ATSWA

ACCOUNTING TECHNICIANS SCHEME WEST AFRICA

STUDY TEXT

INFORMATION TECHNOLOGY

ASSOCIATION OF ACCOUNTANCY BODIES IN WEST AFRICA (ABWA)

ACCOUNTING TECHNICIANS SCHEME WEST AFRICA (ATSWA)

STUDY TEXT FOR

INFORMATION TECHNOLOGY

FOURTH EDITION

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DISCLAIMER

This book is published by ABWA; however, the views are entirely those of the writers.

PREFACE

INTRODUCTION

The Council of the Association of Accountancy Bodies in West Africa (ABWA) recognised the difficulty of students when preparing for the Accounting Technicians Scheme West Africa examinations. One of the major difficulties has been the non-availability of study materials purposely written for the scheme. Consequently, students relied on text books written in economic and socio-cultural environments quite different from the West African environment.

AIM OF THE STUDY TEXT

In view of the above, the quest for good study materials for the subjects of the examinations and the commitment of the ABWA Council to bridge the gap in technical accounting training in West Africa, led to the production of this Study Text.

The Study Text assumes a minimum prior knowledge and every chapter reappraises basic methods and ideas in line with the syllabus.

READERSHIP

The Study Text is primarily intended to provide comprehensive study materials for students preparing to write the ATSWA examinations.

Other beneficiaries of the Study Text include candidates of other Professional Institutes, students of Universities and Polytechnics pursuing undergraduate and post graduate studies in Accounting, advanced degrees in Accounting as well as Professional Accountants who may use the Study Text as reference material.

APPROACH

The Study Text has been designed for independent study by students and as such concepts have been developed methodically or as a text to be used in conjunction with tuition at schools and colleges. The Study Text can be effectively used as a course text and for revision. It is recommended that readers have their own copies.

FOREWORD

The ABWA Council, in order to actualize its desire and ensure the success of students at the examinations of the Accounting Technicians Scheme West Africa (ATSWA), put in place a Harmonisation Committee, to among other things, facilitate the production of Study Texts for students. Hitherto, the major obstacle faced by students was the dearth of Study Texts which they needed to prepare for the examinations.

The Committee took up the challenge and commenced the task in earnest. To start off the process, the existing syllabus in use by some member Institutes were harmonized and reviewed. Renowned professionals in private and public sectors, the academia, as well as eminent scholars who had previously written books on the relevant subjects and distinguished themselves in the profession, were commissioned to produce Study Texts for the twelve subjects of the examination.

A minimum of two Writers and a Reviewer were tasked with the preparation of Study Text for each subject. Their output was subjected to a comprehensive review by experienced imprimaturs. The Study Texts cover the following subjects:

PART I

1 Basic Accounting
2 Economics
3 Business Law
4 Communication Skills

PART II

1 Financial Accounting
2 Public Sector Accounting
3 Quantitative Analysis
4 Information Technology

PART III

1 Principles of Auditing & Assurance
2 Cost Accounting
3 Taxation
4 Management

Although, these Study Texts have been specially designed to assist candidates preparing for the technicians examinations of ABWA, they should be used in conjunction with other materials listed in the bibliography and recommended text.

PRESIDENT, ABWA

STRUCTURE OF THE STUDY TEXT

The layout of the chapters has been standardized so as to present information in a simple form that is easy to assimilate.

The Study Text is organised into chapters. Each chapter deals with a particular area of the subject, starting with a summary of sections and learning objectives contained therein.

The introduction also gives specific guidance to the reader based on the contents of the current syllabus and the current trends in examinations. The main body of the chapter is subdivided into sections to make for easy and coherent reading. However, in some chapters, the emphasis is on the principles or applications while others emphasise method and procedures.

At the end of each chapter is found the following:

- Summary;
- Points to note (these are used for purposes of emphasis or clarification);
- Examination type questions; and
- Suggested answers.

HOW TO USE THE STUDY TEXT

Students are advised to read the Study Text, attempt the questions before checking the suggested answers.

ACKNOWLEDGMENTS

The ATSWA Harmonisation and Implementation Committee, on the occasion of the publication of the first edition of the ATSWA Study Texts acknowledges the contributions of the following groups of people. The ABWA Council, for their inspiration which gave birth to the whole idea of having a West African Technicians Programme. Their support and encouragement as well as financial support cannot be overemphasized. We are eternally grateful.

To The Councils of the Institute of Chartered Accountants of Nigeria (ICAN), and the Institute of Chartered Accountants, Ghana (ICAG), Institute of Chartered Accountants Sierra Leone (ICASL), Gambia Institute of Chartered Accountants (GICA) and the Liberia Institute of Certified Public Accountants (LICPA) for their financial commitment and the release of staff at various points to work on the programme and for hosting the several meetings of the Committee, we say kudos.

We are grateful to the following copyright holders for permission to use their intellectual properties:

- The Institute of Chartered Accountants of Nigeria (ICAN) for the use of the Institute's examination materials;
- International Federation of Accountants (IFAC) for the use of her various publications;
- International Accounting Standards Board (IASB) for the use of International Accounting Standards and International Financial Reporting Standards;
- Owners of Trademarks and Trade names referred to or mentioned in this Study Text.

We have made every effort to obtain permission for use of intellectual materials in this Study Texts from the appropriate sources.

We wish to acknowledge the immense contributions of the writers and reviewers of this manual.

Our sincere appreciation also goes to various imprimaturs and workshop facilitators. Without their input, we would not have had these Study Texts. We salute them.

Chairman
ATSWA Harmonization & Implementation Committee

A new syllabus for the ATSWA Examinations has been approved by ABWA Council and the various PAOs. Following the approval of the new syllabus which becomes effective from the September 2022 diet a team was constitutes to undertake a comprehensive review of the Study Texts in line with the syllabus under the supervision of an editorial board.

The Reviewers and Editorial board members are:

REVIEWERS

This Study text was reviewed by:

-Professor M. O Ajetunmobi Lagos State University, Lagos

-Mr. O. A Adepate, FCA

-Mr. Jacob B. Ekuewa

-

EDITORIAL BOARD

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- Examination Department.

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SYSTEMS DEVELOPMET AND ISSUES IN COMPUTER SECURITY

PAPER 8: INFORMATION TECHNOLOGY (I.T.)

AIM:

To develop a practical knowledge and understanding of the role of information and communication technologies in an organization with special reference to the accounting functions.

OBJECTIVES:

On completion of this paper, candidates should be able to:

a. have an understanding of the roles of information technology to an organization;
b. understand the communication support systems;
c. describe the hardware and software systems of micro computers;
d. have knowledge of the main features of integrated packages with reference to word processing, database, spreadsheet, PowerPoint and other accounting packages;
e. describe the work practices for monitoring and maintaining the security of the computer environment;
f. be well acquainted on recent development in information and communication technologies;
g. understand how accounting functions are affected by information and communication technologies; and
h. interact with the operating system.

STRUCTURE OF THE PAPER

The paper will be a three-hour paper divided into two sections:

Section A (50 Marks): This shall consist of 50 compulsory questions made up of 30 multiple-choice questions and 20 short answer questions covering the entire syllabus.

Section B (50 Marks): Six questions, out of which, candidates are expected to answer four, each attracting 12½ marks.

CONTENTS:

1. BASIC CONCEPTS **17.5%**

a. Information: Basic Concepts

- Definition of data and information.
- Distinction between data and information.
- Meaning of each of the following data concepts and their relationship: Bit, Byte, Field,
  Record, File, Database.
- Data representation, number base system (only bases 2, 4, 8, 10, 16) and
  their manipulations.
- Role of information in the accounting environment
- General characteristics of information.

b. Computer Systems

- Evolution of computers (Hardware only)
- Classification of computers: analog, digital, hybrid
- Characteristics of digital general purpose computers with special reference to Microcomputers
- Advantages and disadvantages of using computers
- Types of microcomputers

c. Office Automation:

- Hardware and Software Components

2. HARDWARE FUNDAMENTALS **17.5%**

a. Hardware

- Block diagram of basic components of a computer system showing input, CPU, Output, secondary storage.
- Input devices: Types and their appropriate uses.
- Output devices: types and their appropriate uses.
- Storage Media types: magnetic and optical discs, and their uses.
- Central Processing Unit (CPU): composition, functions and processing powers.

b. Controls

- Input Controls: Accuracy, completeness, authorisation and validity checks.
- Output Controls: Control totals, authorisation, pre-numbering.
- Storage Controls: Labelling, file backup and physical security.

3. SOFTWARE FUNDAMENTALS 17.5%

a. System Software

- Systems software: definition, examples and functions of: operating systems (OS), utility programs, language processors, editors.
- Operating Environments: single-user, multi-user, networking and window- based environment
- Types of operating systems used for: single-user, multi-user and networking

b. Application Software

- Definition
- Criteria for selecting application packages
- Sources of application packages
- Software Suite and Integrated packages (e.g. database, word processing, spreadsheet, PowerPoint, accounting, payroll and inventory): Features, uses, advantages and disadvantages.
- Principles of programming in relation to business problems: Program flowchart, structured pseudocode, decision tables, decision tree.
- Characteristics of computer programming Languages
- Distinction among computer programming languages including Fourth Generation Languages (4GL)

c. Microsoft Windows and other operation systems for microcomputers, servers and smart Phones

d. Functions of mouse, Graphical user interface, desktop, Task bar, Title bar, Menu bar, Tools bar, etc. Start Button, my computer, my Document, Control Panel, windows explorer

4. INFORMATION PROCESSING 12.5%

a. Information Processing Techniques

- Processing Methods: Centralised, decentralized, Batch, On-line, Real-time distributed and time sharing.
- Advantages and disadvantages of different processing methods
- Multiprocessing, Multitasking, Multiprogramming

b. Computer Services

- The role of microcomputers in the accounting environment, role of users department.
- Information centre: Staffing, services provided
- Computer bureau: Services provided, reasons for using a bureau, advantages and disadvantages.

5. DATA COMMUNICATION AND TRANSMISSION 17.5%

a. Data communication and Computer Networks

- Definition: Networking, Local Area Network (LAN). Wide Area Network (WAN), Metropolitan Area Network (MAN), Remote Job Entry (RJE), Intranet, Extranet, Internet

- Network topologies: Star, Ring, Bus, fully connected/Mesh.
- Data transmission media: Definitions and examples
- Modes of transmission: Simplex, half duplex, duplex, synchronous and asynchronous Data transmission equipment: MODEM, Multiplexors, etc
- Protocols, OSI - 7 layer model

b. Internet: Definition, uses, advantages and disadvantages, Hardware and software requirements. Websites, web pages, blogs. Interacting with the internet through browsing, surfing, uploading and downloading

c. Social and Business communication on the Net:
Electronic mail, internet advertising, teleconferencing and telecommuting: e-business and ecommerce, facebook, twitter, WhatsApp, etc: advantages and disadvantages to business

d. Cloud computing: Technologies, models, advantages and disadvantages

6. SYSTEMS DEVELOPMENT, SECURITY AND ISSUES IN MANAGEMENT OF INFORMATION 17.5%

a. Systems Development
- Approaches to Systems Development: Traditional Systems Development life Cycle (SDLC),
  Prototyping, End-user developments.
- Systems development cycle (in outline only): Linking systems development to identification of a problem, feasibility studies, systems investigation and specifications, systems design, acquisition, implementation, maintenance and review.

b. Computer Security: hardware, software and workplace securities
c. Cybercrimes: types and prevention methods
d. Network and internet privacy and security basics:
e. Computer viruses, worms, Trojans: definition, mode of infection, prevention
f. Computer forensics: definition, basic principles
g. Basics of disaster recovery: methods, techniques
h. Big Data: Characteristics, implications for organisations, analysis of big data.
i. Legal, Ethical, Health and Environmental issues in computing. Artificial Intelligence (AI)

j. Robotics

Recommended Text books

1. ATSWA Study Pack on Information Technology

OTHER REFERENCE BOOKS

Gerald V. Post and Andersen David L. (2000); Management Information Systems: Solving Business Problems with Information Technology. London: Irwin McGraw-Hill.

CHAPTER ONE

DATA AND INFORMATION

Chapter Contents

(a) Concept and Elements of System theory;

(b) Control Systems;

(c) Data and Information;

(d) Internal and External Data Information Representation in the Computer; and

(e) Usefulness of Information in an Accounting Environment.

(f) Computer systems

1.0 OBJECTIVES

After reading this chapter, the reader should be able to;

(a) understand the concept and principal elements of a system and recognize the elements of business organization;

(b) understand the interrelationships between the subsystems;

(c) (c) understand the feedback and feed forward control systems;

(d) (d) differentiate between data and information; and

(e) appreciate the importance and benefits of information to an accounting environment.

(f) the evolution of the hardware system

(g) Differentiate the various computers by size, processing power and storage capabilities

1.1 SYSTEM THEORY

1.1.1 INTRODUCTION

System theory provides a spectrum of scientific principles, concepts and philosophy which may be applied to the study of systems of all types. In the context of this book, it embraces all types of business systems including control systems relating to quality control, production control, budgetary control, cost control, financial and cash control. These systems provide the fabric of a management information system.

A system may be defined as a combination of interrelated elements, called subsystems, organized in such a way so as to ensure the efficient functioning of the system as a whole.

This necessitates a high degree of coordination between the subsystems, each of which is designed to achieve a specific purpose.

A system element can be a tangible object (such as data, information) or an event (such as an anniversary day).

Examples of systems include:

a) Business systems
b) Manufacturing systems
c) Service systems
d) Information systems
e) Computer-based management information systems.
f) Stock control systems.

A system must have an objective or goal. It is probably true to say that all systems have more than one objective.

A business organization, for example, might have the following objectives:

i) Generate a reasonable financial return for shareholders;
ii) Maintain a high market share;
iii) Increase productivity annually;
iv) Offer an up-to-date product range of high quality and proven reliability;
v) Develop a reputation as responsible employers;
vi) Acknowledge social responsibilities; and
vii) Grow and survive autonomously.

In most cases, the differing objectives of a system will be conflicting, so that some form of compromise or trade-off between them must be reached. A system will not operate as efficiently as it should if these compromises are not reached in a satisfactory manner. For example, the wish to reduce production cost might conflict with any of the following:

- High measure against health and safety conditions at work;
- The high costs used for the treatment of waste and effluent from production;
- The quality of goods produced; and
- Spending on new technology or research and development (R & D).

1.1.2 SYSTEM ENVIRONMENT

The environment of a system consists of elements which surround the system and interact with it. The environment is not part of the system. For example, the environment of a business system consists of the government and the competitors.

A system is normally delimited by a boundary, which separates the system from its environment. Anything within the boundary is part of the system; while anything

outside the boundary is part of the environment. Elements included in the system and the elements included in the environment depend on the particular problem being studied.

For example, considering the problem of determining the turnaround time in Batch processing, the system elements will include people (in the form of the speed of data- entry operators and the schedule established by the computer operator).

On the other hand, if the problem is to study how to make a particular computer program execute more efficiently on a given computer, the system elements will include purely technical details of the program, system software routines, the data used and the hardware, while people will be in the system's environment.

Just as every system has an objective which ought to be identified and specific, so too will every system have constraints or limiting factors, which restrict its capacity to achieve its objectives. In a business system, constraints restricting the objective of profit maximization might include any of the following:

a) Scarcity of key resources such as cash or skilled labour;

b) Technological constraints limiting what goods and services can be produced;

c) Economic constraints;

d) Political and legal constraints;

e) Product completion time;

f) Responsibilities towards society and for preserving the environment from pollution.

1.1.3 Sub-systems

Every system can be broken down into subsystems (elements) and in turn, each sub- system can be further broken into sub-subsystems. Separate subsystems interact with each other and respond to each other by means of communication or observation.

Subsystems may be differentiated from each other by:

a) function (e.g. in a manufacturing system, we might have, production, finance, marketing, sales, personnel etc);

b) space (e.g. Northern area and southern area sales managers);

c) time (e.g. morning shift, afternoon shift, and evening shift managers);

d) People (e.g. skilled people, unskilled);

e) formality – various ways of getting information;

f) automation – various processes carried out by the computer system

Illustration 1

a) A manufacturing organization is a system with subsystems such as;

i) Personnel department,

ii) Marketing department,

iii) Audit department,

iv) Production department,

v) Information technology (I.T.),

vi) Maintenance department, and

vii) Purchasing department.

Note that in (a) above, the manufacturing organization has been divided into subsystems (elements) by the functions undertaken by the elements.

b) The production subsystem can be further divided into sub-subsystems such as:

- Machine operations control,
- Work-handling,
- Power supply, and
- Material production.

1.1.4 Coupling and Decoupling of Systems i. e. (Integration and Disintegration)

A system is a combination of subsystems (elements), which are integrated to each other by means of their inputs and outputs. Coupling is a measure of the degree or extent of the dependence of the subsystems on one another. If subsystems are over-integrated, they may become too complex to understand and operate and if one part of the system ceases to function correctly, the other elements are affected and may cease to function completely. Decoupling, both in a physical and information sense, allows subsystems more independence in planning and control. When systems are decoupled, it is easier to administer them in some cases as they become less complex and more flexible. This enables them to react to random influences as they occur without too much disruption. Decoupling generally leads to system stability which is essential for continued operation and survival in a dynamic environment. Decoupling creates a situation whereby subsystems exist separately on a functional basis but are coordinated by the chief executive for the achievement of the overall objectives. Each functional sub-system has more independence even though they are still interrelated in reality, but loosely connected for administrative convenience.

1.1.5 Components of a System

When classifying systems, distinction is made between a system's logical description and physical description. The logical description of a system is a representation that specifies essential system elements irrespective of how these elements may be implemented. The physical description addresses implementation. For example, in a computer-based Management Information System (CBIS), the terms input, processing and output are logical descriptions of the general Transformation process. However, during implementation, keyboard can be used as an input device while the monitor or printer can be used as output devices. The three logical components of a system are INPUT, PROCESS and OUTPUT.

a) **INPUTS:** These provide the system with what it needs to be able to operate. Input may include matter, energy, human, data or information.

b) **PROCESSES:** These transform the input into output, such as task performed by human, plant, machines etc.

c) **OUTPUTS:** These are the results of processing e.g. In a manufacturing system, finished products and Work-in- progress (WIP), are output elements.

1.1.6 Types of Systems

One way of classifying systems is the way in which they interact with the environment such as Open and Closed systems.

a. Open System

Open systems are those which interact with their environment for the collection and exchange of information. Such information includes; business transaction with suppliers, customers, the general public, government departments, trade organization etc. Such system adapts to changes in the environment in order to survive which requires speedy reactions to competitive situations and other threats in the most effective way. All business systems are open systems.

b. Closed System

A closed system does not interact with its environment either for the exchange of information or business transaction. A closed system has neither an input nor output, i.e. it is self-contained. In fact, no such system exists, but the term is used for systems that interact only partially with their environment. An approximation is the reaction in a sealed, insulated container.

1.1.7 Classification of Open Systems

Open systems may be classified according to the degree of reaction to their environment in the production of output as:

a) Deterministic or Mechanistic,

b) Probabilistic or Stochastic, and

c) Adaptive (self-organizing) or cybernetic.

Deterministic or Mechanistic systems

A deterministic or mechanistic system is one in which various states or activities follow each other in a completely predictable way. It is designed to operate on the basis of standardized rules and regulations which restrict its ability to react to its environment. A deterministic system enables the outputs generated from specific inputs to be measured without any error. An example is a computer system. Business and economic systems are not deterministic systems, since they are highly unpredictable.

Probabilistic or Stochastic Systems

A probabilistic or stochastic system is one in which some states or activities can be predicted with varying degree of probabilities. Business and economic systems are probabilistic systems since they are subjected to random influences from the environment. The state of such systems can therefore be defined or known only within specified limits even when they are subject to control. For examples, stocks of raw materials, parts and finished goods are influenced by changes in demand and variations in supply. Generally in probabilistic systems, the outputs from specific inputs are not certain because it is not possible to ascertain what events will occur outside their boundaries.

Adaptive or Cybernetic System

Cybernetics is defined as the science of communication and control in man and machine systems. The term is derived from the Greek word “Kybernetes”, the derivation of the Latin work, “gubernator” meaning governor or controller. An adaptive or cybernetic system is one, which adapts and reacts to a stimulus. The way in which it adapts is uncertain as the same input (stimulus) to the system will not always produce the same output (response). An adaptive system responses to changing situation by adjusting its behaviour on a self-organising basis. The system alters its inputs as a result of measuring its outputs. It attempts to optimise its performance by monitoring its own behaviour. Animals, human beings and business organizations are examples. A physical example is the thermostat controlled heating system in water boilers which cuts off current when temperature is high in order to maintain a steady water temperature. Also, computerized Stock Ordering System is adaptive in nature.

1.1.8 CONTROL SYSTEMS

A system must be controlled to keep it steady or enable it to change safely. Control is required because unpredictable disturbances may arise and enter the system, so that actual results deviate from the expected objective. For example, in a business organization, such disturbances could be:

a) Entry of a powerful and advanced technological new computer into the market;

b) An unexpected rise in labour costs;

c) The failure of a supplier to deliver promised raw materials; and

d) Government legislation etc.

Control systems are often separately structured from the systems which they control. For example;

i) The production control system controls the production quantity;

ii) The quality control system controls the production quality;

iii) The cost control system controls the cost of production.

These control systems are basically administrative systems for monitoring the results and modifying the state of the physical systems to which they relate.

Control is for the purpose of detecting variations in the behaviour of a system so that control signals can be communicated to the appropriate manager for necessary adjustments or changes to be made.

1.1.9 Elements of Control

The basic elements of control in a business systems are:

a) **Planning:** This is the determination of objectives, or parameters such as:

i. standard times for an operation;

ii. level of production activity required;

iii. level of sales required;

iv. maximum expenditure allowed; and

v. performance levels required.

b) **Collecting facts:** This involves the collection and recording of data in respect of such things as:

i. actual times taken;

ii. level of production achieved;

iii level of sales achieved;

iv expenditure incurred; and

v actual performance level.

c) **Comparison:** This involves the computation of the difference between the objective and the actual results for the purpose of indicating variances and the reporting of significant deviations (variances).

d) **Corrective Action:** This involves the action taken by the relevant manager (effector) to maintain a steady state.

1.1.10 Closed and Open-looped Control Systems

The basic types of control systems are Open and Closed – loop control systems.

a) Open-loop control system

In an open -loop control system, the control is exercised regardless of the output produced by the system. Here, control is exercised by external intervention. Physical examples include:

i.) Automatic light switches and

ii.) Traffic light.

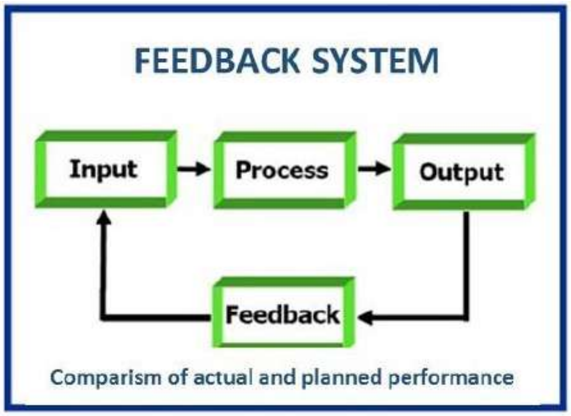
b. **Closed- loop Control System**

In closed-loop control system, the control is exercised by part of the output is fed back into the system as input.

Many closed-loop systems are self-regulating as they contain a built-in control mechanism. Businesses systems contain integrated control systems, performing continuous monitoring activities which are also closed-loop systems, because they contain the essential elements of feedback.

1.1.11 Feedback Control System

Business information is needed to plan or make rules. It is also needed to compare error signals to be generated as the basis for adjusting the input to a system which, in respect of an automatic control system, is achieved by an inbuilt control mechanism.



