refers to measures put in place to protect information system resources from unauthorized access or being compromised. Security vulnerabilities are weaknesses in a computer system, software, or hardware that can be exploited by the attacker to gain unauthorized access or compromise a system.

People as part of the information system components can also be exploited using social engineering techniques. The goal of social engineering is to gain the trust of the users of the system.

Let's now look at some of the threats that information system face and what can be done to eliminate or minimize the damage if the threat were to materialize.

Fig. 15.1: Management information Systems security

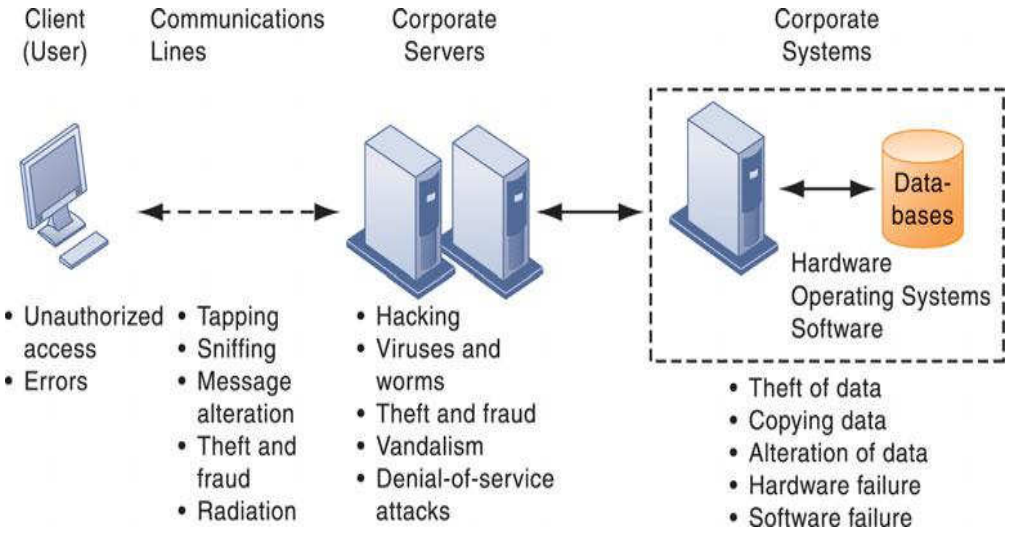


Fig. 15.2: Contemporary Security challenges and their Vulnerability

The architecture of a Web-based application typically includes a Web client, a server, and corporate information systems linked to databases. Each of these components presents security challenges and vulnerabilities. Floods, fires, power failures, and other electrical problems can cause disruptions at any point in the network.

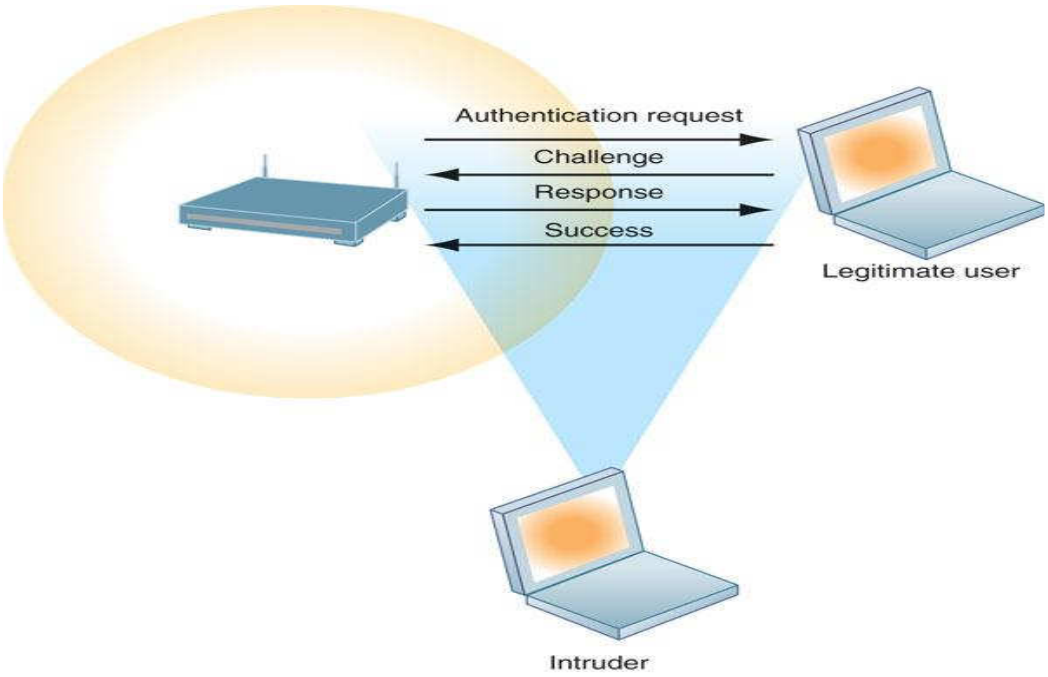


Fig. 15.3: WI FI Security Challenge

Many Wi-Fi networks can be penetrated easily by intruders using sniffer programs to obtain an address to access the resources of a network without authorization.