Source: www.imagegraphics.com

Fig 1.1 Closed-loop Control System

1.1.12 Negative Feedback

Feedback is part of the output which is returned to the input as a means of system control. When the actual output from a system is lower than the desired output, the differences between the actual and the desired outputs are detected as positive deviations (errors) and action is effected in the opposite direction to counteract them. Consider a production line with 10,000 units as required output in the month. If the actual monthly output is 9,000 units, then monthly errors of 1,000 units are detected as positive deviations. Corrective action would then be taken to increase the output to 10,000 units per month. This is an adjustment in the opposite direction to the error. Most business control systems are negative feedback control systems.

1.1.13 Positive Feedback

In a positive feedback control system, actions are taken to enlarge (amplify) the detected deviations. This is in contrast to what happens in the negative feedback control systems. For example, amplification applies to serve-mechanisms whereby a small manual force is detected and amplified to achieve a defined purpose.

1.1.14 Feed - forward Control System

Management can also act proactively on the feed-forward principle. Here, the error signals (deviations) are noted over a period of time by a monitoring process and may be employed to forecast the projected performance of an organizational unit. This approach ensures that the historical trend or inherent behaviour of a system is allowed for when establishing control parameters for future operations. In conclusion, feed-forward controls monitor both process operations and inputs in an attempt to predict potential deviations in order that adjustments can be made to avert problems before they occur.

1.2 NATURE OF DATA AND INFORMATION

1.2.1 Data and Information

Data are raw facts, events, numbers and transactions which have been collected, recorded, stored but are not yet processed. Data consist of numbers and characters (i.e alphabets and special symbols) which are used to record facts and events about activities occurring in an environment or system.

Information is processed data. It is obtained after subjecting data to a series of processing operations which convert related groups of data (raw facts) into a meaningful and coherent form. Processing could be in the form of addition, subtracting, comparison, sorting, rearrangement etc. This makes information useful and meaningful. In other words, information could be defined as the desired form to which data is finally transformed after undergoing a series of processing or transformation. Let us consider an example which distinguishes data from information. The costs of five different items are data while the total cost or average cost which is obtained from the different costs is information.

Information must be communicated and received by a manager who uses it for decision making. On most occasions, what is information to one manager might be data needing further processing to another manager.

We should know that the main reason why people muddle both terms: data and information is because they are both dynamic in their state. That is, data used as input for a computational process may be an output of an earlier computation performed on the same computer and vice versa.

Table 1.4. 1 below shows example of data being used as information and vice versa.

Table 1.4.1

	OPERATION	DATA	INFORMATION
1	Typing of students name, Matriculation number and scores in computer science	Characters like alphabets (A-Z, a-z), digits (0-9), or special charaacters (+,- ,*,/)	Set of characters (words) like ade, 70, Sola etc
2	Computation of a class average science in computer science	Each student's test score in computer science	The class average score in Computer science
3	Computation of a school average score in Computer science	Each class' average score in Computer science	The school's average score in Computer science

If we study Table 1.4.1 above, we shall realise that information (output), for a particular computational stage serves as input for the next operation.

For example, the information (set of characters like Ade, 70, Sola etc) is what will be used as data input in the second operation (Computation of a class average score in computer science), and the same logic is applicable to the third operation.

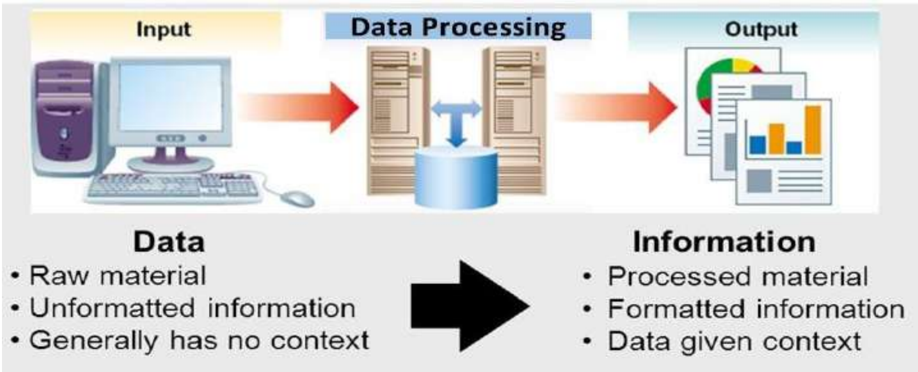
The table below gives some distinctions between data and information.

	DATA	INFORMATION
1	Data is raw, an unchanged fact.	Information is an organised and sorted fact
2	It serves as input into the computer system	It serves as an output from the computer system
3	Observation and recording are done to produce data	Analysis of data are done to obtain information
4	Data is the lowest level of knowledge	Information is the second level of knowledge
5	Data by itself is not significant	Information is significant

Table 1.4.2

Data Conversion Process

The conversion of data to information is represented diagrammatical in figure 1.4.2



Source: Imagegraphics.com

1.2.2 General Characteristics of Information

The following are the essential attributes of information for management decisions:

(a) It must be detailed enough to allow for effective decision

(b) It must contain an appropriate level of details for the recipient. At the top management level, the information must be very broad in scope while at the operating or departmental management level; the information must be of a very detailed nature;

(c) It must relate to the current situation and have acceptable level of integrity;

(d) It must be produced at an optimum cost and must be compatible with response time needs of the systems;

(e) It must be easily understood by the recipients. Presentation, in forms of charts, diagrams and tables may be essential. It must be concise and not contain unnecessary redundancy;

(f) It must be precise and have an acceptable level of accuracy to the recipient. It must be producible at regular intervals and be relevant to its purpose. For example, bank balances are given to 2 decimal places for accuracy; and

(g) It must be verifiable. Many knowledgeable people acting independently will produce the same information.

(h) It must be arranged or organised to suit the requirement or purpose for which it is needed.

(i) Information when derived must be communicated through the right channel to the recipient.

1.2.3 Types of Information

Information needs of an organization can either be quantitative or qualitative.

a) Quantitative Information

Quantitative information deals with the magnitudes of variables, their variability or absolute values. Some examples are:

Annual sales of a production company,

(i) Variation in the wages of low-level staff in an organization,

(ii) Prices of goods; and

(iii) Number of hours worked on a production line.

b) Qualitative Information

Qualitative information is related to the attributes of an entity in respect of quality factors. This type of information is not exact (precise) in nature but it is very useful for comparative measurement.

Example include:

(i) Standard of finished product in respect of paintwork or electroplating; and

(ii) Variation of tolerances of manufactured parts i.e. deviation from standard dimensions.

1.2.4 VALUE OF INFORMATION

This is the perception of the receiver of the message or report which is of great importance for the information specialist. It has to do with the change in behavior or the action of the users, less the cost of producing or generating the information. The message being sent as information has different meaning to different people i.e. the message being sent as information can be interpreted differently. Information can have three meanings:

- What the sender intend to send
- What is actually contained in the message

- What meaning the receiver understood from the message? The implication of these to the specialist is to ensure that the users are adequately provided for. This is because; it is the user that will determine the value of information. The specialist must know what the recipient expects to see and hear. They must be familiar with the language terminology and experience background of the recipient.

HOW TO PROVIDE THE VALUE OF INFORMATION

The information specialist can enhance the perception of the receiver in the following ways:

- Avoid information technical jargons
- Collaborate the receiver on contents, formation and presentation of report and statement.
- Regular feedback from receiver to sender
- Gain the confidence of the receiver
- Avoid excessive detail
- Reduce noise to the bearest minimum
- Use of proper and effective communication channel
- Production of the information to time.

1.3 Information System

With the proper definitions of data, information and the attributes of information given above, we can now define an Information System as distinct from information. An Information System is the set of interconnected procedures, the purpose of which is to provide managers at all levels and in all functions of an organization with the information necessary to enable them make timely and effective decisions.

Information Systems can also be defined as a combination or collection of people, hardware, software, communication networks and data resources that collects, transform and provides information to managers at all levels in all functions to allow timely and effective decision making in an organisaton. These decisions are for:

a) Planning,

b) Directing and

c) Controlling of all activities for which they are responsible

The common characteristics of all information systems are:

(i) The existence of procedures for orientating and/or collecting data;

(ii) The existence of procedures which sort and classify data, carry out arithmetic and logical operations on the data, holds data in the form of records for immediate or future use, summarise and analyse data and check the results for accuracy.

All these activities constitute the processing of data; and

(iii) The existence of procedures for communicating the processed data to appropriate managers

1.4. Accounting Information System (AIS)

A special type of Information System for accounting professionals is the Accounting Information System.

An Accounting Information System (AIS) therefore consists of people, procedures and Information Technology (I.T).

Just as we have above, the AIS performs three important functions in any organisation:

a) It collects and stores data about activities and transactions so that the organisation can review what has happened;

b) It processes data into information that is useful for making decisions that enable management to plan, execute and control activities; and

c) It provides adequate controls to safeguard the organisation’s assets, including data.

d) It helps in the analysis of information presented in;

- Payroll/ Payslips;
- Stocks report;
- List of debtors/creditors;

- Cost summaries;
- Budget reports;
- Labour turnover statistics;

These controls ensure that the data is available when needed and that it is accurate and reliable.

1.4.1 Subsystems of Accounting Information Systems (AIS)

Most business organisations engage in many similar and repetitive transactions/activities. These transaction types can be grouped into the five basic cycles, which constitute the basic subsystems in the AIS:

(a) The Expenditure subsystem/cycle which consists of the activities involved in buying and paying for goods or services used by the organisation;

b) The production subsystem/cycle which consists of the activities involved in converting raw materials and labour into finished products (only manufacturing organisations have production subsystem);

c) The Human Resources /payroll subsystem /cycle which consists of the activities involved in hiring and paying employees;

d) The Revenue subsystem/cycle which consists of the activities involved in selling goods or services and collecting payment for those sales; and

e) The Financing subsystem/cycle which consists of those activities involved in obtaining the necessary funds to run the organisation and in repaying creditors and distributing profits to investors.

The above basic subsystems suggest the most important work activities performed by Professional Accountants:

(i) Accounting systems and financial reporting;

(ii) Long-term strategic planning;

(iii) Managing the accounting and finance function;

(iv) Internal consulting;

(v) Short-term budgeting;

(vi) Financial and economic analysis;

(vii) Process improvement;

(viii) Computer systems and operations;

(ix) Performance evaluation (of the organisation); and

(x) Customer and product profitability analysis.

Remark: The AIS differs from other information systems in its focus on accountability and control.

1.4.2 Benefits of Information systems

Information systems can help an organization in any of the following ways:

a) **Operational Efficiency:** This entails doing routine tasks faster, cheaper, neater and more accurately. The use of transaction processing software, word processing and electronic spreadsheet help to make operations more efficient:

b) **Functional Effectiveness:** This entails the use of decision support software which are oriented towards helping managers to make better decisions:

c) **Provision of better improved services:** This entails the use of help technologies like the automatic teller machine (ATM), e-commerce and the reservation systems used by travel agents. All these are examples of provision of improved services to customers:

d) **Better Product selection:** The provision of information helps in the selection of products offered for sales by industries like Banks, insurance companies, travel and financial services. Products that can be differentiated largely on the basis of the information inherent in them are called Information- Intensive Products; and

e) **Competitive Advantage:** The provision of information and the creation of new products through information technology can give some companies competitive advantage over other companies in the same industry.

1.4.3 Disadvantages of Information System

Everything that has an advantage will have some disadvantages and Information Systems is not an exception. Some of the disadvantages of Information systems includes:

a) **Ease of Fraud:** Information System makes whoever uses it efficient. This implies that if fraudsters have access to information systems, it will make their fraudulent activities efficient too.

b) **Data Loss:** If there is a disaster and an organisation fails to back-up her data regularly, the information she has may be lost and this can lead to legal liability and may eventually lead to the collapse of an organisation.

c) **GIGO Effect**: The popular term GIGO (Garbage-in Garbage-Out) implies that whatever you feed into the system is what you get. This becomes a disadvantage if wrong data is fed into the system, as it will produce wrong information that may ultimately lead to wrong decision making in businesses.

d) Information can be deceptive sometimes, e.g statistical information, if not well explained, which can lead to wrong use.

1.4.4 Roles of Information in the Accounting Environment

Accounting information plays major roles in organisations which include the following:

a) It identifies activities requiring action. For example, a cost report with a huge variance might stimulate investigation and possible corrective action;

b) It reduces uncertainty and thus provides a basis for choosing among alternative action. For example, it often used to set prices and determine credit policies

c) Information enables decision making process of the accountant to be fast

d) It makes the Accountant's output to be accurate

e) It enables the Accountant to develop strategies and formulate policies for the survival of their profession

f) It enables effective planning and control, desirable in the accounting profession

g) Information is needed in the accounting profession to proactively respond to rapidly changing conditions in the environment

h) It enables the Accountants to be abreast of government policies and regulations

i) It enables the Accountants to monitor and gain insights into the activities of their professional competitors

j) It enables the Accountants to meet customers' request adequately

k) It enables the Accountants to maintain patronage and goodwill of their customers

1.5 Information Technology (IT)

In the definition of information systems (I.S) in (1.4.3), no reference was made to any form of mechanization: It is a definition of how information is used rather than how it is obtained.

In Information Technology (IT), processing is carried out with the assistance of machines (electronic machines). IT is a computer – based information system (CBIS) in which the computer system plays a major role. All the various aspects of electronic technology include:

a) the use of microcomputers for the processing and storage of information;

b) the application of electronic spreadsheet to the modeling of business problems;

c) the use of word processing software for preparing standard reports and other correspondence at high speed;

d) the use of electronic-mail (e-mail) for transmitting messages. It partially eliminates the physical postal systems;

e) the introduction of electronic trading (e.g. e-commerce, e-marketing) and (electronic banking (which includes principally electronic money transfer); and

f) the introduction of electronic library enables the business to conduct its activities in a more efficient manner and stand above its competitors in the same trade.

g) electronic funds transfer. The means of transferring money from one bank account to another electronically.

h) data transmission. The sending of data electronically from one place to another.

1.6 Type of Decisions

One major objective of the AIS is to provide information for management decision making. IT aids AIS to meet this objective. To understand the roles played by IT and the design of such an AIS, we now explain the kinds of decision made by an organisation.

Decisions can be categorised either in terms of the degree of structure that exists or by the scope of the decision:

(a) Decision Structures:

Decisions vary in terms of the degree to which they are structured, among which are:

(i) **Highly Structured Decisions:** They are repetitive routine and understood well enough that they can be delegated to lower level employees and in fact such decisions can be automated. For example, the decision to grant credit to established customers requires the following:

- Personal Identification Number (PIN)
- Customer credit limit, and
- Current balance

(ii) **Semi-Structured Decisions** are characterised by incomplete rules for making the decision. There is need for subjective assessment and judgements to supplement formal data analysis. Such decisions can be made using Computer Based Decision Aids such as Neural systems, Decision Support Systems (DSS), Executive Support System (EIS) etc. For example, setting a marketing budget for a new product requires:

- the marketing status of the other products
- the level of advertisement and
- other subjective decisions.

(iii) **Unstructured Decisions** are non-recurring and non-routine. Examples include:

- choosing a cover for a magazine
- hiring a senior management
- the choice of basic research project to undertake

In this case, no framework or model exists to solve such problems. Instead, they require considerable judgement and intuition.

Nevertheless, they can be supported by Computer Based Decision aids that facilitate gathering information from diverse sources.

(b) **Decision Scopes are:**

(i) **Operational Control;** is concerned with the effective and efficient performance of specific tables. Lower-level supervisors and employers face semi-structured or structured decisions involving operational control. Examples include decisions relating to inventory/stocks management and extending credits.

(ii) **Management Control** is concerned with the effective and efficient use of resources for accomplishing organisational objectives. Middle managers deal with semi-structured decision; involving management control. For example, budgeting, developing human resources practices, deciding on research projects and product improvement are management control activities.

(iii) **Strategic Planning** is concerned with establishing organisational objectives and policies for accomplishing those objectives. Top management faces unstructured and semi-structured decisions involving strategic issues. Examples include:

- setting financial and accounting policies
- developing new product lines and
- acquiring new businesses.

1.7 DATA REPRESENTATION IN A COMPUTER

The introduction of computer technology into information systems compels us to learn how data/information are transformed or coded to facilitate their storage and processing in the computer – based information system (CBIS).

There are two types of data, namely characters and numbers.

A character is an alphabet or any special symbol (such as punctuation marks).

For example, the character set includes

a) the 26 uppercase alphabets, A,B,C,D,E,….., Z;

b) the 26 lower case alphabets a,b,c,d,e,……,z;

c) the punctuation marks such as . , ; : (see the standard keyboard); and

d) the special symbols such as ! ^ * + - _

A number is composed of digits and there are 10 of such digits namely 0, 1 ,2, 3, 4, 5, 6,7, 8, 9 in the decimal number system. Examples of decimal numbers are 5.1, 126, 5897. A data that is a string of alphabets and numbers is called an alphanumeric.

1.7.1 External and Internal Data Representation

a) **External data representation:** This is the representation of data in the usual normal language of the user. For example, the use of English alphabets to represent characters. When documents are presented for coding and processing, the data in the document is in external representation for the computer.

b) **Internal Data Representation:** Physical devices used to store and process data in computers are two-state devices as we have in:

i. Punched cards. The two states are the presence and absence of a hole on the card.

ii. Magnetic devices: The two states are achieved when a magnetic surface is magnetized in either one of two opposite directions.

iii. Conducting devices: The two states are achieved when the material is in conducting mode or non-conducting mode, as in semi-conductors.

Thus, all data to be stored and processed in computer are transformed or coded as strings of two symbols, one symbol to represent each state. For convenience, let us denote the two different states by 0 and 1. In punched card phenomenon, 0 represents a punched hole and 1 represents not punched.

In magnetic devices, 0 represents magnetic aligned left to ~~right~~ →

(S ← N)

and 1 represent magnetic poles aligned right to left (N S).

In conducting devices (such as diodes) 0 represents conducting 1 represents non- conducting mode.

In general, for any switch (i.e. a device that can exist in two states), let 0 represent OFF and 1 represent ON.

c). **BIT:** These two symbols 0 and 1 representing binary digits (base two numerals), each of which is called a BIT.

Thus, a bit is the smallest unit of data in a computer system.

The string of bits is then used to code data in a computer. The number of bits in each string will depend on the technology (i.e. architecture) of the computer involved. For example, in a 2-bit computer, each character is represented by 2 bits.

The possible characters then are 00 01 10 11

Thus, the maximum number of characters that can be processed by a 2-bit computer is 4, i.e. 2^2.

For a 3-bit computer, the maximum number of characters that can be processed will be 2^3

= 8, and the possible unique representation of the characters is 000 001 010

011 100 101 110 111

For a 4-bit computer, the maximum number of characters that can be processed will be 2^4

= 16 and the possible unique representation of the characters is
In the normal usage of data, there are

- 26 upper case alphabets;
- 26 lower case alphabets;
- 10 decimal number digits; and possibly
- 36 other special characters.

Hence, in standard usage of data, we need a computer that can process at least

(26 + 26 + 10 + 36) = 98 unique characters.

For such an n-bit computer, $2^n > 98$
and n = 7 since $2^7 = 128$ and 2^6
= 64.

Hence a computer in which each unique character is represented by a string of 7 bits is adequate to code the 98 characters in normal usage.

In order to facilitate the exchange of recorded data between computers, coding of characters has been standardized. The standard coding form in which each character is coded using 7 bits is known as ASCII (American standard code for information interchange)

Another standard coding form (International Business machines corporation) developed by IBM in which each character is coded using 8 bits is known as EBCDIC (Extended Binary coded Decimal Interchange (code).

In the case of BCD (Binary coded Decimal) coding form, each character is coded using a string of 4 bits.

A byte is a string of bits used to represent a character.

For the BCD, a byte is made up of 4 bits. For the ASCII, a byte is made up of 7 bits while for the EBCDIC a byte is made up of 8 bits.

d) **Definition of a Byte:** In normal practice, a byte is defined as consisting of 8 bits i.e. 1 byte = 8 bits. This is the standard definition of a byte. It is a representation of a character which could be an alphabet, digit, or special character, ie a character is made up of 8 bits.

A WORD is defined as a combination of 2 bytes. i.e. 1 word = 2 bytes

In information technology, $2^{10} = 1024$ is called a kilo. For easy of calculation, 1 kilo is taken as 10^3 which is a close approximation to 2^{10}.

We now present higher dimensions of the byte

1000 bytes	=	10^3 bytes	=	1 kilobyte = 1KB
10^3 KB	=	1 Megabyte	=	1MB
10^3 MB	=	1 Gigabyte	=	1 GB
10^3 GB	=	1 Terabyte	=	1 TB

1.7.2 Data Train or Data Stream

In the ASCII coded form, the following characters are coded as

A $\longrightarrow$ 1000001

E $\longrightarrow$ 1000101

J $\longrightarrow$ 1001010

T $\longrightarrow$ 1010100

SPACE $\longrightarrow$ 0100000

M $\longrightarrow$ 1001101

O $\longrightarrow$ 1001111

→ • 0101110

Then the internal computer representation for

M.O. AJE is

1001 101	0101 110	1001 111	0101 110	1000 001	1001 010	1000 101

Figure 1.3

Observe that the punctuation marks (full stops) following the letters M and O are also coded. Figure (1.3) is known as a data train/data stream. Thus, a stream is a sequence of characters that flow into or out of a process. Each stream is either an input stream or output stream for the process.

1.7.3 Representation of Integers:

Decimal integers are also represented in the computer in the binary form as a string of bits. A number in binary form is said to be in base 2. Given a binary equivalent of a data (i.e. character or number), the leftmost bit is called the most significant bit while the rightmost bit is called the least significant bit.

For example, in 10010 the leftmost bit 1 is the most significant bit while the rightmost bit 0 is the least significant bit. Conversion of decimal numbers to binary numbers and vice versa is done automatically by the computer. Let us illustrate how this is done manually.

Example 1: Convert the decimal number 4903 to a binary number.

Solution: Dividing the given number by 2 continuously and recording the remainder after each division are as follows:

2	4903	
2	2451	R1
2	1225	R1
2	612	R1
2	306	R0
2	153	R0
2	76	R1
2	38	R0
2	19	R0
2	9	R1
2	4	R1
2	2	R0
2	1	R0

Then

$4903_{ten} = 1001100100111_{two}$

Note that the result is recorded from bottom to top following the direction of the arrow.

Example 2: Convert the decimal number 29 to a binary number

Solution

2	29	
2	14	R1
2	7	R0
2	3	R1
	1	R1

Hence

$29_{ten} = 11101_{two}$

1.7.4 Conversion of binary numbers to Decimal numbers

A binary number is converted to a decimal number by attaching weights to each position and sum the products of the weights and the bits. The weights are 2^0 (=1), 2^1, 2^2, 2^3, 2^4, etc starting from the right most bit to the leftmost bit. Given the binary number

1 11 0 1

Left most bit right most bit

Then the decimal number is

$1x2^0 + 0 \times 2^1 + 1 \times 2^2 + 1 \times 2^3 + 1 \times 2^4$

$= 1 + 0 + 4 + 8 + 16$

$= 29_{ten}$

Example (3): Convert 100111 to a decimal number.

Solution

$100111_{two} = 1 \times 2^0 + 1 \times 2^1 + 1 \times 2^2 + 0 \times 2^3 + 0 \times 2^4 + 1 \times 2^5$

$= 1 + 2 + 4 + 0 + 0 + 32$

$= 39_{ten}$

1.7.5 Computer Representation of Fractions

Decimal fractions are interpreted as follows:

For example

$0.625_{ten} = 6 \times 10^{-1} + 2 \times 10^{-2} + 5 \times 10^{-3}$

Decimal point

In the same way, binary fractions are interpreted

as: for example

$0.1101_{two} = 1 \times 2^{-1} + 1 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4}$

Binary point

$= \frac{1}{2} + \frac{1}{4} + \frac{0}{8} + \frac{1}{16}$

$= 0.5 + 0.25 + 0 + 0.0625$

$= 0.8125$

Decimal point

Let us now see how to convert a decimal fraction to binary fraction. We first observe the following:

$\frac{1}{2} = 0.5$

$\frac{1}{2^2} = \frac{1}{4} = 0.25$ (i.e. 0.5 □ 2)

$\frac{1}{2^3} = \frac{1}{8} = 0.125$ (i.e. 0.25 □ 2)

$\frac{1}{2^4} = \frac{1}{16} = 0.0625$ (i.e. $0.125 \div 2$)

$\frac{1}{2^5} = \frac{1}{32} = 0.03125$ (i.e. $0.0625 \div 2$) etc.

Given a decimal fraction, disintegrate it into the sum of the weights 2^{-1}, 2^{-2}, 2^{-3}, 2^{-4}, 2^{-5} etc i.e. 0.5, 0.25, 0.125, 0.0625, 0.03125 etc

Then the binary fraction has a bit corresponding to each of these weights from the binary point to the right.

Example (4): Covert 0.625 to a binary fraction

Solution: $0.625_{ten} = 0.5 + 0.125$

$= \quad 0.5 + 0 + 0.125$

$= \quad 2^{-1} + 0 + 2^{-3}$

$= \quad 0.101_{two}$

Example (5): Convert 39.8125 to a binary fraction

Solution: First convert the integral part to a binary number before considering the decimal fraction. Now,

Solution

2	39	
2	19	R1
2	9	R1
2	4	R1
2	2	R0
	1	R0

Now, 39 ten= 100111two

$0.8125_{ten} =$

$0.5 + 0.3125$

$0.5 + 0.25 + 0.0625$

$2^{-1} + 2^{-2} + 0 + 2^{-4}$

$(1)(2^{-1})+(1)(2^{-2})+(0)(2^{-3})+(1)(2^{-4})$

□$0.8125_{10} \quad = \quad 0.1101_{two}$

Thus $39.8125 = 100111.1101_{two}$.

1.7.6 Alternative Method of Representing Decimal Fractions

We can utilize a similar algorithm used in the direct method of converting decimal integers to binary numbers to the conversion of decimal fractions to binary fractions. Here, we continuously multiply the decimal fraction by 2 and record the integral part in each case. These sequences of integral parts form the binary fraction starting with the most significant bit.

Example (6): Convert 0.625 to a binary fraction.

Solution: Continuously multiply 0.625 by 2 and record the integral part. 2 x 0.625 = 1.250 Record 1 (most significant bit)

2 x 0.250 = 0.500 Record 0

2 x 0.500 = 1.000 Record 1(Least significant bit) Thus 0.625 = 0.101_{two}

Explanation: Recall that 0.625 = 0.5 + 0.125

= ½ + $^1/_8$

= $1(2^{-1}) + 0.(2^{-2}) + 1.(2^{-3})$ Now

2 x 0.625 = 1 + $1.(2^{-2})$ Record 1

= 0 + 0.500 Record 0

2 x 0.500 = 1.000 Record 1

Example (7): Convert 0.8125 to a binary fraction

Solution

2 x 0.8125	=	1.6250 Record 1
2 x 0.6250	=	1.2500 Record 1
2 x 0.2500	=	0.5000 Record 0
2 x 0.500	=	1.0000 Record 1

Thus

0.8125 = 0.1101two

1.7.7 Elements of a Database

Field

Definition of a Field: A field is a data item or value that contains one or more characters. The field may denote a name, a value a number or an operator**.** Examples are Joshua – the name of a person consists of the following 6 characters;

J O S H U A

Records

Definition of a Record: A record consists of one or more fields, which are normally treated together as a unit when dealing with a file, which can be accessed through a (KEY). For example, information about scores of a student in an examination might constitute a record, with the student's identification number serving as the KEY.

File

Definition of a File : A file is a collection of related records. For example, a record of all Accounting students in a particular class.

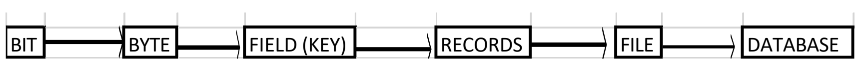
Database

Definition of a Database : A Database is a collection of interrelated files. For example the files of each of our customers is stored in one database.

Debtors files – This consists of records of customers who are owing the company. For each customer, the customer name or PIN is the Key which is a unique identifier of the customer. Each of this item is a BYTE and each BYTE is made up of BITs.

The above interrelationship is represented in the following diagram

Figure 1.5



1.8 DATA ACQUISITION.

This is a general process by which phenomena from the real world is captured and recorded in digital format. The basic elements of a computer-based data acquisition system such as sensors and transducers and final control elements are analog devices and they generate or operate on analog electrical signals. Data acquisition hardware performs the conversion from analog to digital signals and vice-versa. The data acquisition device works in conjunction with a computer such as personal computer that runs the data acquisition software that processes and records the data.

The major function of data acquisition system is data conversion from analog signals to digital format and vice- versa. Two steps are involved in the conversion: representing the continuous values of the analog signal using a set of discrete values and representing these discrete values by bit sequences. Analog- to-Digital and Digital- to- Analog conversion provides the interface between the analog world and the world of digital computations and processing.

1.9 DATA CLEANSING

Data collected from the various resources may be dirty and this will affect the accuracy of predicted results. Data cleansing offers a better data quality which will be of greater help for the organization to make sure their data is ready for analysis. Data cleansing process mainly consist of identifying errors, detecting errors and correct the errors. In other words, the major aim is to improve the quality of data by identifying and removing errors and inconsistencies. Since businesses rely on data like Customer Relationship Management and Supply Chain Management, it is important for them to have excellent quality data in order to achieve more precise and useful results.

What is Data Cleansing?

Data Cleansing is an operation that is performed on the existing data in order to remove anomalies and obtain the data collection that is an accurate representation of the real world. It involves eliminating the errors, resolving inconsistencies and transforming the data into a uniform format.

Data Cleansing process is complex and consists of several stages which include:

---specifying the quality rules;
---detecting data errors; and
---repairing the errors.

The challenges of Data Cleansing include: incompatible data formats, incomplete data, non-aligned data structure and inconsistent data. All these can affect the analysis results. Data Cleansing is frequently common when using Big Data.

Benefits of Data Cleansing

1. There is removal of errors when multiple sources of data are at play.

2. Fewer errors make for happier clients and less frustrated employees
3. Ability to map the different functions and what your data is intended to do.
4. Monitoring errors and better reporting to see where errors are coming from; fix incorrect data for future applications
5. More efficient business practices and quicker decision making is enhanced.

1.10 DATA ANALYSIS

In years back, Quantitative and Qualitative data are analysed manually. Nowadays, due the advent of sophisticated and powerful software has made data analysis more convenient and easier. Earlier, the software which could only run on large Mainframe can now run with considerable ease on personal computers. Statistical Package for Social Sciences (SPSS) is one of such software that is used for educational researches. SPSS can analyse large computer data files with thousands of variables on your PC without compromising the quality and the precision of analysis. Other packages (software) used for data analysis include: Statistical Analysis System (SAS) which is used for Quantitative analysis and NUDIST that is used for Qualitative analysis

1.11 COMPUTER SYSTEMS

1.11.1 Evolution Of Computers (Hardware Only)

An easy way of understanding the evolution of computers is to look at them from the point of view of generations as stated below;

- First Generation (1939-1954) - vacuum tube
- Second Generation Computers (1954-1959) - transistor
- Third Generation Computers (1959-1971) - IC
- Fourth Generation (1971-Present) - microprocessor
- Fifth Generation (Present and Beyond)

1. First Generation (1939-1954) - Vacuum tube

The main features of first generation are:

- These computers used vacuum tube technology.
- They were very unreliable for data processing.

- They supported machine language only.
- They were very costly.
- They generated lot of heat requiring huge air conditioners.
- Their input and output devices were slow
- Huge size.

2. Second Generation Computers (1954 -1959) - transistor

The main features of second generation are:

- the computers used transistors.
- they were more reliable in comparison to first generation computers.
- they were smaller size as compared to first generation computers.
- they generated less heat as compared to first generation computers.
- They consumed less electricity compared to the first generation computers

3. Third Generation Computers (1959 -1971) – Integrated Circuit (IC)

The main characteristics of 3rd generation computers are as follows:

(a) use of Integrated circuits instead of individual transistors.

(b) the computers are smaller, cheaper, more efficient and faster than second generation computers.

(c) they used high-level programming languages.

(d) Storage media was Magnetic storage

1. **Fourth Generation (1971-Present) - microprocessor**

The main features of fourth generation computers are:

- They used VLSI technology used.
- They are very cheap compared to the earlier generation computers.
- They were portable and reliable.
- The computers are personal leading to the name, ‘Personal Computers (PC).
- They used pipeline processing for data processing.
- The 5.25 – inch floppy disk was introduced at this stage
- These computers are microprocessors with memory disks and LCD display

screen

- Word processing, spreadsheet and office automation software was introduced at this stage. It is important to note that the concept of internet was introduced at this stage.

2. **Fifth Generation Computers (Present and Beyond) Nanotechnology**

- These computers are no longer data based but control based. Some other features includes;
- Use of ULSI technology for data processing.
- Development of true artificial intelligence.
- Development of Natural language processing.
- Advancement in Parallel Processing.
- Advancement in Superconductor technology.
- More user friendly interfaces with multimedia features

1.12 Type of Computers

A computer system can be defined as a data processing machine that is under the control of stored programs which automatically accepts and processes data, and supplies or stores the result of that processing.

The key elements in the definition are that a computer is an electronic machine that

(a) accepts data,
(b) processes the data into information using the logic applied by the end-user,
(c) stores or supplies the information and
(d) Make information available to end users

1.12.1 Classification of Computers:

One way to classify computers is the way data is represented in the computers. This classification is as follows:

(a) Digital computers are those in which data and information are represented in digital form by a coded set of electrical pulses. Examples are programmable calculators, mainframe, minicomputers and micro computers.

(b) Analog computers are those in which data and information are represented in a more direct manner by a physical quantity that is proportional to it or to its defined function. Examples include thermometer, pressure gauge, and voltmeter.

(c) Hybrid computer consists of the combination of both the digital and analog computers connected together in a single system. They combine the high speed of the analog computer with the flexibility of the digital computer. They are mostly found in scientific and technical applications.

1.12.2 Comparison of Digital and Analog Computers

Digital computers have the advantage of accurate output, high arithmetic speed particularly in the solution of mathematical problems and mathematical modelling, ease of programming and coding.

Analog computers are very cheap and have the advantage of high speed of output but the output may not be accurate. Most of the computers in use today are digital computers.

1.12.3 Classification of Digital Computers

Digital computers are classified as

(a). General – purpose; and

(b). Special – purpose

General-purpose digital computers are those computers which are completely programmable and can be used to perform a variety of numerical calculations and business problems.

Special-purpose computers are designed for special type of application and have their programs pre-written.

a. Digital General Purpose Computers

The computers used in the homes, schools, offices and for business applications are digital general purpose computers.

These computers are generally classified according to their processing power, memory capacity and the number of peripherals that can be simultaneously supported such as:

(i). Supercomputer; (ii). Mainframes;

(iii). Minicomputers; and (iv). Micro computers

However, the rapidly changing technology has made this traditional classification very difficult. In fact, today, many super microcomputers are more powerful (in terms of processing speed) than the minicomputers so we can at best use the following features for the classification:

- Processing power;
- Memory capacity;
- Heat evolution;
- Environment in which the computer is used;
- Cost;
- Security measures put in place in the environment;
- Installation procedure;

1. Maintenance inter-periods;
2. The number of peripherals that can be simultaneously supported;

- Word size;
- Bus size;
- The capabilities of the peripheral devices, and
- The extent of usage.

A word size is the number of bit of data that can be processed in one cycle. Now 128 bit microprocessor chips are in use.

The processor power is the overall power and speed of a microcomputer, which is the frequency of the processor's electronic clock, that is, how many cycles a computer can execute per second, which is mea8sured in Hertz. Also, the Bus size is the number of bits transmitted at one time from one computer location to another.

We now give brief descriptions of these computers (in itemized form).

i. Super Computers

These are computers which are generally more powerful than the mainframe computers. They make use of parallel processing. They are more expensive than the mainframe computer and can work at extraordinary fast speeds and are exceptionally accurate. These features make them to be used for

a) Computer – generated movies and commercials; and

b) Weather forecasting and structural modelling.

Major disadvantages are that it requires highly trained staff for its operation and its software is poor.

ii. Mainframe

- It is very expensive;
- It is a large system;
- It is used mainly by large multinational companies;
- It is capable of handling multiple simultaneous functions such as batch- processing, and interactive processing under the control of operating system;
- It supports a wide range of peripheral equipments e.g. high speed storage devices and communication line;
- It evolves large quantity of heat;
- It is normally housed in air-conditioned rooms surrounded by security measures and run by a team of professional operators;
- It can run for several uninterrupted hours; and
- It has a large primary memory (in the order of 128Mb) with several disk units each with a capacity of 3-6 T.

iii. Mini Computers (or Minis)

- Smaller in size than a mainframe;
- It has a low cost compared to the mainframe;
- It is easier to install but still by a professional;
- Used by medium-sized companies;
- Its use has no complex management structure;
- Can be used in networking; and
- It is used for engineering and scientific applications.
- Its capabilities are lower than that of a mainframe but higher than that of a micro computer.

iv. Microcomputer

- It is used as part of a network;
- It is very small in size (usually placed on table), but now in smaller sizes in the form of laptop, pocket form etc;
- Consists of a processor on a single silicon chip mounted on a circuit board together;
- Has a keyboard to enter data and instructions;
- Has a screen also called monitor, or VDU (Video Display Unit) to display Information;
- Has interfaces for connecting peripherals (e.g. graph plotters, cassette units, disc drivers, light pen, mouse, joystick etc.);
- Has a small word length size (32 bits);
- It is the cheapest in the range of computers;

- It operates under normal room condition;
- It can be operated by unskilled users; and
- It can be installed by unskilled users.
- It is used as stand-alone computers and midi computer.

j. Special Purpose Digital Computers

These computers are designed to carry out dedicated operations only.They are meant to handle a very narrow category of data processing activities e.g.

- Video Games
- Air Traffic Control
- Sales of petrol from the tank
- Robot for processing control in an industry
- Metrological station for weather forecast

These computers are often installed in devices whose functions are completely unrelated to computing e.g.

- Microwave oven
- Television sets
- Compact disc
- Digital camera
- Video set
- Petrol Gauge

The programs (i.e set of instructions) in a special purpose computer are permanently installed in the computer.

1.13 Type of Micro computers

Microcomputers are personal computers designed to be used by one person at a time.

Classifications within their category includes;

- **Desktop computer**

  These are the most common types of Microcomputers and are designed to fit into the surface of a desk or workplace. They are designed to complete complex operations in addition to having each component such as the mouse, keyboard and screen separate from the main unit and simply attached by wires.

- **Mini tower**

  This is a version of the desktop computer but has a smaller main unit or tower. This not only means it takes up less space on a surface or desk but is designed to stand upright on any surface, whereas a desktop computer tower is designed to lay flat with the screen often on top.

- **Workstation**

  These are expensive, high end personal computers that have powerful calculating and graphics capabilities. They are frequently used by engineers for product design and testing

- **Notebook Computers**

  These can be as small as a physical notebook, hence their name. They can be great for commuters as they are still powerful but very easy to carry about in your bag.

- **Laptop**

  Bigger than a notebook and heavier but still portable. As their name suggests, they were built to fit on someone's lap to enable the user to type and use anywhere simply by placing it on their lap.

- **Palm Top Computers**

  These contain several built-in or interchangeable personal information management functions such as a calendar to keep track of events, an address and phone file and a task list of things to do. Palmtop computers do not have disk storage devices but with non-standard keyboard (not arranged or sized like a typewriter).

- **Pen Computers**

  These are specialized portable computers that use a pen-like device to enter data. They can be used to write information on a special input screen and can be used as a pointing device to select processing choice presented on a screen. Pen systems have special software that allows the system to recognize handwritten input.

  A type of small pen input system is called the Personal Digital Assistant (PDA) or Personal Communicator. Pen computers are designed for workers on the go and often have built-in communication capabilities that allows the PDA to use voice, fax or data communicators.

1.14 CHAPTER SUMMARY

Business organization is an example of an open system which interacts with its environment for the exchange of information. The elements or subsystems of a system interact with themselves and the extent of interaction determines the coupling or decoupling of the system. Every open system needs a form of control which is implemented either as a feedback or a feed forward control system. Data are raw facts, while information is the processed data. Data and information are represented in the computer in binary form. The smallest element of data is called a bit and 8 bits make a byte, which is a character or digit number.
These bytes make up a field, leading to records, files and databases.

We discussed the evolution of Computer systems over a 5 generation period. This is in addition to classifications based on their sizes, processing powers and storage capabilities.

1.15 MULTIPLE - CHOICE QUESTIONS (MCQ)

1. Which of the following is a personal Computer?
   - A. Mainframe
   - B. Supercomputer
   - C. Minicomputer
   - D. Microcomputer

E. Computer chips

2. Semi-conductor memory is made from

A. Silicon chips

B. Mercury chips

C. Memory chips

D. Core chips

E. RAM

3. Micro processor consists of………………………….

A. Main memory and computer processor

B. Arithmetic Unit

C. Logic unit

D. Control unit

E. Computer program

4. Which of the following is not a kind of data?

A Text

B Picture

C Voice

D Information

E Signal

5. Which of the following is **NOT** an example of data transformation

A Scores on examination paper

B Teacher collates marked examination paper

C Examination scores entered into score sheets

D Score sheets given to the class teacher

E Calculation of the total and average scores of each student

6. The type of system in which the various states and activities follow each other in a predictable manner is

A Stochastic system
B Adaptive System
C Cybernetic system
D Probabilistic system

E Mechanistic System

7. The following are the basic elements of control in a business system EXCEPT

A Planning

B Leading

C Collecting Facts

D Comparison

E Corrective Actions

8. Which of the following is not a quantitative information

A Variation of tolerance of finished goods

B Annual sales of production company

C Variation in the wages of low level staff in an organisation

D Price of goods

E Number of hours worked in a production line

9. The external environment in an organization consists of…………………….

A. All forces outside the organisation

B. All buildings outside the organisation

C. All functions outside management activity

D. All functions outside technical activity

E. Competitors' actions

10. The transformation process of a system consists of input, process and which of the following?

A. Action

B. Integration

C. Delivery

D. Output

E Storage

11. The essence of decoupling is to allow subsystems more _____________

A. efficiency

B. Effectiveness

C. independence

D. Adaptability

E. Probability

12. The distinguishing features of a deterministic system is _______________

A. hardness

B. Control

C. Feedback

D. predictability

E. Adaptability

13. The system that has the ability to change itself or its environment in order to survive is called __________ system.

A. Stochastic

B. Adaptive

C. Mechanistic

D. Probabilistic

E. Deterministic.

14. Data is transformed to information through which of the following?

A. Sorting

B. aggregation

C. integration

D. Control

E. processing

15. The meaningful data the results from the processing of unorganized data is called ___________

A. Information

B. Program

C. Data

D. Megabyte

E. Software

16. Which of the following computer is NOT considered as portable?

    A. Laptop computer
    B. Minicomputer
    C. Notebook computer
    D. Pen Computer
    E. Palmtop computer

17. A word of storage is made up of which of the following number of bits?

    A. 8
    B. 2
    C. 16
    D. 32
    E. 64

18. Which one of the following represents the binary equivalent of the decimal number 23?

    A. 01011
    B. 10111
    C. 10011
    D. 11001
    E. 10101

19. A data item that consist of one or more characters is known as ___________

    A. record
    B. File
    C. Field
    D. Bit
    E. Database

20. Which of the following is the decimal equivalent of the binary number 1010101?

    A. 85
    B. 87
    C. 105
    D. 81
    E. 89

21. The combination of 4 bits of memory is referred to as __________

A. Byte

B. Word

C. Nibble

D. Double word

E. Kilobyte

22. A standard coding form developed by IBM in which each character is coded using 8 bits known as?

A. EDCDIC

B. BCD

C. ASCII

D. Octal

E. Hexadecimal

23. The major character of third generation Computer is which of the following?

A. Use of vacuum tubes

B. Use of integrated Circuits

C. Use of Transistors

D. Use of Very large Scale Integrated Technology

E. Use of machine Language for programming

24. Which of the following is NOT an operation designed for special purpose digital computers

A. Video Games

B. Air Traffic control

C. Metrological station for weather for cash

D. Robot for processing control in industry

E. Application programs for solving problems

25. Which of the following is **NOT** a basic element of control in business system?

A. Planning

B. Collecting facts

C. Comparison

D. Leading

E. Corrective action

26. The smallest unit of data in a computer system that is addressable is

B. Byte

C. Word

D. Nibble

E. Character

27. Which of the following is NOT one of the main features of first generation computers?

A. Support Machine language only

B. Computer uses transistors

C. Computers are very costly

D. Huge in size

E. Generates lot of heat

28. Which one of the following is NOT a feature used for classification of computers?

A. Complexity of the computers

B. Processing power

C. Memory capacity

D. Cost

E. Word size

29. Which one of the following is NOT a subset of a database?

A. Record

B. Field

C. Bit

D. Text

E. Data item

30. Which of the following is not attribute of a good information?

A. must be relevant

B. must be in coded form

C. must be timely

D. must be reliable

E. must be simple and understanding

31. Which of the following is NOT an example of data transformation?

A. scores recording on examination paper

B. Teacher collated examinations paper

C. Entering of examination scores into score sheet

D. Score sheets given to class teachers

E. Calculating of the totals and averages scores of each students

32. 10 bytes in computer is known as

A. Megabyte

B. Kilobyte

C. Terabyte

D. Records

E. Gigabytes

33. Which of the following is NOT an advantage of using computers?

A. It increase errors

B. It enhances accessibility

C. It required large sum of money

D. It arranges data according to a specific order

E. It saves time of recall when information is needed quickly

1.16 SHORT-ANSWER QUESTIONS

1. A special purpose digital computer used in the production of office document is called……………………
2. An output organized in a meaningful fashion prepared for both internal and external use is called…………………..
3. The collection of people, hardware, software, communication

networks and data resources that collects, transforms and provide information to managers for timely decision making is called _____

4. An audible sound coming from the speaker when an audio CD disc is played on the computer is an example of _ ____________________

5. The major component of first generation computers is ______________

6. The type of computer that can process both analog and digital data is known as ________

7. EBCDIC stand for ____________

8. ASCII stand for ______________

9. The measure of the degree or extent of the dependence of the subsystems on one another is referred to as ________________

10. A system that does not interact with other systems or its environment either for exchange of information of business transaction is called _____________

11. The basic elements of control in a business system are planning, collecting facts, comparison and ________

12. The control system where control is exercised by part of the output being feed back into the system as input is called ________________

13. The type of information that deals with the magnitude of variables and absolute values is known as ______________

14. The type of planning concerned with establishing organizational objectives and policies for accomplishing these objectives is called ______________

15. The category of computer system consisting of both the Analog and Digital computers connected as a single unit is called _____________

16 A rearranged and refined basic fact is regarded as ___________

SECTION B (THEORY)

1. a. Give two examples in each of Qualitative information and Quantitative information

SOLUTION

Examples of Qualitative information include:

i. Standard finished products

ii. Variation of tolerances of manufactured parts or products

Examples of Quantitative information include:

i. Annual sales of a production company
ii. Variation in wages of low-level staff in an organization
iii. Price of goods
iv. Number of hours worked in a production line

2. State any FOUR constraints that can restrict the objectives of profit maximization in a business system

SOLUTION

a. Scarcity of key resources like cash and skilled labour
b. Technological constraints limiting what goods and services can be produced
c. Economic constraints
d. Political and legal constraints
e. Product completion time
f. Responsibility towards society and for preserving the environment from pollution

3. Enumerate the aspects through which subsystem can be differentiated from one another

SOLUTION

a. Function (e.g manufacturing system, there is production, finance, marketing, sales, personnel, etc)
b. Space e.g Northern area and southern area sales managers
c. Time e.g. morning shift, afternoon shift and evening shift
d. People e.g skilled and unskilled
e. Formality – various ways of getting information
f. Automation – various processes carried out by the computer system

4. Enumerate any FOUR distinctions between data and information

SOLUTION

DATA	INFORMATION
a. Data is raw and unchanged fact	Information is an organized and sorted fact
b. It serves as input into the computer system	It serves as output from the computer system
c. Observation and recording are done to produce data	Analysis of data are done to obtain information
d. Data serves as the lowest level of knowledge	Information is the second level of knowledge
e. Data by itself is not significant	Information is very significant

5. List any six functions performed by a professional accountant in a business organization.

   SOLUTION

   a. Accounting systems and financial reporting;
   b. Long-term strategic planning;
   c. Managing the accounting and finance functions;
   d. Internal consulting;
   e. Short-term budgeting;
   f. Financial and economic analysis;
   g. Process improvement;
   h. Computer systems and operations;
   i. Performance evaluation;
   j. Customer and product profitability analysis

6. The two types of data that can be inputted or entered into the computer system are characters and numbers. You are required to:
   Enumerate the characters and numbers that can serves as input data into the computer

   SOLUTION

   a. Uppercase alphabets: A, B, C,…..Z

b. Lowercase alphabets: a, b, c,……z

c. Punctuation marks: , . ; ?

d. Special symbols such as !, ^, *, +, -

e. Digits: 0, 1, 2….9

7. Decimal numbers can be converted to binary numbers with ease. You are required to

a. convert the decimal number 1297 to binary

b. convert the binary number 10111011 to decimal

SOLUTION

2	**1297**	**R**	
2	648	1	
2	324	0	
2	162	0	
2	81	0	
2	40	1	
2	20	0	
2	10	0	
2	5	0	
2	2	1	
2	1	0	
	0	1	

Therefore, $1297_{ten} = 10100010001_{two}$

b. 10111011_{two} to decimal number

$= 1x2^7+0+1x2^5+1x2^4+1x2^3+0+1x2^1+1x2^0$

$= 2^7+0+2^5+2^4+2^3+0+2^1+1$

$= 128 + 32 + 16 + 8 + 0 + 2 + 1$

$= 187_{ten}$.