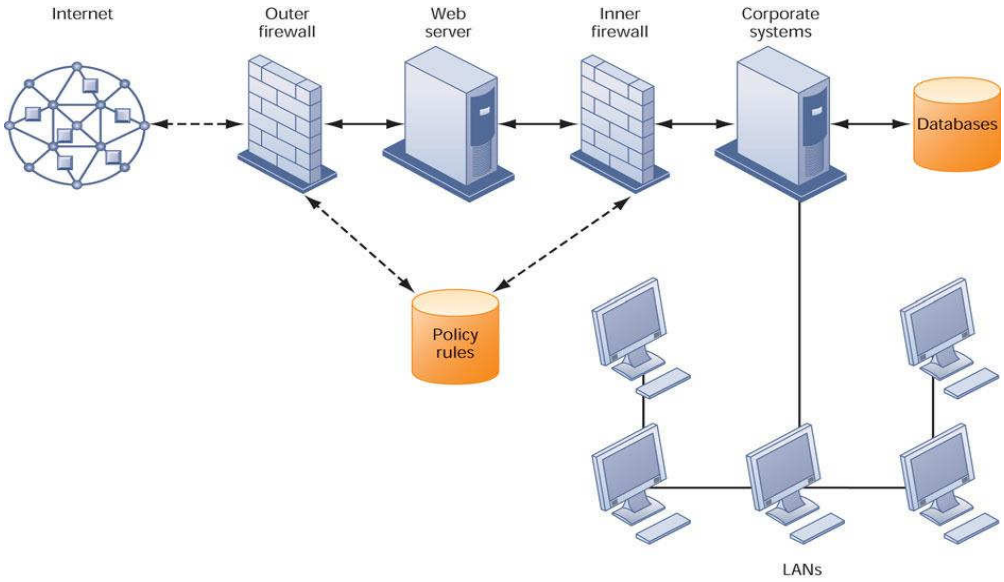


Fig. 15.4: A Corporate Firewall

The firewall is placed between the firm‘s private network and the public Internet or another distrusted network to protect against unauthorized traffic.

Computer viruses: These are malicious programs as described in the above section. The threats posed by viruses can be eliminated or the impact minimized by using Anti-Virus software and following laid down security best practices of an organization.

Unauthorized access: The standard convention is to use a combination of a username and a password. Hackers have learnt how to circumvent these controls if the user does not follow security best practices. Most organizations have added the use of mobile devices such as phones to provide an extra layer of security.

Let's take Gmail as an example, if Google is suspicious of the login on an account, they will ask the person about to login to confirm their identity using their android powered mobile devices or send an SMS with a PIN number which should supplement the username and password.

If the company does not have enough resources to implement extra security like Google, they can use other techniques. These techniques can include asking questions to users during signup such as what town they grew up in, the name of their first pet, etc. If the person provides accurate answers to these question, access is granted into the system.

Data loss: If the data centre caught fire or was flooded, the hardware with the data can be damaged, and the data on it will be lost. As a standard security best practice, most organizations keep backups of the data at remote places. The backups are made periodically and are usually put in more than one remote area.

Biometric Identification: This is now becoming very common especially with mobile devices such as smartphones. The phone can record the user fingerprint and use it for authentication purposes. This makes it harder for attackers to gain unauthorized access to the mobile device. Such technology can also be used to stop unauthorized people from getting access to your devices.

3.3 Information System Ethics

Ethics refers to rules of right and wrong that people use to make choices to guide their behaviours. Ethics in MIS seek to protect and safeguard individuals and society by using information systems responsibly. Most professions usually have defined a code of ethics or code of conduct guidelines that all professionals affiliated with the profession must adhere to.

In a nutshell, a code of ethics makes individuals acting on their free will responsible and accountable for their actions. An example of a Code of Ethics for MIS professionals can be found on the British Computer Society (BCS) website.

3.4 Information Communication Technology (ICT) Policy

An ICT policy is a set of guidelines that defines how an organization should use information technology and information systems responsibly. ICT policies usually include guidelines on;

- Purchase and usage of hardware equipment and how to safely dispose them
- Use of licensed software only and ensuring that all software is up to date with latest patches for security reasons
- Rules on how to create passwords (complexity enforcement), changing passwords, etc.
- Acceptable use of information technology and information systems
- Training of all users involved in using ICT and MIS

4.0 CONCLUSION

Information systems have made many businesses successful today. Some companies such as Google, Facebook, eBay, etc. would not exist without information technology. However, improper use of information technology can create problems for the organization and employees.

5.0 SUMMARY

With great power comes great responsibility. Information systems bring new opportunities and advantages to how we do business but they also introduce issues that can negatively affect society (cybercrime). An organization needs to address these issues and come up with a framework (MIS security, ICT policy, etc.) that addresses them.

6.0 TUTOR-MARKED ASSIGNMENT

1. What ethical, social, and political issues are raised by information systems?
2. Explain how ethical, social, and political issues are connected and give some examples.
3. List and describe the key technological trends that heighten ethical concerns.
4. Differentiate between responsibility, accountability, and liability.
5. What specific principles for conduct can be used to guide ethical decisions?
6. Why do contemporary information systems technology and the Internet pose challenges to the protection of individual privacy and intellectual property?
7. Explain how the Internet challenges the protection of individual privacy and intellectual property.
8. Explain why it is so difficult to hold software services liable for failure or injury.

7.0 REFERENCES/FURTHER READING

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