8. Database is made up of elements. You are required to:

a. Define:

i. Bit

ii. Character

iii. Field

iv. Record

v. File

vi. Database

b. Indicate how the elements of database in (8a) are related

SOLUTION

a. i. Bit – Binary Digit 0 or 1

ii. Character: A combination of 8bits

iii. Field: Data item/value that contains one or more characters e.g. name

iv. ` Record: Consists of one or more fields and treated as a single unit

v. This is a collection of related records

vi. Database: This is a collection of interrelated files

b. The elements of database above are related as below:

Bit(s) → Character(s) → field(s) → record(s) → file(s) → database.

9. Enumerate any FOUR main characteristics of third generation computers

SOLUTION

a. The use of integrated circuit (IC) instead of individual transistors

b. The computers are smaller, cheaper, more efficient and faster than second generation computers

c. Use of high-level-languages (e.g. Fortran, cobol)

d. Storage media becomes magnetic storage

10. State any FIVE types of microcomputers

SOLUTION

a. Desktop computer

b. Mini tower

c. Workstation

d. Notebook computers

e. Laptop computers

f. Palmtop computers

g. Pen computers

11. State and explain the function of each of the 5 basic sections of a typical accounting information system (AIS)

SOLUTION

1. Expenditure – consists of the activities involved in buying and paying for goods and services used by the organization

2. Production – consists of the activities involved in converting raw materials and labour into finished products (as in manufacturing)

3. Human resources – consists of activities involved in hiring and paying employees payment for those

4. Revenue – consists of the activities involved in selling goods and services and collecting sales

5. Financing – consists of activities involved in obtaining the necessary funds to run the
organization and in repaying creditors and distributing profit to investors.

Solutions to Multiple Choice Questions.

1. D
2. A
3. A
4. B
5. A
6. E
7. B
8. A
9. A
10. D
11. C
12. D
13. B
14. E
15. A
16. B
17. C
18. B
19. C
20. A

21. C

22. A

23. B

24. E

25. D

26. B

27. B

28. A

29. D

30. B

31. A

32. C

33. C

Solutions to Short Answer questions

1. Word Processor
2. Information
3. Information System
4. Information
5. Vacuum Tubes
6. Hybrid
7. Extended Binary Code Decimal Interchange Code
8. American Standard Code for Information Interchange
9. Coupling
10. Closed system
11. Corrective Action
12. Closed –loop
13. Quantitative Information

14. Strategic
15. Hybrid computer
16. Information

CHAPTER TWO

HARDWARE FUNDAMENTALS

Chapter Contents

a. Block diagram of the hardware system

b. Input Devices;

c. Output Devices;

d. Storage Devices

e. Central processing Unit

f. Application Controls

2.0 OBJECTIVES

After reading this chapter, you should be able to:

(a) understand the computer architecture which is referred to as the Block-diagram of the hardware system

(b) the auxiliary and peripheral components of the hardware

(c) the input devices

(d) the Output devices

(e) the central processing unit

(f) the internal and external storage

(g) differentiate between the direct and indirect input systems

(h) differentiate between the impact and non-impact output devices

(i) differentiate among RAM and the various forms of ROM

(j) Understand the different aspects of control using input devices, Control using output devices and control in the storage media.

2.1 COMPUTER HARDWARE STRUCTURE

A Computer System consists of three broad components: the Hardware, the software and the human ware. The hardware is the physical unit, which is the connection of electronic components of the computer system.

The software is the suit of programs which are processed by the hardware and allows the hardware to function effectively and efficiently. A program is a sequence of instructions written in a particular computer language, which is carried out by the hardware to solve a given problem.

The human ware consists of people who operate and maintain the computer system. Since no computer system can function without human beings no matter how remotely controlled, human-ware is omitted for now.

2.1.1 Hardware Components

The hardware is divided into two major components: The central processing unit (CPU) and the support devices (see figure 2.1)

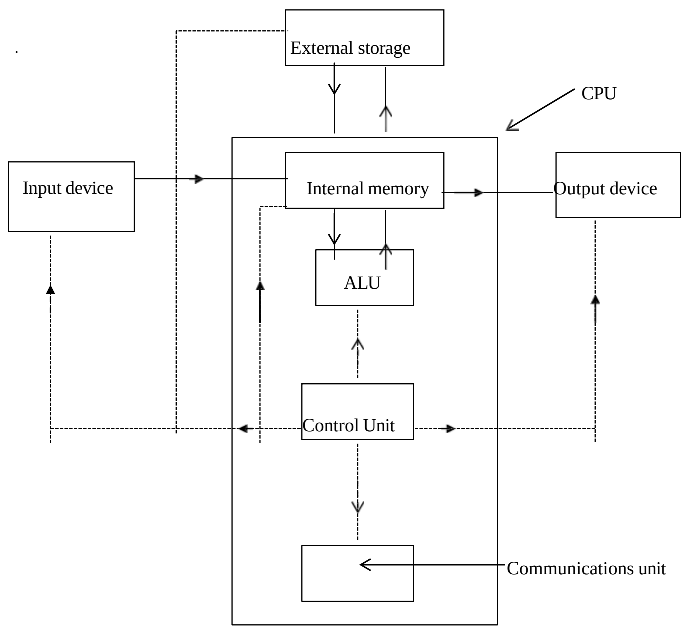


Fig. 2..1 Functional Components of the Hardware

Key: ⟶ Data signal transfer

- - - -> Control signal

The CPU consists of the processor and the primary memory. Working in concert with the processor during processing is the primary memory, which temporarily stores incoming data and processed results for easy access.

The support devices are primarily involved with input, output and/or secondary storage functions. Storage devices provide an area to keep programs and data/information as well as a means to save and retrieve them.

Support equipment is often classified with respect to its relationship with the CPU as either peripheral equipment or auxiliary equipment

2.1.2 Online and Offline Equipment

A support equipment that is currently setup so that it can transmit data to or receive output information from the CPU over a communications line is said to be online (i.e. a support equipment that is connected to the CPU), whereas a support equipment without this capability is classified as offline.

A peripheral equipment is a support equipment that is designed primarily to be used in an online mode.

Examples include

a) communication terminals

b) Printers and VDU

c) Keyboard

An auxiliary equipment is a support equipment that is designed to work in an offline mode. Examples include:

(i) the microfilm reader found in many libraries and

(ii) the data-entry devices that are used in large data processing centres to enter data offline onto a tape or a disk.

2.1.3 Summary of the Elemental Structure of the Hardware

(a) **Input Device** is one which transfers data and programs to the internal memory

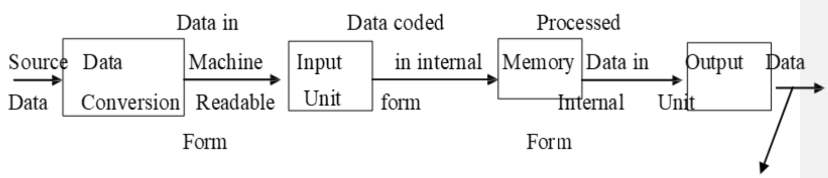
(b) **Central Processing Unit (CPU)** is the main unit of the hardware. It consists of the internal memory, Arithmetic Logic Unit (ALU) and the control unit. It accepts data from an input device, performs instructions specified by the program and results are sent to an output device. The control unit interprets and executes instructions received from the computer system. The processor is the combination of the ALU and the Control unit.

(c) **Output Device** receives the results of processing from the processor.

(d) **Storage Device** is an external (bulk) auxiliary device providing for the storage of records and programs until required for the processing activities.

2.2 COMPUTER INPUT UNIT

Data to be stored or processed in a computer system is first converted to a form (machine readable form) which can be read by an input unit. The data in machine readable form is read by an input unit, transformed to appropriate internal code and stored in the memory (see fig 2.2)



Transformed to a readable form

Fig 2.2 Data Entry System

2.2.1 Direct and Indirect Input Devices

Data input is categorized into direct and indirect.

The term “direct” means that data is in a form suitable for processing without the need for data conversion. Examples of data input devices that produce direct data input include optical mark reader (OMR), Magnetic Ink Character Reader (MICR), Optical Character Reader (OCR)

Examples of systems that need data conversion include punched card, barcode, tag and paper tape. In these systems, the data they contain is usually converted to magnetic media prior to being input for processing.

The term “direct” means that data is in a form suitable for processing without the need for data conversion. Examples of data input devices that produce direct data input include optical mark reader (OMR), Magnetic Ink Character Reader (MICR), Optical Character Reader (OCR)

Examples of systems that need data conversion include punched card, barcode, tag and paper tape. In these systems, the data they contain is usually converted to magnetic media prior to being input for processing.

2.2.2 Categories of Input Media

The input media can be categorized as follows:

(a). Tags / barcode systems

(b) Punched cards/paper tape systems

(c) Magnetic media

(d) Optical Media

(e) Voice-input devices

(f) Imaging devices

The magnetic, optical, voice and imaging devices are direct data entry devices. The direct data entry system has the advantage of source data automation where data is captured electronically at the point where it is penetrated. For example, when a sale is made, source data entry implies that the transaction is recorded immediately in machine-readable form. This means that

i. data is made available quickly for use,

ii. fewer errors are made in data input since there is no manual data transcription

iii. Data integrity and accuracy are enhanced through the use of validation programs in the system

iv. Data can be made available on a real-time basis or on a fast batch turnaround basis.

(a) **Magnetic Media** are systems where data is converted to the machine readable form

(electronic pulses) using magnetic properties, these systems include:

(i) **Keyboard**

The primary input device to the microcomputers is the keyboard, which is a device that contains typewriter- like keys that, when depressed, provide input to the computer system.

The keyboard contains

(i). Alphabetic keys

(ii). Numeric keys

(iii) Punctuation keys

(iv) Arithmetic operation keys

(v) 12 function keys (labeled F1 – F12)

(vi) Control keys and

(vii) Some special symbol keys.

The keyboard is used in conjunction with a screen as an input device.

(ii) Mouse:

This usually contains a rolling metal ball and one or more buttons that can be pressed to execute commands and is used particularly with computers having windows. As the mouse is moved gently around on a flat, smooth surface, the ball rolls and feeds electrical signals to the computer moving the cursor on the screen (The cursor is a screen element, such as a blinking underline character or a small arrow, that points to a particular position at which the next character may be entered on the screen).

The mouse is not designed to replace the keyboard; it merely enhances the user's cursor moving ability.

(iii) Magnetic Ink Character Recognition (MICR)

Here magnetic ink made of ferromagnetic substance is used for printing the characters, designed in a special type font. These characters can be interpreted both by human and machine.

An input device known as a magnetic ink character reader (MICR)/sorter accomplishes magnetic ink character recognition. The technique of MICR is mainly used in banks and other financial institutions for the processing of cheques.

(iv) **Key-to-disk System**

This includes a number of key stations, which enable many operators at one time to read data from source document and encode the data onto magnetic disks. This system verifies data and validates data fields. All these are done under the control of READ ONLY MEMORY (ROM). Data is then transmitted to the mainframe some distance away.

The essential elements of key-to-disk system include the key station, mini-processor, disk drive, tape decks and a supervisor's console for monitoring the status of the system.

(v) **Key-to-diskette System**

Here, a data station is used for recording data onto floppy diskettes. As data is entered, it is stored in a buffer on the data station and displayed on a screen for the purpose of correcting errors before being recorded on a diskette. It also verifies data is set to verify mode.

Input onto a computer system is accomplished by means of an integrated floppy disk unit built into a processor's cabinet or by a free standing floppy disk unit.

(vi) **Joystick:** This is familiar to those who play any electronic arcade games. When attached to microcomputer, the joystick is used much like a mouse but instead of using a rolling ball, there is a moveable stick that is used to position the cursor on the screen. Buttons mounted on the stick or elsewhere on the unit are pressed to execute commands.

(vii) **Magnetic stripe card**

This is a rectangular shaped card on which machine – sensitive data are contained on a magnetic stripe, which is a thin strip of magnetic recording tape stuck on the card. The magnetic stripe card reader converts the information into directly computer – sensitive form. It has applications as bank credit or service cards for use in automated teller machines (ATMs) and bank payment systems.

(viii) **Smart Cards**

This is similar to a magnetic stripe card but the information on a smart card is held on a plastic card for the customer to use at will. It is a plastic card on which is embedded a microprocessor chip, which utilizes Erasable Programmable Read Only Memory (EPROM). Besides basic accounting data, a smartcard would contain a memory and a processing capability. The smart card is used in a similar way like a magnetic stripe card for money transmission. A smart card has the advantage of being much harder to duplicate, and so is more secure than the magnetic stripe card.

b. **Optical Devices**

Input devices that use optical phenomenon include

(i) **Optical Character Recognition (OCR)**

Here, optical characters are designed in a special type font capable of being interpreted both by human and optical scann8ing equipment. Special ink is not required in this case as we have in MICR, for the printing of OCR characters. Optical Characters are often read by a scanner that is attached to another device, such as an electronic cash register. In existence, the most familiar optical code is the barcode, called the universal product code (UPC) found on supermarket goods and on many other retail products. OCR equipment is very widely used in the retail and grocery industries.

The term "point-of-sale" (POS) applies to situations in which optical scanning equipment is used to record purchases for source data entry in transaction processing systems that interface with the consumer. At the hub of any POS system, is an electronic cash register, which is a microcomputer system or communications terminal, which allows data to be transmitted online to appropriate managers.

(ii) Optical Mark Recognition (OMR)

Here, the source document is pre-printed as a turnaround document, with pre-designated column values and a mark in pencilled (graphite), ball point pen or typed line or cross is recorded in the appropriate column. The card is then read by a device (scanner), which senses the graphite in each column using an electric current, and translates it into machine code. OMR is applied in the marking of examinations using multiple-choice questions such as University examinations. A turnaround document is a document that is initially produced by the computer to collect data for the computer and then re-input to the computer for processing. OMR and OCR are turnaround documents.

(c) Source Data Automation

An example of source data automation device is the scanner. Scanners are means of inputting documents to a computer system. A document in the form of text or an image is fed into the scanner, which passes a light band along the page, and the pattern is transferred to the computer. Scanners can be used for document image processing (DIP) or in desktop publishing (DTP) to input an image to the desktop published document.

(d) Light Pen

This is an electronic device in the form of a photo-diode on the end of a cable which is used in combination with a VDU (a display device). It is used to display, modify or detect images on the screen in CAD (Computer Aided Design) applications. This is across the surface of the screen to trace the outline of the image to be displayed. The computer can detect the position of the pen on the screen by counting the number of vertical and horizontal synchronization pulses.

(e) Touch Screen

Some computer systems have display screens that are touch–sensitive. When a finger is pointed at a command displayed on the screen, the command is executed. Touch screen finds applications in:

(i) Factory work, where a factory worker wearing gloves, can point to a selection displayed on a screen to initiate some actions.

(ii) Banks and stores, where untrained or unsophisticated customers, reluctant to read instructions, can interact with the system through the labelling on the touch screen.

f Image Input Devices

An imaging device is a hardware device that is designed to transform graphical images such as drawings, photographs and maps into machine readable form.

(i) Graphic Tablet (or digitizing tablet) is constructed from a sensitive semi -conducting material, which can trace the movement of a stylus forming graphical shapes. The shapes are converted into digital signals, which are input directly into the computer system's memory and sent to the display device.

A cross hair cursor is an imaging device that is used when it is necessary to input such graphical intensive objects as maps, surveys, and designs of floor plans or electrical circuits. It operates similarly to the stylus of the digitizing tablet: An image is digitized and stored as the cross hair on the cursor mechanism passes over it. A keypad on the cursor allows other information such as names to be entered.

Image scanner is another imaging device. It is particularly useful for digitizing images such as photographs and documents upon which important signatures are recorded into the computer memory.

2.3 COMPUTER OUTPUT DEVICES

The primary output devices are Monitor, Printer, MODEM, and loudspeaker. Computer output is categorized as softcopy or hardcopy

A softcopy is a transient message, which will disappear when power is off. It cannot be touched or kept for a long time. It can only be seen or heard. Examples of a softcopy are

- the display on the monitor;
- the information transmitted by a MODEM;
- the sound given by a computer loudspeaker during computer operation.

Computer programs are designed so that the loudspeaker will beep when a mistake is made in entering data or command or when a wrong keypad is depressed.

A hardcopy is a permanent message on paper or other writing material. It can be touched and stored for a very long time. Examples include the output from a printer or a graph plotter.

2.3.1 Advantages and Disadvantages of Display Equipment

Display equipment such as a monitor produces softcopy.

Advantages: The display equipment has the following advantages over the other output equipment e.g. Printers and plotters that produce hardcopy. It

(a) allows easy access to vast amount of data;

(b) does not encourage paper wastage.

Disadvantages

(a) Output cannot be removed from the screen;

(b) the amount of output that can be handled at any one time is limited by the size of the screen and by the rate at which one can flip through screen-sized pages;

(c) One cannot output with a pencil or pen;

(d) One must be physically present at the display device site to see the output it provides.

2.3.2 Category of output Devices

(a) Monitor

A monitor is a display device, which works in conjunction with a keyboard. As noted earlier, a monitor alone is an output device while the monitor and the keyboard together serve as an input device for microcomputers. The monitor is also called

VDU (Visual Display Unit) or (Video Display Unit); or Screen.

The message displayed on the screen is a softcopy. The screen allows users to see what they have typed in and how the system is responding. In a microcomputer, the VDU is connected to a keyboard.

The VDU has the following primary features:

(i) Screen Resolution;

(ii) Colour Presentation; and

(iii) Screen shape;

(iv) VPU (Visual Presentation Unit) is another name for VDU.

- **Screen Resolution**

This refers to the clarity of the images formed on the screen. The display device forms images from tiny dots – called pixels (i.e. picture elements) that are arranged in a rectangular pattern.

The more pixels available to display any image on the screen, the sharper the image is. More pixels imply higher resolution.

- **Colour Presentation**

VDU can be either monochrome or colour. Monochrome display devices output in a single foreground colour (e.g black on a white background).

The colour screens include

(i) VGA – Video Graphic Array

(ii) CGA – Colour Graphic Adapter

(iii) EGA – Enhanced colour Graphic Adapter

(iv) MCGA – Multi Colour Graphic Adapter

(v) SVGA – Super Video Graphic Adapter.

Colour screens allow for better presentation of material because important items can be highlighted. Many display devices can produce both text and graphic outputs. Text output includes alphabetic characters, digits and special characters, while graphic output includes images such as drawings. Output and images maps. Graphics are used for presentation purposes by managers for information – intensive images such as bar chart, pie chart and line charts.

- **Monitor shapes**

Monitors are either the CRT (cathode ray tube) type or flat-panel type.

The CRT type uses a large tube-type element that looks like the TV set. CRT types are bulky and limited in the resolution which they provide but they are rather inexpensive.

Flat –panel display monitor uses either a liquid crystal display (LCD) technology or a gas-plasma technology.

LCD devices use crystalline materials sandwiched between two planes of glass. When voltage is applied, the crystals line up, preventing light from passing through certain areas, and thus producing the display.

In the gas – plasma displays, gas is trapped between glasses to form images. Gas-plasma displays provide better resolutions than LCD. The major advantages of flat –panel display are as follows:

(i) they are lightweight;

(ii) they are compact;

(iii) they provide better resolution than CRT.

(iv) they are modern.

b. Graph Plotter

A plotter is a peripheral device that is primarily used for the output of complicated fine graphical information. It produces hardcopy which can be multicolour. It is used for engineering and scientific applications as well as business presentation graphics. Modern plotters can produce there dimensional and multicolour drawings.

c. Computer Output on Microfilm/Microfiche (COM)

COM is used to store massive data in a compact form. It is often used for archival purposes. The output from the computer, which is alphanumeric or graphics instead of being printed out, is displayed on a high resolution cathode ray tube and then photographed into a very much reduced form – that is a microform. The microform can be in the form of a microfilm or a micro fiche.

A microfilm is a continuous strip, with images formed in frames one at a time, along the strip of the film.

On the other hand, a microfiche consists of separate sheet of film, each sheet containing many frames or "pages" of information. A special microfilm reader is used to read the output. It is easier to read a microfiche with a microfiche reader than a microfilm.

Some microfilm readers also produce a hardcopy using xerographic process.

Advantages of COM

1. Large volume of information can be condensed into a physical storage space.
2. Information can be stored permanently for future use in small space.
3. Film can be indexed by computer to aid in searching for information.
4. Higher speed printout
5. Cheaper output medium for high volume applications
6. Frames can be viewed easily on a special COM reader which projects that image on screen.
7. Microfilm frame or page can be produced on paper or enlarged readable form when and if required.

Disadvantages of COM

The use of Microfilm output device is restricted for the following reasons:

1. Prohibitive price i.e. it is highly expensive

2. There is restricted access to information since it is not readable to the naked eyes.
3. It requires highly trained/ skilled personnel to handle.

d. Printers

These are computer output devices that produce hardcopy. One way of classifying printers is whether or not they make noise during printing.

(i) Impact and Non-impact Printers

Impact printers work by having wires or embossed characters strike a piece of paper or a ribbon, so that a character is formed on a page.

On the other hand, non-impact printers use some quieter method, such as heating, spraying or electrically forming characters onto a page.

Another way to classify printers is the output

quality and the speed of the device such as:

a) Character printers;

b) Line printers; and

c) Page printers.

- **Character Printers** (also called serial printers) print a character at a time and are bidirectional. Examples include Dot-matrix and daisy wheel which are impact printers. The letter quality of the Dot-matrix is enhanced when in "Near letter quality (NLQ)" mode but the speed is now reduced. Unlike the dot matrix, daisy wheel cannot print graphical images, although the output quality is exceptionally high but it is slow.

- **Line Printer** is an impact printer, which prints a complete line at a time. Examples include the chain or barrel printers and the band printers. They are used for large volume printing requirements in mainframes and minicomputers, as they are operated at high speeds.

- **Page Printers** are non-impact printers which, due to their high speed of operation, appear as if a page is printed at a time. Examples of page printers include printers that work by LASER (Light Amplification for the Simulation of Emitted Radiation) technology. In LASER printers, images are formed by charging several dots on a plate with a laser beam. Toner is then affixed to the plate and, when paper comes into contact with it, an image is formed from the toner that adheres to the charged dots. Here, the quality of a daisy wheel is combined with the flexibility of a dot –matrix. It produces a very high quality output material including graphics, but it is more expensive

Page printers are also computers. They contain a processor and a memory. The memory is used to store fonts and forms for automatic document preparation.

- **Ink-jet Printer** is a non-impact, character printer in which electrically charged ink is sprayed onto a page through small apertures (fine nozzle) in a print head to produce images. It is capable of graphical output in multi-colour by means of a selection of ink wells connected to the printing head.

- **Thermal Transfer Printers**

  This is a non-impact character printer which uses thermal electro-sensitive paper, which has a thin coating of aluminium over a black-inked or blue-inked surface. It can be used to produce letter –quality texts and graphics in colour. It is expensive.

2.4 Central Processing Unit (CPU)

The CPU is the brain of the computer system. It is divided into two parts, namely

(a) the processor and

(b) the primary memory

2.4.1 The Computer Processor

The processor consists of the arithmetic – logic unit (ALU) and the control unit

The set of operations that the processor performs is known as the instructions, and this partly determines the processor's speed.

(a) The Arithmetic – Logic unit (ALU) is the part of the processor where arithmetic and logic operations are carried out. The arithmetic operations include

(i) Addition and subtraction,

(ii) Multiplication and division,

(iii) Exponentiation.

The logic operations include:

(i) Comparison;

(ii) Branch operation (a branch operation changes the order of execution); and

(iii) Movement of data.

(b) The control unit (CU) of the processor performs the following operations: it

(i) receives instruction in a program one at a time, from the main memory
(ii) interprets the instructions
(iii) sends out control signals to the peripheral devices (particularly the I/O devices).

The operations of the control unit are coordinated by a clock. The number of pulses (cycles produced per second is measured in hertz (MHZ) and is an indication of the processing speed. Other measures of the processor speed are Mips and Flops. Mips means million instructions per second, which measures the number of MIG (micro instructions) (each of which is executed during one clock cycle) performed per second.

Flops means floating – point operations per second and are used to compare microcomputer speeds.

(c) Central Processor and Specialised Processor

One way to distinguish among computers is whether they possess central or specialized (slave) processor. A central processor does a variety of operations. Such processors are in the microcomputers.

A specialized (or slave) processor is dedicated to perform specialized tasks, such as

(i) Speeding up computation; and

(ii) Providing better graphics.

Slaves are embedded into a peripheral device such as computer key boards, printers and they are under the cover of the computer unit itself.

The development of slaves has led to the development of reduced instruction set computing (RISC) computers, which contain smaller instruction set than the conventional computers, which increase the speed of the processor.

2.4.2 The Primary Memory

This is also called main or internal memory. A memory is made up of a large number of cells, with each cell capable of storing one bit. It contains the following:

(a) Programs which contain instructions that will be used for processing;

(b) Data that have been read from an input device or a secondary storage device;

(c) Intermediate results; i.e. data that are currently being processed or are used for processing other data;

(d) Output information that is ready to be sent to an output device or a secondary storage device.

Data and instructions stored can be addressed and accessed very quickly and hence it is referred to as immediate access storage (IAS). The reasons for holding programs and data in the memory are to speed up processing. The transfer of data, such as program instructions, within memory is slower than the transfer of data between the processor and peripheral devices. It has a small capacity and hence it is complemented by the external storage, which has a larger capacity, but a slower access time.

Data and programs needed for immediate uses are in the main memory while data and program needed for later use are in the backing storage. It must be clear that all data and programs must be resident in the internal memory before processing can take place. The primary memory is produced from silicon chips and is based on metal oxide semiconductor (MOS) technology (also called metal oxide semiconductor field effects transistor technology (MOSFET) and is divided into RAM and ROM.

(a) Random Access Memory (RAM)

This is the larger part of the primary memory and is used for working storage requirement when running application programs i.e. it holds the data and program in current use. Data can be written on to or read from RAM.

RAM has the ability to access any location in the memory in any order with the same speed.

The term "random access" implies that the computer can go directly to any given address within the memory and read or write data there. The time taken to read a symbol from a cell is called read-time and the time taken to write a symbol is called write-time.

Since RAM is the larger part of the memory, the primary memory is loosely called RAM Relative to other forms of memory. RAM is expensive.

RAM is volatile i.e. it loses its contents when the computer's power is shut off. So the data and instructions in RAM are temporary or transient.

Normally, reading a symbol from a cell should leave it undisturbed. Such a cell (memory) is known as one where readout is non-destructive otherwise it is destructive.

(b) **Read Only Memory (ROM)**

A memory is said to be read only if information is permanently written and can only be read. Such a memory cannot be written to. ROM is non-volatile micro programs for I/O operations and the booting programs are kept in ROM.

The following variants of ROM are available:

(c) **Programmable ROM (PROM)**

This can be programmed by the user unlike ROM which is pre programmed by the manufacturer. A special device is required for putting the bit pattern into a

PROM programmer.

(d) **Erasable Programmable ROM (EPROM)**

When data are recorded on EPROM, they are just like ROM in behaviour, but the contents of the ROM can be changed by the use of an ultraviolet light to revert all the cells to '1's. Then new data and programs can be written on the chip. Another important memory is the Cache memory

(e) **Cache Memory**

This is a high –speed memory capable of keeping up with the processing speed of the processor. It acts as a buffer between the processor and the slower primary memory. As the processor is not delayed by memory accesses, the overall speed of processing is increased. The operating system (OS) transfers segments of programs and data from disk backing storage into the Cache buffer.

2.5 External Storage Devices

External storage devices are also called secondary, auxiliary, backing or bulk storage devices. They are used to save (store) programs and data for repeated use. They are non-volatile and have higher capacity than the primary memory. Also they cost far less than the primary memory. A major disadvantage is that they are slower than the primary memory.

Secondary storage involves both the medium and a peripheral storage device or unit. The medium is used to store programs and data, whereas the medium is mounted on the device (or unit) which has the read/write mechanism.

Magnetic and optical technologies are used for the external storage media.

2.5.1 Magnetic Storage Media

These are in the form of disks and tapes.

(a) **Magnetic Disks**

These are smooth metal plates coated on both sides with a thin film of magnetic material. A set of such magnetic plates are fixed to a spindle: one below the other to make up a disk pack. Data is held on a number of circular, concentric tracks on the surfaces of the disk, and is read or written by rotating the disk past red/white heads. A set of corresponding tracks in all surfaces of a disk pack is called a cylinder. The tracks are divided into sectors, and the data on a disk is located by its sector.

Read/write head does not come in contact with the disk surface but floats above it on a cushion of air, preventing wear. During rotation, it is possible for a dust particle to accidentally settle between the surface and the head thus causing a crash. Such a crash will damage the disk surface and the head.

An exchangeable disk medium is commonly called a hard disk. (b)

(b) Winchester Disk

In a Winchester disk, the head assembly in these disks is sealed – in with the disk pack in order to alleviate the problem of crashing caused by dust particles.

Winchester disks are non-exchangeable as they are in sealed units.

Generally, magnetic disks are direct or random access media i.e. records are retrieved in any sequence, independent of the specific addresses of the record.

(c) **Magnetic Floppy Disk (or Diskette)**

A diskette is an exchangeable circular, flexible disk which is made of magnetic oxide –coated Mylar platters. Today, a diskette is available in $3^1/_2$ -inch and $5^1/_4$ -inch diameters, which is held permanently in a rigid plastic case or a square paper sleeve.

The case or sleeve contains identification label for recognizing the disk and its contents. The $3^1/_2$ - inch floppy disk is encased in a hard sleeve for protection and does not feel floppy to handle compared to the $5^1/_4$ - inch floppy disk. The sleeve or case has openings for moveable combined read/write head. The medium is inserted into the disk unit/drive on the CPU casing during Read/Write operations.

The $5^1/_4$ -inch disk is packaged in a square plastic envelops with a long slit for read/write head access, a hole in the centre for mounting the disk drive hub, and a hole for index mark sensing.

Today, the optical media have completely replaced the magnetic floppy disks.

(d) **Cartridge Disk**

This consists of a hard disk packaged into a plastic cartridge. In order to access the data and programs on the cartridge, it must be inserted into the appropriate unit/device.

Cartridges generally have more capacities than Winchester disks. The cartridges are also more secured because they are removable.

(e) **Magnetic Tapes**

A magnetic tape memory is similar to the commonly used audio tape. It is no longer in use since it has been superceded by the disc storage technology which has a higher speed due to direct access nature. Although the speed of the tape is low, it is still useful for archival purposes because of its low cost.

Tapes use serial/sequential access mechanism. The most common is the nine-track tape which is the standard data interchange between PCs and main frames. Out of the nine tracks, eight tracks are used to record a byte of data and the ninth track is used to record a parity bit for each byte. Here, data are recorded in blocks and the distance between two blocks is called inter-block gap (IBG). The block should be at least 10 times as long as the IBG to reduce wastage of tape.

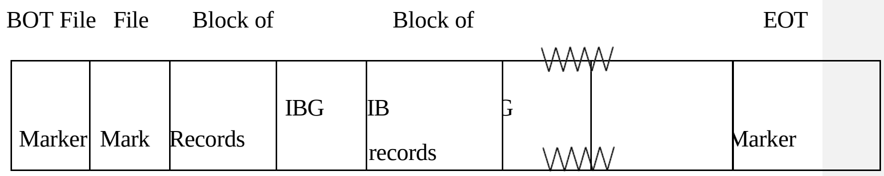


Fig 2.3 File Organisation on a magnetic tape

The beginning of the tape (BOT) is indicated by a metal foil called a marker. When a write –command is given, a block of data is written on the tape and it waits for the next block. The next block is written after the IBG. A series of blocks are written in this manner. The end of tape (EOT) is indicated by an end of tape marker which is a metal tail stuck in the tape. The tape is read sequentially, i.e. the data is read one after the other in the order in which the data has been written hence the data recorded on a tape cannot be addressed.

(f) **Digital Cassette Tape**

This is also used as a storage medium for microcomputers. It is cheap but has a slow speed and data is retrieved sequentially. It is popular because it is easily available.

(g) Streaming Tape

This is used to backup the contents of hard disk and has much higher capacity. It has a high speed and it is inexpensive

(f) Video Tape Recorder

This is a high density backup tape used for the video and audio.

2.5.2 Optical Storage Media

The optical storage media are divided into the flash EPROM and the optical disks.

(i) Optical disks are similar to the compact disk audio system used in the homes; the most common are the COMPACT DISK – READ ONLY MEMORY (CD-ROM), WRITE ONCE READ MANY (WORM) video disk and the magneto-optical disk.

(ii) **CD-ROM Disks**

CD-ROM (compact disk read only memory) allows for the reading of the content of the disk but data on the disk cannot be changed. The data on the disk are pre-recorded and are read by using optical disk unit.

Today, CDs are available which can be written using CD-writer and the data are "burnt in" i.e. the contents of the CD cannot be changed.

CD-ROM has a higher capacity than the magnetic disk and it is more secure than the floppy disk.

(iii) **WORM (Write Once Read Many)**

WORM media allow data to be written onto them but once written, the data cannot be changed. The data can only be read several times.

WORM media are written in sequences i.e. access is sequential. They have a very vast capacity and it is not possible to erase data on a WORM medium. It is very ideal for archiving very large amount of data.

(iv) **Video Disk**

This is an optical disk that stores audio, video and text data. It can be accessed a frame at a time for motionless viewing or can be played like a video tape for moving action and sound. It can be accessed very quickly.

(v) **Magneto – Optical Disks**

These are erasable disks. They have both magnetic and optical properties. They comprise a magnetized recording medium sandwiched between two plastic disks. The contents of the disk can be altered magnetically at high temperature.

b. **Flash EPROM Disks**

Today, these are the most widely used optical storage. Data can be stored and erased in a flash. It is very small in physical size but has a very high storage capacity.

2.6 APPLICATION CONTROLS

Application controls are controls over the input, processing, and output processes to:

- ensure that the input data is complete, accurate and valid
- ensure that the internal processing produces the expected results
- ensure that the output reports are protected from disclosure

2.6.1 Input Controls

These include;

- Input Authorization
- Accuracy, Batch Controls and Balancing
- Error Reporting and Handling
- Batch Integrity in Online or Database systems

Input authorization - These are controls to ensure that data has been properly authorized to be input into the application system. Examples include;

- User Name
- Passwords
- Signatures on batch forms;

Batch controls and balancing – This involves controls put in place to ensure that total monetary amounts, total items etc are arithmetically correct.

Error reporting and handling are controls to prevent erroneous data being input into the computer system. Some of the input control techniques here include things like;

- transaction log;
- reconciliation of data;
- documentation;
- error correction procedures;
- transmittal log;
- Version Usage – e.g March file cannot be used to update April file. It should be the other way round.
- File updating and maintenance authorization – Only authorized person can log in to update the database.

2.6.2 Output Controls

The essence of output control is to ensure the following;

- that the information distributed get to the appropriate recipient
- That the information distributed is correct
- That there will be no change in the content and presentation of information between the point of process and output

In view of the above, some output controls includes;

a) Sensitive report must have specific printers where they can be printed from

b) There must be a controlled way of distributing reports

c) How long are the sensitive reports retained

d) Are the sensitive/confidential reports stored in a protected environment?

e) There must be screen saver on the desktop where sensitive information is input.

f) Data Validation checks to prevent bad data from being stored in the database. Examples of these checks include;

- Control totals – this involves having a control total field on each file being stored in the database.
- Sequence check – for example if you have 1,2,3, 5 (this is wrong as 4 should follow 3)
- Limit check – A maximum amount may be placed as limit on the database. E.g amount more than ₦1Billion should be rejected.
- Validity check – Example 34th January 2017 is invalid as January ends on 31st.
- Reasonableness check – In running a payroll application, if the number of records is 50million, it will fail the reasonableness check. How many employers have 50million staff in their employment.
- Existence check – e.g Check that the name is existing before processing the salary of the individuals
- Completeness check. If employees are 45, completeness check will check that the number of records in a payroll file is 45, otherwise it will fail the completeness check.
- Duplicate check – Surnames and first names must not be duplicated
- Logical Relationship check – There is no logical relationship between Sales figure and MD's haircut expense?

2.6.3 Storage Controls

These are controls put in place at the database level where data is stored. This is to guarantee that data cannot be changed when resting on the tables in the database. Examples of storage controls includes:

(a) File labeling in a particular order to prevent accidental loss of storage media

(b) Segregation of duty between the input and storage officers

(c) Access to storage media must be properly authorized and authenticated

(d) Access to the database must be properly authorized and authenticated

(e) There must be a log file which records every activity carried out on the database.

(f) Physical security of storage media environment including the data processing centre.

(g) File backup regularly and storage in a secure place to prevent data loss

2.7 CHAPTER SUMMARY

The components of the hardware system are Input, Output, Storage and the CPU. The CPU is composed of the main memory and the processor, which consists of the ALU and the control unit. The three types of hardware (called computer) are the digital, analog and the hybrid, which are distinguished by the manner in which data are represented in them. The digital computers are classified as super machine, mainframe, minicomputer and micro computer. They are being distinguished by their size, heat evolved during processing, purchase price, security measures involved around them, the level of usage etc.

The input devices are of magnetic or optical technology, the input device can be classified as pointing devices, document reader and speech devices. The most common are the keyboard and mouse.

The most common output devices are the monitor which produces softcopy and the printer, which produces hardcopy.

The storage devices are divided into internal memory, which comprises ROM and RAM, and the external storage. The internal memory is direct access and is made of the metal-oxide semiconductor, while the external memory is either direct access or sequential access, and are made of the optical and magnetic technology.

To ensure confidentiality, integrity and availability of data, there must be input controls, output controls and storage controls in any application system.

2.8 MULTIPLE CHOICE QUESTIONS

1. Which one of the following is **NOT** a model?

   A Mathematical

   B Graphical

C Arithmetic Operation

D Narrative

E Logical

2. An approach to problem solving that involves using modeling theory in combination with sampling experiment is called…………………

A Mathematical model

B Optimisation model

C Monte Carlo Simulation model

D Linear programming model

E Non-linear programming model

3. Which of the following is correct?

A A logical description specifies essential part while physical description specifies implementation.

B A logical description specifies implementation while physical description specifies essential

C Logical representation gives physical implementation

D Physical implementation gives logical description

E Both logical and physical descriptions do not exist separately.

4. One thousand megabytes is equivalent to one

A Terabyte

B Kilobyte

C Gigabyte

D Multibyte

E Polybyte

5. The brain of any computer system is______________

A. Control unit

B. Arithmetic and logic unit

C. Central Processing Unit

D. Storage Unit

E. Memory Unit

6. Analog computers work on which of the following inputs?

A. Continuous electrical signals

B. Discontinuous electrical Signals

C. Magnetic strength

D. Numerical data

E. Alphabetic Data

7. USB is an acronym for ___________

A. Unique serial Bus

B. Unique save bus

C. Universal serial bus

D. Ultra serial bus

E. Universal system bus

8. Which of the following features does not describe a Super Computer

A. Smaller in size and processing than Micro computers

B They are usually used by multinational companies

C They contain thousands of microprocessors

D They are large in size and generate lots of heat

E They are used to solve complex computing problems

9. Which one of the following is a direct input device?

A. Optical Character reader

B Bar code

C Punch card

D Paper tape

E Optical Mark r

10. Which one of the following loses its content when the computer is turn off or put off

A. RAM

B ROM

C CD ROM

D PROM

E Hard Disk

11. Which ONE of the following is the role of Logical Unit in a CPU?

A Production of results

B Comparison of quantities or numbers

C Control of the flow of information

D Performing arithmetic computations

E Interpret instructions

12. The following are storage media for computer system except

A. Magnetic

B. Hard disk

C Soft disk

D Optical disk

E Solid state storage disk

13. The language that the computer understands without translator is;

A. High level language

B. Machine language

C. System program

D. Assembly language

E. Low- level language

14. Which one of the following is NOT a hardware component?

A. Printer

B. Monitor

C. Magnetic tape

D. Microsoft Excel

E. Smart card

15. Which of the following is required when more than one person use a central computer at the same time?

A. Terminal

B. Light Pen

C. Digitizer

D. Mouse

E. Magnetic Disk

16. Which of the following is NOT an output device?

A. Printer

B. Plotter

C. Touch screen

D. Flat screen Monitor

E. Microfilm

17. Which of the following is NOT an example of pointing input device?

A. Mouse

B. Joystick

C. Smartcard

D. light pen

E. Touch screen

18. Examples of peripheral devices does not include which ONE of the following ?

A. Communication terminals

B. Printer

C. Visual display unit

D. Keyboard

E. Internal memory

19. All the following are the shortcomings of display equipment EXCEPT:

A. user must be physically present to see what in displayed

B. One cannot output with a pencil or pen

C. Output cannot be removed from the screen

D. Encourage paper wastage

E. output to be handled is limited to size on the screen

20. The following are examples of impact printers EXCEPT:

A. Line printer

B. Drum printer

C. Dot-Matrix Printer

D. Thermal Printer

E. Daisy Wheel Printer

21. Which of this following is NOT an example of output devices?

A. Microphone

B. Speaker

C. Plotter

D. Projector

E. Headphone

22. Which of the following is NOT the classification of printer

A. Character Printer

B. Plot Printer

C. Page Printer

D. Ink-jet Printer

E. Line Printer

23. Which of the following is NOT a unit used for measuring the capacity of computer memory

A. Gigabyte

B. Multibyte

C. Megabyte

D. Byte

E. Kilobyte

24. Which one of the following combinations represents a computer processor?

A. CPU and Memory

B. Memory and control unit

C. ALU and control unit

D. ALU and memory

E. CPU and motherboard

25. Which of the following operation is performed by the control unit of the computer

A. Perform logical comparison

B. Receives the results of processing from processor

C. Interprets the instructions given to computer

D. performs multiplication and division

E. Performs addition and subtraction

26. Which one of the following is NOT an example of impact printer?

A. Dot-matrix printer

B. Daisy-wheel printer

C. Line printer

D. drum printer

E. Laser-jet printer

27. The following are types of secondary storage device EXCEPT

    A. Hard disk drive

    B. Soft disk drive

    C. Optical disk drive

    D. Floppy disk drive

    E. Zip drive

28. Which of the following is not a peripheral device?
    A Communication terminal
    B Printers
    C Visual Display unit
    D keyboard
    E Data entry device

29. Which of the following is not part of the CPU?
    A Control unit
    B Arithmetic unit
    C Logical unit
    D External storage
    E Internal storage

30. The following input devices produce direct data input into the computer EXCEPT.
    A. OMR
    B. barcode scanner
    C. OCR
    D. MCR
    E. Magnetic disk

31. Which one of the following is NOT an image input device?
    A. Graphics Tablet
    B. Gross hair Cursor
    C. OCR
    D. Image Scanner
    E. Digitizing camera

32. Which one of the following is not part of input controls?
    A. Input authorization
    B. Accuracy, batch controls and balancing
    C. logical relationship check
    D. Error Reporting and handling
    E. Batch integrating in online System

33. Which of the following is not an example of validation check?
   A. Sequence check
   B. Existence check
   C. Duplicate Check
   D. Limit Check
   E. Screen saver check

2.9 SHORT-ANSWER QUESTIONS (SAQ)

(1) Auxiliary equipment is an equipment which is offline to the…………….

(2) During data processing, Turn-around is the time that elapses between job submission and return of…………….

(3) Magnetic disk and Magnetic tape are examples of external… .... devices.

(4) Magnetic tape can be used as both serial and…................access memory.

(5) A video disk is an optical disk that can store text, pictures and.................data.

(6) A computer operates under the control of instructions stored in its____________

(7) The category of computer that can be used to process, Numeric, Alphabetic and alpha numeric da is known as ______________________________

(8) A device embedded with microprocessor chip and contain EPROM that can be used as bank payme systems is called

(9) An output devices that takes text and image displaying on a computer screen and the sending them on a large screen of clearly for audience is called

(10) The type of memory used for storing information parameter and external to the central processing unit (CPU) is called

(11) The processor is the combination of arithmetic and logic unit (ALU) and

(12) A computer System is made up of Hardware, Software and ……………………………..

(13) A suit of Programs processed by the hardware and allows the hardware to function effectively and efficiently is known as ……………

(14) A sequence of instruction written in a certain computer language carried out by hardware to solve a given problem is called……………….

(15) The hardware device designed for transforming graphical images such as drawings, photographs and maps into machine readable form is called……………

(16) The input device that can take pictures and immediately store them into a digital memory and can be displayed on screen is known as……………

(17) The optical disk for storing audio, video and text data is known as…………..

(18) The type of input controls that prevent erroneous data from being entered into the computer

system is called…………..

(19) A high speed memory capable of keeping up with the processing speed of the computer processor is called ……………

(20) The type of memory that store input-output operations and booting programs is called…………...

(21) The measure of the processing speed of the computer which is the number of cycle per second is called…………...

(22) The type of processor capable of performing specialized task such as speed up computations is called…………...

(23) The clarity of the image formed on the monitor of the computer is known as…………...

(24) The messages displayed on the Screen/monitor of the computer that can be seen and nor touch is called…………...

SECTION B

1(a) Compiler can be classified using different attributes such as signal generation, purpose and sizes. You are required to.

(i) List and explain briefly the three classes of computer

(ii)Enumerate any five features and characteristics in each of the third and fourth generation of the computer

(b)Give two examples of computer based on purpose and give 4 examples of computer based on sizes.

SOLUTION Q1

(a)i) The 3 types of the computer are:

1)Digital computer: personal computer that received information in a discrete form (“ON” or ” “OFF”), that is in form of binary digital (0s and 1s), All data used on digital computer must b e converted to the binary form. Example: TV channel selector .

2) Analog computer: Are computer that receives physical information or data in a continuous form or vibration or wares or electrical states. Analog computer needs to be process physical quantity like temperature, presages speed etc. Examples include: Thermometers, speed-meters, or petrol pump filling station.

3) Hybrids computer: Are computer that combine the high speed of the analog machine with the flexibility of a digital system. These are computer connected together as a single system to receive information in a discrete and continuous manner. This computer are used in hospital, aircraft etc

where measuring physical quantity and converted them into digital data to analyze in require.

a(ii). Third Generation Computers (Feature \ Characteristics) include:

1. Use of integrated circuit (IC) instead of transistors
2. Use of ICs make the computer smaller in size, cheaper and farter
3. It marked the beginning of keyboards as input and visual display unit (VDU) or monitor as output device
4. Metal oxide semi- conductor replaced the magnetic core memory
5. On-line, real-time system became popular.
6. Sophisticated operating system was designed to aid communication
7. It marked the use of high-level language e.g FORTRAN, COBOL etc

A(ii). Fourth Generation computers: Features:

1. Microprocessors are used as switching devices
2. It marked the arrival of microcomputers because of microprocessors
3. Improved input and output devices
4. Many high level languages developed to solve business problems
5. CPU became smaller and faster
6. Cost of computer was reduced that people can afford to buy
7. Development of application packages (software)

b. i. Examples of computer based on purpose are:

1. Special-purpose computers
2. General-purpose computers

ii. Examples of computers based on size are:

1. Mainframe computers
2. Mini computers
3. Super computers
4. Micro computers

2. a. List any four example of microcomputers (2mks)

b. State two features in each of mechanistic and stochastic systems (4mks)

c. Enumerate any four unpredictable disturbances that may allow a business system deviate from expected objectives (4mks)

d. Enumerate any five roles of information in any accounting environment

SOLUTION Q2

a. i. Desktop computers
   ii. mini tower
   iii. workstation
   iv. Notebook computers
   v. Laptop computers
   vi. palmtop computers
   vii. Pen computers

b. Features of mechanistic system
   - Various states or activities follow each other in a predictable way or manner
   - Operates on the basis of standard rules and regulations that restricts its ability to react to its environment
   - The output from the system can be dictated from its inputs
   - Examples include computer program/software

   Features of stochastic system include:
   - The outcome from the system cannot be predicted exactly
   - The output from the system cannot be dictated from the inputs with precision
   - They are subjected to random influences from the environment
   - Examples of stochastic systems include: business systems, economic systems, agricultural system, weather system, etc.

c. The unpredictable disturbances are:
   - Introduction of powerful and advanced technological new computer into the market
   - An unexpected rise in labour costs
   - The failure of a supplier to deliver promised raw materials
   - Government legislation, etc.

d. Roles of information in any accounting environment include:
   - Identification of activities requiring action
   - It reduces uncertainty and provides basis for choosing among alternative action
   - Information makes decision making process of the accountant to be fast
   - It makes the accountant’s output to be accurate
   - It enables the accountant to develop strategies and formulate policies for the survival of their profession

- It enables effective planning and control desirable in the accounting profession
- It enables the accountants to monitor and gain insights into the activities of their professional competitors
- It enables the accountants to meet customers request adequately

3 Computer system is made up of two broad subsystems namely: hardware and software. You are required to:

a. Define computer hardware system

b. List and state one major function of each of the five basic units of computer hardware

c. Enumerate any EIGHT examples of input devices

SOLUTION Q3

a. i. Computer hardware consists of the physical units/components making up the computer configuration that can be seen, touched, and felt.

b. The major components /units of computer hardware are:
   1. Input unit: this is the unit through which data and information is communicated to the computer for processing, e.g keyboard, mouse, joystick, light pen, etc.
   2. Output unit: The unit is used to display data and information that has been processed by the computer. It brings out processed information from the computer to the user e.g monitor, printer, graph plotter, etc.
   3. Control unit: controls and coordinates all the other units to form one integrated unit. It controls the workings of all the other units and ensures that they are properly coordinate and execute instructions. It controls the transfer of data to the main memory and within the main memory as required by the program.
   4. Arithmetic and logic unit (ALU) – Responsible for the purpose of performing arithmetic (addition, subtraction multiplication, & division) and logical operation. (comparison such as =, <, > etc)
   5. Memory unit: storage that hold data and information until needed for processing. It can also be a temporary storage area that holds data and instructions that the central processing unit (CPU) reads.

      It is divided into two parts: Random Access Memory (RAM and Read only Memory (ROM).

c. Examples of input devices include:
   1. Mouse
   2. Magnetic ink character recognition (MICR)

3. Joystick
4. Magnetic stripe card
5. Smart cards
6. Optical character recognition (OCR)
7. Optical mark recognition (OMR)
8. Scanner
9. Light pen
10. Touch screen

4. Computer storage consist of a number of cells for storing data and programs. You are required to:

a. Define direct access storage device
b. List three advantages and two disadvantages of direct access storage device
c. List four examples of direct access storage device

SOLUTION Q4

a. Direct Access Storage Device (DASD) is a storage device in which data can be accessed directly regardless of the sequence or order in which data are stored
b. Examples of DASD include:
    - Hard disk
    - Flash drive
    - Compact disk
    - Diskette
    - Magnetic drum
    - DVDs

c. Advantages of DASD include:
    i. They have high data transfer speed
    ii. They have high storage capacity
    iii. Data in the device is relatively

Question 5

Application controls are controls over inputs processing and output processes. You are requested to:

a. State the essence of output controls.

b. Enumerate Five examples of output controls.

c. List Five examples of storage controls.

Solution

a. The essence of output controls includes:

i. That information distributed get to the appropriated recipient.

ii. That the information distributed is correct.

iii. That there will be no change in the content and presentation of information between the point of process and output.

b. Examples of output controls includes:

i. Sensitive report must have specific printers where they can be printed from.

ii. There must be a controlled way of distributing reports.

iii. How long are the sensitive repots retained?

iv. Are the sensitive/confidential reports stored in a protected environment?

v. There must be screen saver on the desktop where sensitive information is input.

vi. Data validation checks to prevent bad data from being stored in the database.

c. Examples of storage controls includes:

i. File labeling in a particular order to prevent accidental loss of storage media.

ii. Segregation of duty between the input and storage officers.

iii. Access to storage media must be properly authorized and authenticated.

iv. Access to the database must be properly authorized and authenticated.

v. There must be a log file which records every activity carried out on the database.

vi. Physical security of storage media environment including the data processing center.

vii. File backup regularly and storage in a secure place to prevent data loss.

Q6 A memory is made up of a large number of cells. You are required to:

a. State any four content of the primary memory.

b. Enumerate any four distinction between read only memory(ROM) and random access memory (RAM)

SOLUTION

a. The content of the primary memory include:

1. Programs containing instruction to be used for processing

2. Data that have been read from input device or secondary storage device

3. Immediate results i.e. data that are currently being processed or to be used for further processing

4. Output information that is ready to be sent to an output device or secondary storage device

READ ONLY MEMORY (ROM)	RANDOM ACCESS MEMORY (RAM)
-Memory information are permanently stored -Information can only be read from ROM -It is smaller than RAM -Rom is non volatile but does not lose its memory when there is power failure -Less expensive than RAM	-Information are temporarily stored (working) - Information can be read and write from RAM It is bigger than ROM -Ram is volatile but it's lose its content when power failure -Very expensive.

2.10 SOLUTIONS TO MCQ

1. C
2. A
3. B
4. A
5. C
6. A
7. C
8. D
9. A
10. A
11. B
12. C

13 B

14 D

15 A

16 C

17 C

18 E

19 D

20 D

21 B

22 D

23 B

24 C

25 C

26 E

27 B

28 A

29 D

30 B

31 B

32 D

33E

\\

2.11 SOLUTION TO SAQ

1. Central Processing Unit
2. Results or Information
3. Memory or storage
4. Sequential
5. Sound
6. Primary/Internal/Main Memory or ROM
7. Digital Computers
8. Smart Card
9. Projector
10. Secondary or Auxiliary memory unit
11. Control unit
12. human ware
13. Software
14. Program
15. Image input device
16. Digital camera/copier
17. Video disk
18. Error reporting
19. Cache memory
20. Read only memory
21. Hertz
22. Slave processor
23. Screen Resolution
24. Softcopy

CHAPTER THREE

COMPUTER SOFTWARE

CHAPTER CONTENTS

a). Definition of Software;

b). System Software;

c). Operating Software;

d). Language Processor;

e). Utility Programs;

f) Processing environment

g). Spooling;

h). Virtual Memory Capability;

i). Application Software;

j). File Manager and Database Management System;

k). Presentation Software;

l). Statistical Packages;

m). Mathematical Packages;

n). Integrated Software;

o). Off – the – Shelf Packages;

p). In-house packages

q) Computer Bureaux

r) Computer languages

s) Principles of Good Programming Practise

t) MS Windows

u) Windows Operations and Windows Explorer

3.0 LEARNING OBJECTIVES

After reading this chapter, readers should be able to learn:

(a) the category of software: System software and Application software:

(b) the category of System Software; and

(c) the types and sources of application packages

(d) categories of computer languages

(e) programming techniques

(f) properties of good programming

(g) Most common operating systems used in desktop Computer systems vis-a- vis Windows, MAC, and LINUX

(h) Basic Windows Operations and Windows explorer, My Documents, My Computer, and Control Panel

3.1 INTRODUCTION

The software is a suite of programs that allows the hardware to function optimally and which allows the end user to interact with the hardware. The system software is produced by the computer manufacturer while the application packages are acquired from many sources. The application packages, which can be off-the-shelf or bespoke software are intended for specific tasks.

The most important System Software is the Operating System (OS). There are Operating Systems for various task/processes such as single-user, multiprocessing, multiprogramming, distributed processing and multiuser.

3.2 DEFINITION

Software is a generic term for all computer programs that run on the hardware system and their accompanying documentation. The documentation i.e the complete set of instructions enables computer system users to use the computer system to perform some tasks.

The computer programs are divided into; Systems Software and Applications Software (often called application packages).

A computer program can be defined as a sequence of instructions to solve a particular problem written in a particular computer language.

3.3 SYSTEM SOFTWARE

This consists of background programs that enable application software (application packages) to run smoothly on a specific set of hardware. In essence, systems software refers to the suite of programs that facilitates the optimal use of the hardware system and provides suitable environment for the writing, editing, debugging, testing and running of users' programs.

Thus, System Software forms an interface between application programs and the hardware system. Usually every computer system comes with a collection of these programs because they constitute an essential part. Most System Software comes with the computer system and is often referred to as bundled software.

The types of System Software include Operating system, language processor, utility routines, Loaders and Editors.

3.3.1 Operating System (OS)

The most important systems software is the Operating System. It is a collection of programs that manage the Computer Based information System (CBIS) resources in the wisest manner possible. It provides the user with features that make it easier to code, test, execute, debug and maintain user's programs while efficiently managing the hardware resources.

The functions of the OS include:

(a) Resources sharing;

(b) Provision of a virtual machine (virtual storage is an interleaving technique performed by some OS in which disc storage is made to operate as a logical extension of Random Access Memory. (RAM);

  (i) Input and output (I/O) handling;

(c) Memory management;

(d) Filing system;

(e) Protection and error handling;

(f) Program control; and

(g) Initial set-up of the computer, when it is switched on. This is achieved by the boot/or bootstrap program, which is normally resident in ROM. It leads the rest of the OS from the secondary storage into RAM.

The main components of an Operating Systems are:

(i) A supervisor;

(ii) A command language translator;

(iii) An input/output control system (IOCS) and

(iv) A librarian

Examples of OS

(a) DOS (Disk operating system) used on stand-alone microcomputers. This includes MS-DOS, PC-DOS which are used on the IBM-PC and compatibles.

DOS has the following limitations:

i. It cannot be used for multi - tasking operations;

ii. It is not suited for networking activities

(b) Windows offers a full graphical user interface (GUI) simplifying DOS commands

(c) OS/2 used with IBM PS/2 line of microcomputers. It allows multitasking using GUI

(d) Unix is a multi- user, multi -tasking OS used on micro and mini with Xenix and Venix as variances of Unix.

(e) MVS, VM are used with IBM mainframes

(f) Novell"s Netware is a network OS

(g) Windows NT improves on windows by offering multi tasking activities also.

3.3.1(a) Bootstrap Program

This is part of executive program of the operating system that resides in the memory of the computer system that is used to start up the computer. When the computer is switched on, it must bring some of its controlling software into the main memory from the secondary or backing storage and the operating system will take over the supervision of the computer's operations. In other words, bootstrap is the program that calls in software that make the computer operational.

3.3.2 Language Processor

A language processor (or language translator) is a program that converts the user's code (i.e. source code) or program into machine language code.
The user's code is called the SOURCE code while the machine code is called the OBJECT code.

The computer machine can only process data that are in binary form (i.e. as a string of 0 and 1). This form is called the machine code and it is very difficult for many people to write. Users write (code) data in some familiar languages, called the sources code. This source code is then converted to the machine code by a language processor before processing can take place.

Fig 3.1 Code conversion Process

There are three most popular language processors; namely Assembler, Compiler and Interpreter.

(a) **Assemblers**

These are programs which translate a source program written in low-level (assembly) language into the machine code/object program. The translation process is performed by the computer itself. The purpose of the assembler is to simplify and speed up the task of programming and enabling the programmer to write programs in a language much simpler than machine code.

After translating, the linkage editor binds the object codes to form a load program, which the processor executes. Programs can be saved on disk either as source program, object program or load program form.

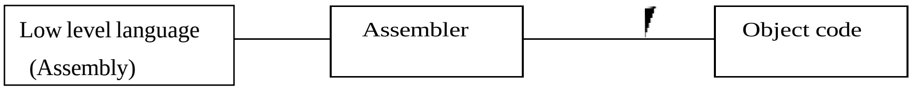


Fig 3.2 Assembly conversion process

(b) **Compilers**

These are programs which convert a source program written in a high level language into a machine code/object program. A compiler performs the task of assembling the object program, just like the assembly, but it is generally more complex. All the same, both compiling and assembling are performed to reduce the complexity and time involved in writing programs. The conversion of high level languages into machine code using a complier is as represented in figure 3.3 below

Compiler

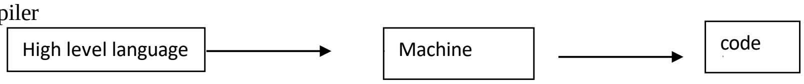


Figure 3.3 Compiler conversion process

(c) **Interpreters**

Interpreters, like compilers, convert high level languages into machine code/object programs, but unlike compilers which convert into machine code all at once, before program are run, interpreters convert programs a line at a time, as they are being run. With an interpreter, each statement is converted into machine language just before it is executed. No object code is ever produced. BASIC Programming language uses an interpreter.

Advantages and Disadvantages of Interpreters over Compilers

Although, interpreters have the glaring weakness of inefficiency, because they need to translate over and over again the same statement, they have the following advantages:

(i) They are fast and easier to use, since one is not bothered with distinct and time-consuming compilation process

(ii) They produce superior error messages which are easy to trace;

(iii) They require less RAM space than compilers. So they can be used in environment with limited memory space;

(iv) They are cheaper;

(v) They are suitable for interactive work, where the programmer wishes to test (or amend) the program on –line in segments as the result can be seen immediately; and

(vi) They are very useful for small programs writing.

However, they have the following disadvantages:

(i). It takes a longer time for a program to run;

(ii) Since it does not compile, when a run program is to be re-run, it needs to be interpreted all over again.

Table 3.4 (Advantages And Disadvantages of Interpreters Over Compilers)

S/N	ADVANTAGES	DISADVANTAGES
1	They are fast and easier to use, since one is not bothered with distinct and time- consuming compilation process	It takes a longer time for a program to run;
2	They produce superior error messages which are easy to trace;	Since it does not compile, when a run program is to be re-run, it needs to be interpreted all over again
3	They require less RAM space than compilers. So they can be used in environment with limited memory space;	
4	They are cheaper;	
5	They are suitable for interactive work, where the programmer wishes to test (or amend) the program on –line in segments as the result can be seen immediately;	
6	They are very useful for small programs writing.	

However, many small computers now have compilers available on them, which means that it is necessary to translate the program only once, during the compilation run, and the compiled program is then stored on secondary storage until the relevant application is to be run.

As each statement does not have to be translated at run time, the program runs faster than an interpreted program.

3.3.3 Utility Programs

These are also called Service or General-Purpose Programs as they are used for applications in general regardless of the nature of specific application programs. They perform the following operations:

(a) File copy;

(b) File re-organisation;

(c) File maintenance;

(d) Sorting;

(e) Dumping routines (This program transfers a working program/data into secondary storage at regular intervals, from where the program can be reloaded using a restart program);

(f) Housekeeping operations: They include programs to clear areas of storage, writing file labels, and updating common data; and

(g) Conversion of programs in ASCII code into EBCDIC code;

(h) Disk copying and formatting.

3.3.4 Loader

Before an instruction can be executed, it must have been placed somewhere in the primary memory. It is the loader that places the program segments into the appropriate locations in the memory ready for execution.

Thus, the output from the linkage – editor during program compilation process is usually the input to the loader.

3.3.5 Editors

The primary function of an editor is to convert input into a particular format output, based on the editing commands which accompany the input. Most editors work on the source program allowing the user to format, delete, insert or modify all or part of a file. We consider two types of editors: The text editors and the linkage-editors.

(a) **Text Editor**

A text editor is a utility program closely associated with application packages. It solves the problem of cutting and pasting programs together, changing data files by editing data fields, or changing the format of data. Text editors are not word processors which are specifically designed to prepare document materials e.g. letters and reports.

Text editor lacks the extensive text-formatting and document printing capabilities.

(b) **Linkage - Editor**

This is a more important editor. It is a piece of system software. It works on object programs (during program compilation) resolving undefined references, linking together several object programs which should work together and reassuring all relocate-able addresses.

3.4 ASSOCIATED PHENOMENA

We now examine some phenomena associated with systems software.

3.4.1 Multi-User Application

Multi-user (or time-sharing) application allows a number of users consisting of various people in different departments to process their own particular requirements in an on-line basis. It allocates to terminal users several small, fixed slices of time as their jobs are being processed.

This way, the computer is able to work so quickly that each user feels as though he has exclusive use of the computer system.

Multi-user application requires:

(a) terminal controllers for controlling the operations of groups of terminals;

(b) if the terminals are located remotely, it requires;

(i) MODEMS (Modulator – demodulator);
(ii) Multiplexors and

(iii) Front-end processor

(c) Private leased communication lines;

(d) A powerful processor to support the multi-user environment as it must be capable of polling the lines to allocate time slots (time slices) to each terminal;

(e) large memory capacity for storing the various user program as well as the high overhead required for storing the OS (overhead is the area of the primary memory which is inaccessible to the user);

(f) Protection features for preventing system crash as a result of several users processing the same file simultaneously; and

(g) Record/file locking and unlocking facilities to prevent a record file being updated by another users.

The individual terminals in a multi-user system cannot communicate with one another, this being unnecessary since they share common files

A major disadvantage is that if the connecting cable of a terminal is severed, it becomes inoperative as it has no link with the central computer (i.e. server). Here, networking (distributive) is an advantage, because the microcomputer disconnected from the network can still continue to process.

3.4.2 Multi-tasking Environment

This refers to the ability of the microcomputer OS to execute a user's tasks concurrently. For example, printing a word processed document and typing simultaneously.

3.4.3 Multi-Programming Environment

This is a process whereby the mainframe computer works on several programs concurrently. Since a single computer can do only a single operation at one time, it will work on one program for a while and then switch over to another program.

Thus, with multi-programming, the OS keeps the CPU busy.

Time – sharing (i.e multi-user) differs from Multi programming in that, with time-sharing, a predetermined time slice is given to each user while in multiprogramming, the time slice is determined by I/O interrupts that are logically encountered in each program.

3.4.4 Multi processing Environment

Multiprocessing (or parallel processing) involves the use of several CPUs (i.e. processors), linked together to perform coordinated work at the same time. Note that in multi programming, only one processor is involved.

3.4.5 Spooling

Because of the low speed of I/O devices, jobs are batched to the input devices which store the contents on a magnetic disk which are later fed into the CPU, because the speed of the magnetic disk is close to that of the processor. The results (information) are also transformed to magnetic disk which later transfers them to a printer. These methods of batching inputs and placing them on a magnetic medium and queuing the output on the same magnetic medium is known as spooling.

3.4.6 Virtual Memory Capability

In a virtual memory system, the operating system continually moves data back and forth between primary and secondary memories so that the system appears to have a virtually unlimited amount of primary memory.

3.5 APPLICATION SOFTWARE

Application software is written to perform specific functions and to support users. Application software is divided into User Application Programs and Application Packages (which is used by specialist and for generalised purposes).

(a) User Application Programs /In-house Application packages

This focuses on expanding the role of the computer beyond traditional tasks. Examples include Decision Support Systems (DSS), Expert Systems (ES) and Artificial Intelligence (AI).

(b) Application Packages

These are pre-written computer programs which are widely used for specific applications in order to avoid unnecessary duplication of similar programs by many users. They consist of programs which carry out specific tasks for the user as opposed to the systems software programs which control the working of a computer.

A package consists of a suite of programs and documentation in the form of a program/system manual, which are details of how to setup the program and run it on a computer, and the relevant medium on which the program is stored, which is usually a magnetic disk or a CD-ROM. The documentation should also include specifications of input and output formats and file layouts, user instruction manual, the minimum RAM capacity and details of how the package may be varied to suit the user's individual needs. Some packages are made to be compatible with a specific make of computer or to run on a model with certain minimal memory capacity or on a specific operating system like windows.

Some application packages are written in-house by the programmers in an organization to meet a specific process i.e. they are tailored to a specific need. These are called bespoke software.

Some other application packages could be bought off-the-shelf and are for general use. These could still be tailored to specific use either by the vendor; or the end-user.

Examples

Some application packages on microcomputer include:

(i) **Electronic spreadsheet:** e.g. Excel, Multiplan, PC-focals, professional plan, Quattro, supercals, Lotus 1-2-3, SUN. These packages turn a computer system into a sophisticated electronic calculator in which data are presented in rows and columns and the user will determine how the data or information should be presented on the grid and how the data should be manipulated by the program.

The program has presentation graphic generators, which take data and other graph for management presentation at meetings. These packages are mainly used for accounting purposes.

(ii) **Word Processing packages** e.g. WordStar, WordPerfect for Windows, Display Write, MS- Word, MultiMate, Professional Write.

These packages turn the computer system into a powerful typewriting tool. They make available the use of special type fonts for document presentation. It is menu driven which executes commands such as PRINTS, SAVE, SAVE AS, EXIT
e.t.c. It also has facilities for formatting document pages such as margin justification, underlying words, deleting, highlighting and pasting of paragraphs.

Some have facilities for desktop publishing, electronic calendaring and electronic mail.

(iii) **File Manager and Database Management Systems**

Database Management System application packages include: Dbase, Rbase, Reflexive Oracle database.

A database is a collection of data files which are integrated and organized so as to provide a single comprehensive file system.
The data is governed by rules which define its structure and determines how it can be accessed. The purpose of a database is to provide convenient access to the common data for a wide variety of users and user needs.

A database management system (DBMS) is the software that builds, manages and provides access to a database. It is a system which allows a systematic approach to the storage and retrieval of data in a computer system.

They are designed to store large amounts of data, as well as to provide rapid access to these data and to prepare reports from them.

A database system is used to;

(i). avoid data duplication (or redundancy) by allowing a single data to be used in a number of applications;

(ii) make data independent of the programs which use it; and (iii). ensure consistency in an organization's use of data

A file manager is a proprietor, applications generator that allows users or programmers to organize data into files and process those files one at a time. It is used for information retrieval and report preparation. File managers on microcomputers allow end users to create files with easy-to-use, menu-driven routines that accompany the package. Although file manager can be used to create and store as many files as is necessary, it constraints users and programs from transparently interrelating data appearing in different files since it processes only a single file at a time.

(iv) **Graphics Generators**

These are used to construct quickly such graphs as line chart, bar chart, pie chart, histograms and scatter diagrams.

Most graphic generators are bundled as adjunct routines with packages like spreadsheets and reporting packages.

(v) Desktop Publishing (DTP)

Examples of DTP software packages include CorelDraw, Adobe PageMaker, and

PowerPoint. DTP involves the use of microcomputer systems that are equipped with special hardware and software features to produce documents that look as though they were done by a professional print shop.

In using DTP, users can combine word processing text with artwork, photographs and a variety of magazine –style fonts.

(vi) Statistical Packages

These are used for the analysis of statistical data to aid management decisions. One important statistical package is SPSS (Statistical Package for Social Sciences)

(vii) Mathematical packages

These packages are used in mathematical modelling such as creation of: (i). System of linear equations

(ii) Differential Equations

(iii) Symmetries and in giving numerical solutions of such models.

Examples of such packages include Matimatica and Matlab.

3.6 Integrated Software

This is a suite of programs that perform a variety of different processing operations, using data which is compatible with whatever operation that is being carried out. Integrated software aimed at microcomputer systems, allows the user operations, such as transferring data from spreadsheet into a word processing document. Examples of such packages include Framework, Enable, and Symphony. Jazz and MS-Works.

3.6.1 Off-the-Shelf Packages

These are application packages which may be acquired separately or as part of an integrated system and are tailored to specific user's requirements.

Many application packages used by small organizations on microcomputers are off-the-shelf packages. Examples of such application areas are:

(a) Insurance;

(b) Marine; and

(c) Banking.

3.6.2 Advantages and Disadvantages of Off-the-Shelf Application Packages Over In-House Packages

We consider the merits and demerits of acquiring off-the-shelf application packages over In-house application developed from scratch (bespoke software)

a. Advantages

(i) It is written by software specialists and so it has a very high quality.

(ii) It is continually updated by the software manufacturers, so the purchased version is up-to-date.

(iii) It is long in the market, so it will be error-free and well-suited to the general public.

(iv) It will be well documented with ease, to follow user's manual;

(v) It is cheap compared to the "in-house" packages which will take long time to develop and are costly;

(vi) It is well tested, so the end-user can start to use it immediately after purchase;

(vii) In some cases, off-the-shelf packages are general purpose packages which could be tailored to the user's requirements unlike in-house packages which are tailor-made/ customized packages.

b. Disadvantages

(i) It produces standardized solution which may not be well suited to individual user;

(ii) The end-user will be dependent on the manufacturer or vendor in case of any serious trouble-shooting or maintenance;

(iii) It may not have some special features required by the end-user.

(iv) Sometime the off-the-shelf packages may not be compatible with the Hardware and/or data structure of the organisation

(v) The off-the-shelf may demand for higher memory capacity which may be very expensive for an organisation.

Table 3.5.4 (Advantages and Disadvantages of Off-the-Shelf Application Packages Over In-House packages)

S/N	ADVANTAGES	DISADVANTAGES
1	It is written by software specialists and so it has a very high quality.	It produces standardized solution which may not be well suited to individual user;
2	It is continually updated by the software manufacturers, so the purchased version is up-to-date.	The end-user will be dependent on the manufacturer or vendor in case of any serious trouble-shooting or maintenance;
3	It is long in the market, so it will be error-free and well-suited to the general public.	It may not have some special features required by the end-user.
4	It will be well documented with ease, to follow user's manual;	Different packages used by an organisation may have incompatible data structure
5	It is cheap compared to the "in-house" packages which will take long time to develop and are costly	Sometime the off-the-shelf packages may not be compatible with the Hardware and/or data structure of the organisation
6	It is well tested, so the end-user can start to use it immediately after purchase;	The off-the-shelf may demand for higher capacity memory which may be very expensive for an organisation
7	In some cases, off-the-shelf packages are general purpose packages which could be tailored to the user's requirements unlike in-house packages which are tailor-made/ customized packages	

3.6.3 Sources of Application Packages

Application packages can be acquired (rented or purchased) from the following sources:

(a) Mail order sources as advertised in computer magazines and dailies;

(b) Over the counter from retail shops or stores;

(c) Dealers (Vendors) in microcomputers;

(d) Manufacturers of microcomputers who also develop software;

(e) Specialist organizations, known as "software -houses", which develop software;

(f) Private organizations and Institutions who have developed software for their own use which they make available to other users for a fee;

(g) Computer Bureaux and Information Centres with expanded activities; and

(h) In–house programmers, who

(i) are specialist staff of an organization who develop software as part of their official job routine.

3.6.4 Checklist for Selecting Application Packages

In order to acquire an application package, we need to consider the following factors:

(a) A feasibility report indicating the choice between off-the-shelf-and in-house packages;

(b) Purchase price of the off-the-shelf package;

(c) Type of hardware and operating system designed for the environment e.g. single-user or multi-user

(d) Can the package be integrated with other standard packages i.e. will the new package accept download data from the packages?

(e) Will the RAM capacity of the hardware on which it will be installed be adequate?

(f) After sales maintenance agreement;

(g) History of usage elsewhere, i.e. the performance of the package and the vendor with previous users; and

(h) The technology version of the package i.e. whether the package is the most recent model.

3.7 Computer Bureaux

A computer service bureau is a company that operates computer services to process data for other companies particularly those which cannot justify acquiring a computer system.

3.7.1 Types of Computer Bureaux

We consider two types of computer bureaux:

(a) Independent companies specially formed to provide computing services to clients

(b) Computer users with spare capacities, who allow other forms to use their computer systems either for standby facilities or for program testing to installation of a similar computer system.

3.7.2 Services Provided

The services provided by a computer bureau include:

(a) Data Preparation: This service consists of the conversion of source data into a machine code/object data for computer processing.

(b) Program Preparation and Testing

This service consists of testing prepared programs for debugging purposes and other characteristics

(c) Hiring of Computer Time:

Clients to the bureau use their computer operators to process their data using their own programs. They only use the computer time and resources of the bureau except the program.

(d) Hiring of Computer Systems:

This allows clients to take the computer system away for a short duration usage. In this case, the system is operated by the client or by his staff in a private safe location.

(e) Do-it-yourself Service

The provision of computing facilities to allow the clients' computer operators to process data with their own programs.

(f) Time-Sharing Facility

This implies access to the bureau's computer system by means of communication links which in effect provide each user with computing facilities as if he had an in-house computer system.

(g) Sales of Computer System Resources

Some well established bureau offer some Computer resource for sales. These resources include printer, mouse, keyboard, monitor, cables etc.

(h) Repairs and Maintenance

Well-established bureau with skilled technicians offer the repairs and maintenance of the clients' hardware and software components

(i) Acts As Information Centre

Some bureaux offer information on general computer resources, source of data, use of data etc.

(j) System Installation

Bureaux offer facilities for clients' systems installation

(k) Training of Staff

Bureaux provide training facility for clients' operators. This is particularly useful in the case of installation of new operating system or database software.

(l) Feasibility Study Consultants

During feasibility study for systems development, bureaux staff may act as consultants on the feasibility study team.

3.7.3 Reasons for using a Bureau

(a) To obtain valuable initial experience of processing by computer system before deciding whether or not to install an in-house computer system.

(b) To provide standby facility, by arrangement, in case of breakdown of the in-house computer;

(c) To provide facility for coping with peak data processing loads owing to insufficient capacity of the in-house computer;

(d) Non-availability of liquid fund for the installation of an in-house computer;

(e) Space restriction for accommodating a computer installations. This happens in the case of big computer systems like the mainframe and mini computers;

(f) To avoid the responsibility of operating an in-house computer, the repairs and installation of software are done by the bureau and

(g) Insufficient volume of work to justify the installation or possession of a computer system.

3.7.4 Disadvantages of Using a Bureau

(a) Loss of control over the time taken to process data suffered by an organisation, because of the computing requirements of other clients of the bureau;

(b) Loss of adequate acquired experience for not using in-house computer system, thus giving an advantage to competitors using similar application packages or services;

(c) Lack of adequate security for data processed at the bureau; and

(d) There is no secrecy of the client's data processing activity.

3.8 INTRODUCTION TO COMPUTER PROGRAMMING

Micro computers have increased the computing capability of many non-computer professionals and the use of application packages has become widespread. Some off-the-shelf packages, e.g. database packages, can be made more efficiently and tailored towards specific processing task if the end-user can write some computer codes to supplement the package. We introduce in this section the technique of writing packages and some important computer languages.

3.8.1 COMPUTER LANGUAGES

The computer hardware processes data and program instructions which are in binary form, called the machine code or language. The machine language is not very convenient for programmers because it is time consuming. Over the years, many computer languages had evolved and we now consider them.

(a) Machine Language

Each computer has its own machine language, which is interpreted by the computer's internal circuitry.

A machine language code is in the form of binary digits represented by zero (0) and one (1).
An instruction code in machine language consists of an operation code which specifies the operation to be performed and an operand address which specifies the address in memory where the operand would be stored.

Writing in machine language requires meticulous attention to details and knowledge of the internal structure of the computer. This takes time and only highly skilled programmers can do this.

Machine language is a first generation language developed around 1945 – 1955. An example of a code in machine language is 0001101000111011.

Advantages of Machine Language

(i) It does not need a language processor, since it is already in the form in which it can be used by the hardware;

(ii) It occupies less space in the memory; and

(iii) Processing is very fast with machine language.

Disadvantages of Machine Language

(i) It is machine dependent. The code on one machine will not run on another machine

(ii) It is very difficult to write, since the programmer has to pay attention to machine architecture during coding.

(iii) It is only written by highly skilled programmers and electrical engineers

(b) Symbolic/Assembly Language

Assembly language is a second generation language developed around 1955 – 1965. It is a low –level language and the codes are written in mnemonics (symbolic form such as ADD, SUB, MULT).

Assembly language must be translated into the machine code. The language processor used is called Assembler. When the assembly language source program has been translated by the assembler into the object machine code program, the translated code is saved on magnetic disk and can be used for data processing.

The symbolic program has to be assembled only once. The language is machine dependent, since the assembled code on one machine cannot be run on another machine.

Note that Assembly is the term used to describe the translation process from a symbolic language code to an equivalent machine code. The language translator is the Assembler program.

In this study pack, we use the words Assembly program and Symbolic program interchangeably.

Advantages of Assembly Language

(i) The task of learning and writing the language is easier than in machine language because it is written in mnemonics;

(ii) The machine language resulting from the assembly language is very efficient since it is very close to the machine language;

Note that the machine language is also a low-level language

(iii) Assembly language can be used to write applications programs that take special advantage of computer architecture;

(iv) It runs faster than high level languages; and

(v) It uses less memory space than high-level languages.

Disadvantages of Assembly Language

(i) It is machine dependent (like the machine language). A program written on one machine cannot be executed on another machine, i.e. it is not portable from one machine to another;

(ii) It can only be written by a highly skilled programmer who knows much about the logical structure of the computer; and

(iii) The coding is difficult and time consuming compared to high level language

(c) High level Languages

These are third generation languages developed around 1965 – 1975. Examples are BASIC (Beginner's All purposes Symbolic Instruction Code), FORTRAN (Formula Translator), COBOL (Common Business - Oriented Language), Pascal, PLI (Programming Language I), APL (A Programming Language), Ada, C.

A high-level language is written in the programmer's language (hence they are called natural languages) and there is less coding details to worry about. Anybody who knows a little about logic can write in high-level. It is accessible to a large number of end-users. A high-level language needs a language processor, such as a compiler or interpreter, to translate the source code into machine object code, One high-level statement is translated into many machine statements, This is one-to-many translation. The terminology, high-level language, arises due to this. High-level languages are procedure-oriented languages because they have the power to express a general class of sequence of instructions. They express in detail the procedure used to solve a problem, i.e. the programmer gives details of how to solve a problem.

Some high-level languages are also problem-oriented i.e. they are to solve a narrow class of problems. In this case, the end-user needs not express in detail the procedure used to solve the problem.
These are the fourth Generation Languages (4GL) or Very High level languages.
A high-level language is machine independent i. e, a program in high-level

can be compiled on one machine but executed on another machine.

Features of High-level Languages

(i) Facility to describe the nature of the data to be processed i.e. specification of the data types e.g. integer, Real, Alphanumeric;

(ii) Facility to describe operators on appropriate data items e.g. division operation on Integers;

(iii) Inclusion of allowable character set e.g. upper case and or lower case alphabets;

(iv) Allowable control (or Branching) structures and the syntax used e.g. Logic IF statement, repetition (looping) statements, etc;

(vi) Input and Output statements i.e. statements that allow data to be read through the keyboard or from files and statements that allow information to be sent to the screen or magnetic disk; and

(vii) It must include syntax and semantic structures for all the statements i.e. the precise specification of work and allowable operations.

Advantages and Disadvantages of High-level Languages

The advantages and disadvantages of high-level languages over the low-level languages (i.e. machine and assembly) are given as follows:

Advantages

(i) It is easier to write and understand, since it is written in the programmer's spoken language e.g. English;

(ii) It is machine independent i.e. it can be compiled and executed on different machines;

(iii) It is problem -oriented i.e. it may be written to solve a particular problem easily;

(iv) It is a procedure- oriented language i.e. it expresses in detail the procedure used to solve a problem (4GL are not procedure oriented languages);

(v) It speeds up program testing and error correction.

Disadvantages

(i). It is less efficient in terms of speed since it is necessarily more abstracted and cannot usually take advantage of specific hardware facilities;

(ii) It is less efficient in the use of internal memory management

(d) Very High-level Languages

These are the fourth generation (4GL) computer languages.

A 4GL is an easy-to-learn, easy-to-use, more or less error-free high-productivity language. It can be created quickly and it involves much less maintenance.

Very high- level language consists of a variety of software tools that enable end-users to develop software applications with minimal or no technical assistance.

4GL are computer languages developed after the third generation languages with the following objectives:

(i) It is intended to help users to develop their own application programs more quickly, cheaply and easily;

(ii) It demands fewer lines of code to achieve a given task compared to a 3GL;

(iii) It is a non-procedure – oriented language i.e. it only requires the user to specify the task needed and not how to do it; and

(iv) It is best used for retrieval and reporting of information. Examples are:

- RPG (Report Program Generator);
- SQL (Structure Query Language);
- QBE (Query- B-Example);
- Data;
- Easytrieve Plus;

In general, 4GLs can be divided into seven categories as

(e) Query Languages e.g. SQL;

(f) Report generator e.g. RPG;

(g) Graphics Languages;

(h) Application generators;

(i) Very high-level programming languages;

(j) Application software packages and

(k) PC tools e.g. Word processing, Spreadsheet packages.

- Mark; and
- Intellect.

Two powerful features of 4GL are: Report and Application Generators.

To produce reports, a programmer must select and format data, specify titles and page numbers,

calculate totals and specify the number and width of columns. Report generators were developed to make customising reports easier and faster.

Also, an Application Generator produces a program to accomplish tasks specified by its users. Application generators include a programming language, a code generator, a library of commonly used program code, tools for creating files, databases and a data dictionary.

(l) Fifth Generation Languages

Important areas in the development of 5GL are expert systems, natural languages, object - oriented languages and parallel processing languages.

Object-oriented Language (OOL) and Object-Oriented Programming (OOP)

An approach to prevent the complete re-writing of new programs line by line is to introduce a form of sub-routine called objects.

An object is a predetermined set of program code that, after having been written and tested, will always behave the same way, so that it can be used for other applications. In object-oriented programming (OOP), an object is written for each specific task and saved in a library so that anyone can use it. Rather than writing a new program line by line, a program selects objects by pointing to a representative icon and then linking these objects together, objects can be modified, used, copied or created.

Advantages of Object-Oriented Programming

(i) It uses graphical interface

(ii) Ease of use

(iii) Faster program development

(iv) Enhanced sprogrammer productivity

(v) Programs produced are:

- more reliable; and
- contain fewer errors, since the modules being used have already been extensively tested.

Disadvantages of Object-Oriented Programming

(i) It has a steep initial development costs;

(ii) More extensive start-up time; and

(iii) Programs produced which are:

- larger;
- slower; and
- use more memory and other computer resources than programs produced by traditional methods

Examples of OOP are

- Smalltalk
- C^{++}
- Visual Basic and
- Java

3.8.2 Programming Procedure

1. Problem definition: The first step in programming is to determine the need for programming. For what are we developing the program: It is for computation, stock control, production control, payroll, accounting system etc.? A precise statement of the problem must be formulated.

2. Developing algorithm: This is a step-by-step logic that should be followed in writing a particular program. A computer problem must be reduced to algorithm to facilitate easy programming. Any problem that can be reduced to algorithm is capable of being solved by computer fast and accurately than any other data processing method.

3. Program design: This help to give clear logic of the program pictorially. Various programming tools of design are flowchart, Pseudo codes, decision tables and decision trees.

4. Problems Analysis and Modelling: This enables the programmer to determine the complexity of the problem. It is the essential step needed in solving the problem for it enables the determination of all relevant variables.

Factors to be consider for selecting a particular programming Language
The various factors to be considered in selecting/adopting a particular programming language include:

1. Development cost
2. Availability of language translator
3. Proficiency of the object programmer
4. Degree of portability or compatibility of the program
5. Machine cost an cost effectiveness
6. Time to be taken in writing the program
7. Readability of the language
8. machine – efficiency of the language for each acceptance by computer

Quality of a good program
The essence of programming is to produce a software program with the following attribute/qualities:

1. Reliability: That the program can always be dependent upon to do what need to be done
2. Portability: Ability of the program being able to be transferred from one computer system to another with less modification
3. Readability: Easiness of the program to read and understand
4. Performance: That the program will cause the task to be done quickly and efficiently
5. Stage Space: The program is not allowed to be unnecessarily long

3.8.2 INTRODUCTION TO GRID COMPUTING

Grid computing and data resources to perform that task. Client has no knowledge about where the work is executed. The task is returned to the client once it is completed. The resources fee is handled by the grid manager. On the other hand, the functioning of cloud computing is such that work is submitted by client to the cloud servers.. A cloud server can be established internally as parallel servers or distributed servers. The services fee is handled by utility computing. Application wise, the grid computing is mostly used in remote education services, bioinformatics data storage and chemical calculations processing

3.8.3 MERITS OF GRID COMPUTING

The merits of the grid computing are provided. Access to Inaccessible Resources A user has access to several resources by using the grid computing which are not accessible to user otherwise. Previously, organizations attempt to capitalize their own resources for achieving greater computing power, however, with the use of grid computing, the unused computing resources from other organizations can be utilized. These resources may not be available to an individual client because of financial or some other constraints. These resources go beyond simple hardware and may include other resources such as applications or software and network connectivity. Resources Utilization and Balancing In grid computing, there is a grid-enabling architecture which combine the dispersed resources and enable a centralized controlling system. Without such centralized system, the grid cannot perform its function as a grid. The resources in a grid can be well utilized means the tasks are similar to the grid capability. The resources can be overloaded in situation where there are more tasks then the capacity of the grid. The resources can be under-loaded where there are less tasks but the grid system have greater capability. The benefit of the grid computing becomes more visible in overloaded grid system since if any one part of the grid system is overloaded, so some of the tasks can be shifted to other under-utilized resources. This way, grid computing enables optimum utilization of the resources. Reliability In an individual computing source, the computing depends on a single processor which poses a higher risk or threat. It is risky since if the individual processor fails, it can the whole system can stop functioning. On the other hand, if the tasks are performed under grid computing architecture, so it will benefit the system since tasks are distributed and the overall failure of the grid computing is not likely to occur. In grid computing, if there is partial failure at one processor point, so the tasks can be migrated to the other processor using the grid computing infrastructure? Here, the reliability can also be influenced if the migration of the tasks is not possible due to some problem over the network. Parallel Computing and Scalability Parallel computing is one key feature of the grid computing. This parallel computing is possible for those applications where programs are written in such a manner that different parts of the program can be performed simultaneously. These parts are called ‘sub-jobs’. With grid computing, many applications which have such sub-jobs can be performed simultaneously. So theoretically speaking, if a job takes 10 seconds to complete, by doing the parallel computing, that task can be performed in 5, 2 or 1 second providing the number of sub-jobs written in that program

3.8.4 . GRID COMPUTING APPLICATIONS

Grid computing have several applications. Some of these applications are listed below. Microprocessor Design: microprocessor design can be used to improve the product development life cycle by creating simulations which can be performed using the grid computing. Usually such simulations require higher computing power which is not possible doing at local level. Medical Field: The grid computing is frequently used in the medical field for sharing knowledge and creating repositories which can be used by the experts around the world. Pharmaceutical Industry: Pharmaceutical industry can use the grid computing to stimulate the process of creating new medicine or cure for incurable diseases. E-Learning: In education field, there is greater need for computing due to the increased dependence of educational institutes for e-learning. Thus, grid computing can provide important resources for e-learning to occur. Scientific Applications: Complex scientific problems and research work in fields such as physics, googology, astrology is possible using the grid computing. Mostly, these scientific applications require higher level of computing power which can be easily met by the grid computing. Medical Imaging: Medical imaging requires storage of large size of medical images which requires not only large computing power but also higher data storage requirements. This can be done by using the grid computing.

3.8.5. LIMITATIONS OF THE GRID COMPUTING

The grid computing can provide solutions to the problem of large computing and data requirements. However, its limitations are that it cannot be used in every setting. For example, there are several applications which do not need higher computing power and running such applications using the grid computing will not result in any significant benefit. Furthermore, for some benefits to occur, it is necessary that the other resource on which the application is run using the grid computer, should have higher computing capacity compare to the user’s own computer. If there is no significant difference between the two resources, so the grid computing will not lead to any improvement in the performance. Finally, a limitation of the grid computing is that it is more suitable for the applications which can be run in a batch mode. On the other hand, applications require graphical user interface are not very suitable for the grid computing. The CPU consideration is also a limitation of the grid computing. If the application can be run in parallel processors, then grid computing is suitable as it can utilize heterogeneous resources to run that application in parallel mode based on different sub-tasks or sub-jobs. However, if the applications do not design in parallel mode, so the grid computing will not be very suitable for such application which is also a limitation. Data is also a factor in grid computing use. In grid computing, large data can be transferred over the network to other data grid resources which are a benefit of grid computing. However, moving large data to other computing resources it poses some challenges such as security and the network capacity. Good solution is to reduce the size of the data to minimum possible before moving it to the target location and use of some encryption method and security protocol for data security. A solution to the data security over the grid computing can be making multiple copies of the data which is also a good solution but also creates other problems such as increased load on the network and the continuous upgradation of all data sets. In summary, we can say that grid computing provide solution to the requirement of higher computing and data storage problems. However, the limitations of the grid computing include CPU and data considerations. Furthermore, some applications which are not designed in the parallel mode cannot be operated on grid computing. The grid computing is also not very suitable for the applications which requires higher user interface.

Types of Grid Computing

1. Computational Grid: It is basically used in distribution of resources for better computing power
2. Scavenging Grid: Are used in idle servers so that desktop computer resources are made strong to complete tasks and jobs.
3. Data Grid: It is used in organization where it assigns an interface which help in data checking and security.

Application Areas of Grid Computing

1. Super Distributed Computing
2. Systems distributed in real time
3. Intensive process of data
4. Virtual collaboration environments

3.9 DOCUMENTATION TOOLS

We now develop the technique of writing and the properties of a program

3.9.1 Algorithms

An algorithm is a finite sequence of instructions to solve a given problem. For example, to find the product of ten non-zero numbers, we obey the following instructions;

a) Input the first two numbers,

b) Find the product and call this product PROD,

c) Input the third number and find its product with PROD also,

d) Continue this way, until we reach the tenth number. Multiply this also with PROD, and

e) PROD. is now the product of all the ten numbers.

Properties of an Algorithm

An algorithm has the following properties:

i. it begins with an instruction to accept data. These data are then processed by the subsequent instructions in the algorithm;

ii. The processing rules specified in the algorithm must be precise and unambiguous i.e. the instructions can be carried out. For example, “GO TO HELL” is a precise instruction but it cannot be carried out, because there is no place called HELL;

iii. Each instruction must be sufficiently basic (such that it can, in principle, be carried out in finite time by a person using pencil and paper);

iv. The total time to carry out all the steps in the algorithm must be finite; and

v. An algorithm must produce one or more outputs.

3.9.2 Programming

A computer program is an algorithm written in a particular computer language i.e. either in machine language, Symbolic Assembly languages, any of the high-level language or very high-level languages.

3.9.3 Computer Operations

The basic operations performed in a computer program are:

a. **Arithmetic operations:** These are the usual Additive, multiplicative and exponentiation operations.

b. **Input/Output operation:** These are statements which allow data to be read by an input device and information to be written out to the screen or stored on appropriate output media.

c. **Logical Operations:** These compare two data items. The result is always a Boolean value i.e. TRUE OR FALSE. The operations are:

(i) Less than;
(ii) Less than or equal to;
(iii) Greater than;
(iv) Greater than or equal to; and
(v) Equal to

The Boolean values (i.e. TRUE OR FALSE) are connected by the three basic connectives: OR, AND, NOT.

❖ **Data Initialisation:** A specific value can be assigned to a data item

❖ **Control or Branching Operations:** Computer program instructions are made to be obeyed sequentially. This sequence can be changed by using a branching instruction which can be conditional or unconditional.

❖ **Start and End Operations:** These are instructions which indicate the beginning and end of a program.

(d) Branching Operations

Computer program instructions have three logical structures; namely:

i. Sequencing;
ii. Selection; and
iii. Repetition
iv.

(i) **Sequencing:** Computer instructions are obeyed as they are written in a sequence. for example READ a data item from a file; WRITE this data item into another file

(ii) **Selection Instruction:** This offers the program some choices and the consequent action taken depends on the choice selected.

Examples of these selection instructions are:

- Logical IF
- Arithmetic IF

- IF – THEN –ELSE
- COMPUT
- GOTO
- CASE

These are examples of conditional branching.

GO TO Statement is also a branching operation but it is unconditional

iii. Repetition or Looping

Sometimes, a program is required to execute certain basic instructions several times. The repetition of a sequence of same program instruction is called a loop. This loop is a sequence of instructions that are executed repeatedly until a specified condition is satisfied. Example of a looping instruction is DO – UNTIL

3.10 PRINCIPLES OF GOOD PROGRAMMING PRACTICE

The following norms are expected when preparing a program:

a) The problem to be solved should be specified in full and in writing in order to avoid ambiguities;

b) All working papers used during program development, such as program flowchart and decision table, should be kept, in case there is a need to refer to them for possible error checking;

c) The program coding should be as short as possible i.e. it should be well logically structured;

d) After writing a program, it should be "dry run" or "table run" i.e. the programmer should read over the source code to ascertain the logic;

e) After dry running, the program should be run with a test data to establish whether the program will run according to specification and detect possible errors;

f) Provision should be made for program amendment by using large gaps between instruction number sequences; and

g) Appropriate comments should be inserted in the program to indicate the purpose of some routines.

3.11 AIMS OF PROGRAMMING TECHNIQUES

3.11.1 Reliability, i.e. the program can be depended upon always to do what it is supposed to do;

3.11.2 Maintainability, i.e. the program will be easy to change or modify when the need arises;

3.11.2 Portability, i.e. the program will be transferable to a different computer with a minimum of modification;

3.11.3 Readability, i.e. the program will be easy for a programmer to read and understand (this can aid items (a), (b) and (c) above);

3.11.4 Performance, i.e. the program causes the tasks to be done quickly and efficiently; and

3.11.5 Storage saving, i.e. the program is not allowed to be unnecessarily long.

3.12 SOFTWARE ENGINEERING

Software Engineering is the adoption of systematic methods and engineering principles to the specification, design, implementation and testing of programs, including the management of such activities.

Literally, software engineering is just another name for good programming principles and practices, it is nevertheless a useful term to use when one wishes to indicate that what is meant is professional software development to industrial standards rather than amateur code-writing.

3.13 PROGRAM CONSTRUCTION

The construction of a program means the construction of the algorithm and the selection of an appropriate computer language to use in coding the major tools used in formulating.

The sets of logic in the algorithm are

a. Structured Narrative/English
b. Program Flowchart
c. Decision table
d. Decision tree

(a) Structured Narrative / English

This is a design tool, written in any international spoken language, like French, English, German, Chinese and Japanese, which describes the algorithm in a highly detailed program words which are written in the upper case alphabets. When English language is used, it is called structured English. The available English vocabulary used is limited but it tries to follow the layout and logical operation of a computer program. Since it appears to be a fairly literal translation of a program, it closely resembles the finished product.

This technique is best suited for describing specific program activities. The basic features of structured English are:

i It is more like spoken English than programming in the third Generation languages; and

ii It is much more limited in vocabulary than normal English, as it has to follow a strict logical order.

Let us illustrate some programming operations in structured English

Initialisation:

X = 5

is a statement that assigns 5 to the variable X. Until otherwise changed, X will have this value

I/O Instructions: These are often omitted.

Arithmetic Operations: The arithmetic operators used are ADD, MULTIPLY, SUBTRACT and DIVIDE

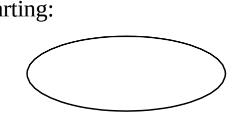
Example:

MULTIPLY unit pay by hours worked to get basic pay ADD basic pay to bonus to get total pay

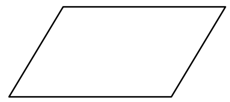
Logical Operation: This is often achieved using the Logical IF. For example, IF hour worked $\leq$ 50 THEN increase pay by 10%

(b) Program Flowchart

A program flowchart is a pictorial/diagrammatic representation of an algorithm. The following symbols are used in program flowcharting:

Oval stands for START or END 

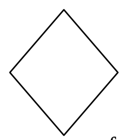
Parallelogram represents I/O instructions



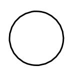
Rectangle represents arithmetic operations

Arrow represents flow line

Diamond shape represents a decision or a condition. This must have two flow lines coming out of it



Small circle representing connector. It connects one part of a flowchart to another, without drawing a flow line



Program Flowchart Conventions

- The horizontal flow is from left to right;
- The vertical flow is top-down unless when indicating a loop.
- Connector symbol is used where a flowchart goes off at the end of a page and continues at another page. Same letter is inserted in the connector where it goes off and where it started again.

Purpose of Program Flowchart

- To clarify the logic of an algorithm,
- To analyse the actions resulting from a set of conditions;
- To sort out the procedural steps in the program;
- As an aid to program construction and coding; and
- . As a communicating document. It is part of the program documentation.

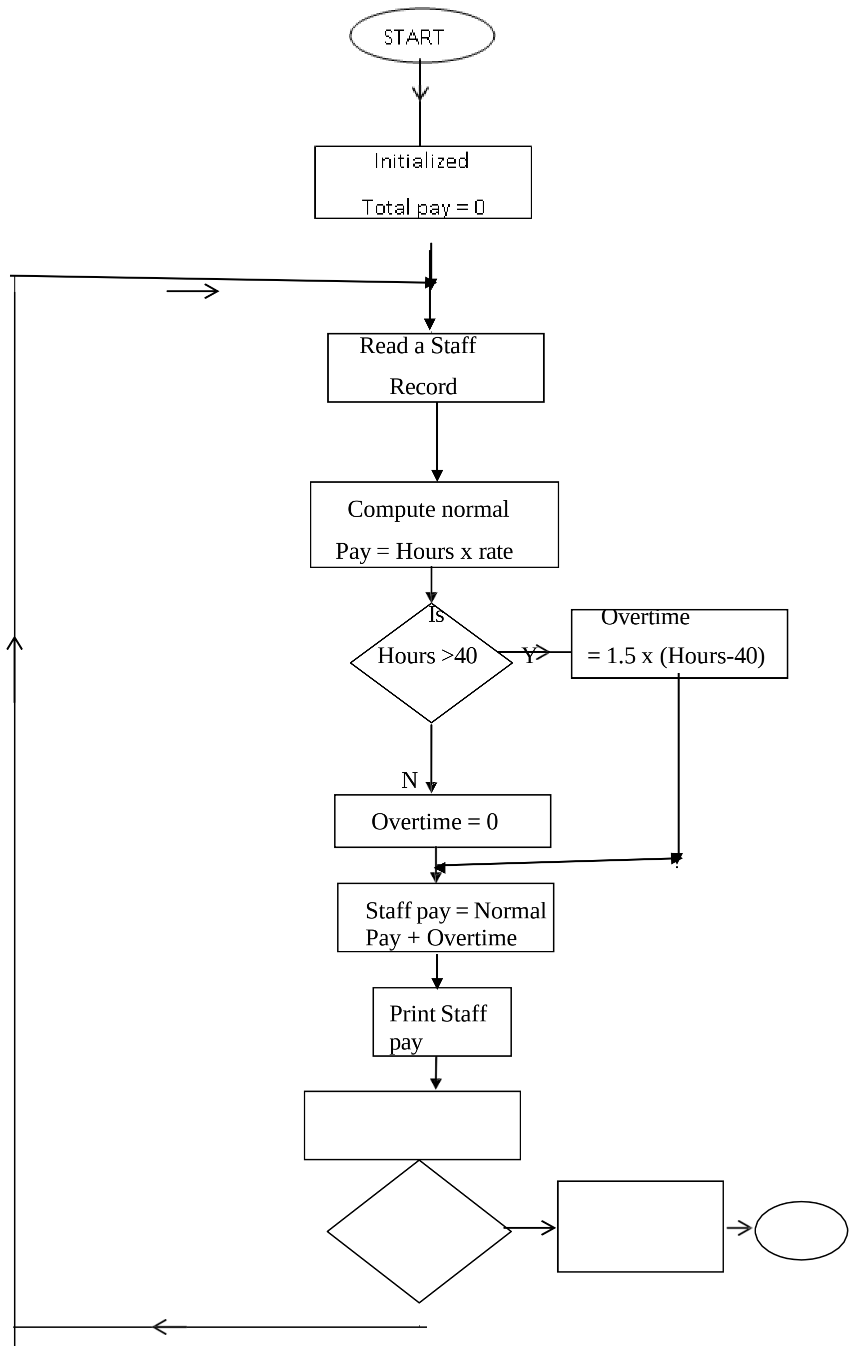
Illustration 3.13.1

ABC Co. LTD has 120 labour forces. The labour normal (regular) pay is computed at an agreed rate per hour to a maximum of 40 hours per week. Extra hours worked per week attract an

additional 50% of the normal rate.

Use a program flowchart to compute the pay per week for each labour staff and the total pay bill for the staff

Solution:3.13.1

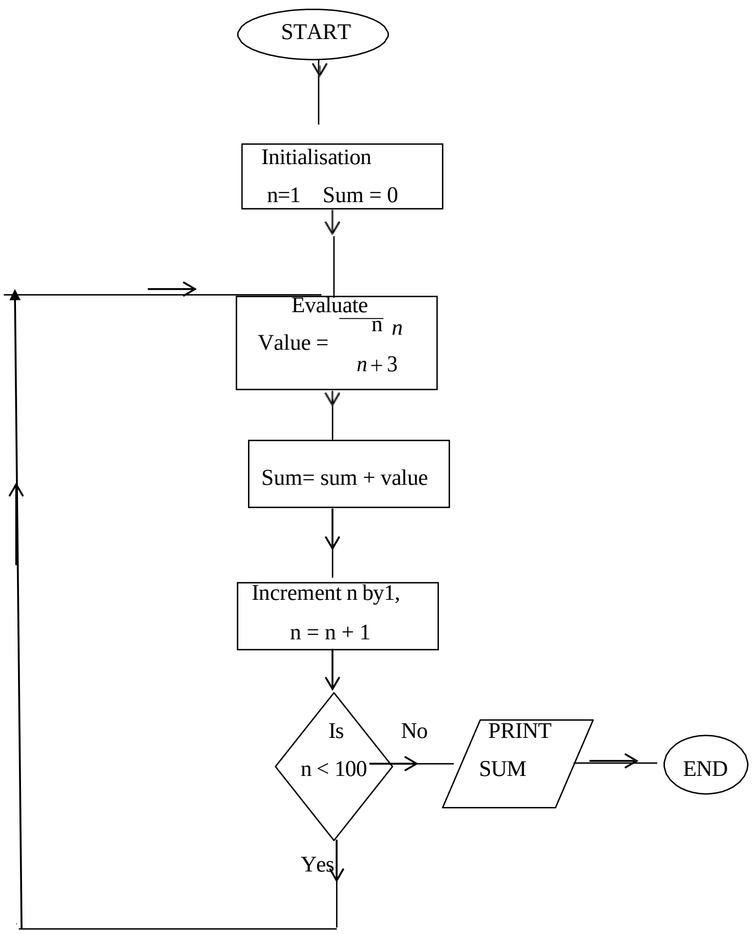


Let us now give an example peculiar to mathematics.

Illustration 3.13.2

Draw a program flowchart to evaluate $\sum_{n=1}^{100} \frac{n}{n+3}$

Solution 3.13.3



General Principles for Drawing Program flowcharts

(i) Make the flowchart clear, neat and easy to follow, so that it has a good visual impact and is an effective means of communication;

(ii) It must have a logical start and end;

(iii) Avoid crossing flow lines;

(iv) All comparisons must result in a Boolean (i.e. Yes or No);

(v) Always follow the flow program;

(vi) Try to "Dry run" the program; and

(v) Make the flowchart consistent in the level of detail illustrated.

Advantages and Disadvantages of Program Flowcharts Advantages

(i) It is an aid to problem definition and program writing. It helps to simplify the logic of a program;

(ii) It is more complete than a decision table, since it contains both the start and end instructions and it illustrates loops in a program;

(iii) It can be used to test whether a program will work by dry running; and

(iv) It is included as part of the program documentation.

Disadvantages

(i) The flowchart of a complex program might extend to several pages;

(ii) It is fairly difficult to amend; and

(iii) It tends to produce a bad structured program design. The logic shown in the flowchart is not necessarily the best or most efficient.

(c) Decision Tables

Decision table is a technique used in program development to define the logic of a process (i.e. the processing operations required) in a compact manner.

The basic format consists of four quadrants divided by two lines intersecting at 90^0, as shown below:

Condition stub	Condition entry
Action stub	Action entry

i. **Condition Stub**

The condition stub section contains the different values of the data under processing. These values may be mutually exclusive of each other i.e. the answer to one will not affect the answer to the other.

ii. **Condition Entry**

The condition entry section is divided into columns, each column consists of a Boolean value i.e. Truth (Y) or False (N). Here Truth (T) is identified with Yes (Y) and False (F) is identified with No (N). If there are n conditions in the condition stub, there will be 2^n columns in the condition entry section. These 2^n Boolean values are combined in the following manner:

The first row is made up of $2^n/_2$ sequence of Y followed by $2^n/_2$ sequence of N.

The next row is made up of $2^n/_4$ sequence of Y followed by $2^n/_4$ sequence of N and this arrangement is repeated until the row is completed. The next row is made of $2^n/_8$ sequence of Y followed by $2^n/_8$ sequence of N and this arrangement is repeated until the row is completed. This algorithm is followed until we get to the last row. Each column now represents a unique result or rule of all the conditions.

Any inconsistent Boolean value is indicated by a " – " or a blank in the appropriate condition entry box. For example, suppose we have 4 conditions in the condition stub section. Then the condition entry section will have $2^4 = 16$. The Boolean values in the columns of each row will then be

Y Y Y Y Y Y Y Y N N N N N N N N Y Y Y Y N N N N Y Y Y Y N N N N Y Y N

N Y Y N N Y Y N N Y Y N N Y N Y N Y N Y N Y N Y N Y N Y N Y N

When the value of n is large, 2^n will be very large and the condition entry section may become very untidy. On most occasions, the value of n is reduced by making the conditions in the condition entry mutually exclusive.

iii. **Action Stub**

The Action stub section consists of all the actions to be taken as specified in the processing operation required.

iv. **Action Entry**

The action entry section shows the action(s) that will be performed for each rule. The column(s) is(are) marked with the symbol "X" opposite the action to be taken.

Illustration 3.13.4 ABC company processes customers requests using the following rules:

a) If an order is between ₦10m and ₦100m, give 5% discount;

b) Orders above ₦100m attract 10% discount;

c) Orders below ₦10m attract no discount;

d) New orders must be above ₦100m and without discount;

You are required to construct a decision table to reflect these procedures.

Solution 3.13.4

There are four conditions?

a) Is order below ₦10m?

b) Is order between ₦10m and ₦100m?

c) Is order above ₦100m?

d) Is order new?

There are three actions: Give

i. 0%

ii. 5%

iii. 10%

There are $2^4 = 16$ rules

The number of rules can be reduced since condition (i) can be removed because if conditions (ii) and (iii) are N, then (i) is Y. Thus, we now have $2^3 = 8$ rules. Also new order is only relevant to orders over ₦100m. So, since an order cannot be over ₦100m and be within ₦10m – ₦100m simultaneously, we have the impossible region.

	1	2	3	4	5	6	7	8
Is order ₦10m – ₦ 100m	Y	Y	Y	Y	N	N	N	N
Is order > ₦ 100m	Y	Y	N	N	Y	Y	N	N
Is order new	Y	N	–	–	Y	N	–	–
Give 0% discount	impossible			X		X	X	
Give 5% discount	combinations		X	X				
Give 10% discount						X		

Remark

(i) The rules resulting in impossible combinations can be removed.

(ii) Columns 3 and 4 and 7and 8 are identical. So they can be combined.

We now redraw the decision table.

	3	5	6	7
Is order ₦10m – ₦ 100m	Y	N	N	N
Is order > ₦ 100m	N	Y	Y	N
Is order new	–	Y	N	–
Give 0% discount		X		X
Give 5% discount	X			
Give 10% discount			X	

Advantages of Decision Tables

The main advantages of using decision tables are as follows:

(i) It is possible to check that all combinations have been considered.

(ii) They show a cause and effect relationship;

(iii) It is easy to trace from actions to conditions (unlike in flow charts).

(iv) They are easy to understand and copy as they use a standardised format.

(v) Alternatives can be grouped to facilitate analysis

Disadvantages of Decision Table

(i) When a small number of logical alternatives exist, the decision tree is more convenient than the decision table.

(ii) It does not provide a graphic representation of the various choices or decisions which are available, the events which might occur and their consequences.

d) Decision Trees

A decision table is a graphical representation of the various choices or decisions which are available in a process, and the events which might occur and their consequences.

A decision tree is a design tool which aids in analyzing the decisions that should be made within the processing and the sequence in which they occur.

Thus, a decision tree describes the path or sequence of events and decisions which will lead a system to some final position or outcome.

Consequently, a decision tree describes an action to be taken if some conditions are observed.

The graphic nature of a decision tree makes it preferable to a decision table, but in a complex process, a decision tree could be too extensive. In drawing a decision tree, each condition results in two branches Y or N (Boolean values). The drawing is top-down.

Let us consider an example under decision table.

Illustration 3.13.5. ABC Company processes customer's requests using the following rules:

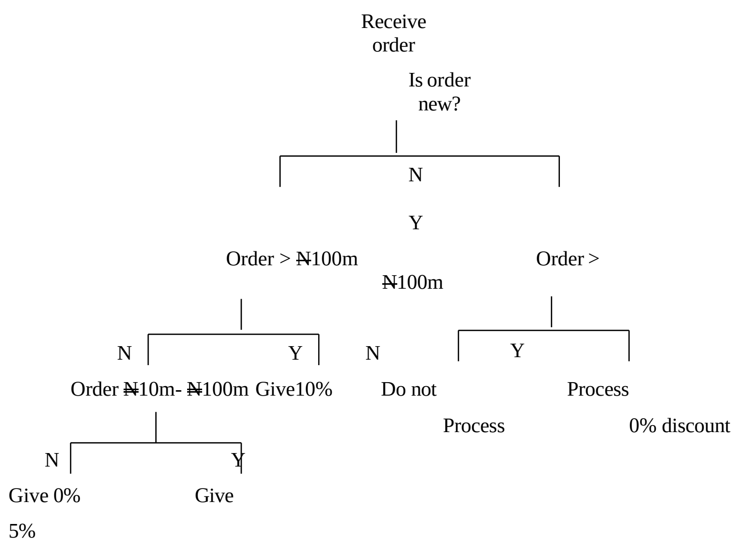
(a) If an order is between ₦10m and ₦100m, give 5% discount;

(b) Orders above ₦100m attract 10% discount;

(c) Orders below ₦10m attract no discount;

(c) New orders must be above ₦100m and without discount

Solution 3.13.5



3.14 OFFICE AUTOMATION (OA)

3.14.1 Introduction

Office automation involves the use of computers, micro-electronics and telecommunications technology to manage information resources automatically.

The whole purpose of office automation is to integrate some, if not all, of the departmental functions in the organisation. The difference between today's office and that of the previous decade or so arise in the channel of communications and the flow of transmission. The terms 'electronic office' or 'paperless office' are often used to describe the modern office environment.

The implication is that more use is now made of varied office equipment in the office than used to be the case in the past, leading to the minimal, if at all, use of paper. For example, organisations now use electronic mail for both internal and external communication.

The computer is used in many different ways to handle almost all office routines. We now consider some of the computer and telecommunication resources used in OA.

3.14.2 Word Processing

Word processing packages have facilities to assist various people, including accountants, in the creation and editing of text and graphics in letters, reports, Web pages or e-mail messages while performing a number of functions including the following:

(a) Text manipulation: The user is given the ability to insert, delete, move, edit, retrieve text, etc;

(b) Production of standard letters: A standard letter can be typed and stored and then be used over a period of time;

(c) Mail-merging: This gives the facility for standard letters to be personalised by the use of details stored on a mailing list;

(d) File merging. It is possible to have standard details stored on a file and then incorporated into other letters or documents; and

(e) Document checking. A dictionary and a thesaurus are available to be used to check spelling and grammar.

3.14.2a. Advantages of word processing

1. Production of personalized letters of a standard type
2. Easy amendment and updating of files
3. Can make corrections easily
4. Low error rate in the text
5. Higher quality for layout of text and printer
6. Quick and fast means of producing a standard document
7. User friendly with easy-to-learn procedures

8. Quieter machines and less bulky equipment and reports

3.14.2a. Disadvantages of word processing

1. Physical health injury by constant looking at VDU or Screen
2. Vexing delays and inactive period for word processing operators
3. High cost of acquisitions and maintenance

3.14.3 Desktop Publishing (DTP)

Desktop publishing packages have become very popular now and may be used to present reports and various documents in an exceptionally professional way. These are applications software that use the PC, mouse, scanner and usually a laser printer to mix text and graphics, including photos, to produce high-quality printed output.

Text is usually composed first on a word processor, artwork created with drawing and painting software, and photographs scanned in using a scanner. Prefabricated art and photos may also be obtained from clip art,

Often the laser printer is used to get an advanced look before the completed job is sent to a typesetter for higher-quality output. Desktop publishing has had a major impact on

the computing world and a wide range of DTP applications are currently available, including, Aldus PageMaker, Venture Publisher, First Publisher and Microsoft Publisher.

Desktop publishing has the following features:

(a) Mix of text with graphics: The package allows user to manage and manage text with graphics. While laying out a page on screen, one can make the text flow like a liquid around graphics such as photographs;

(b) Varied type and layout styles: The package provides a variety of fonts or typestyles and one can create different rules, borders, columns, and page numbering. A style sheet in the package makes it possible to choose and record the settings that determine the appearance of the pages;

(c) Use of files from other programs: The DTP package can be used to integrate a number of files from different programs, including prefabricated art obtainable from disks containing clip art, or images that can be used to illustrate DTP documents; and

(d) Page description language: Much of the shaping of text characters and graphics is done within the printer rather than in the computer. Software called a 'page description language' is used to describe to the printer the shape and position of letters and graphics. An example of a page description language is Adobe's PostScript, used with Aldus PageMaker.

3.14.4 Facsimile (Fax)

A fax machine - or facsimile transmission machine - scans a document or an image and sends it as electronic signals over telephone lines to a receiving fax machine that recreates the document or image on paper.

There are two types of fax machines - dedicated fax machines and fax modems.
The dedicated fax machine is a device that is meant only to send and receive fax documents.

The fax modem is installed as a circuit board inside the system unit of the computer. It is a modem with fax capability that facilitates the sending of signals directly from one computer to another fax machine or computer fax modem.

The main shortcoming with the fax modem is that one requires an image scanner or graphics scanner to scan in external documents.

3.14.5 Audio Teleconferencing and Videoconferencing

Present day telephone systems allow users to connect together a number of callers (usually more than two) in different geographical locations. This makes it possible to hold a conference by telephone. This is referred to as audio teleconferencing (or conference call). A variation of this

Meeting format is called videoconferencing, in which use is made of television video and sound technology together with computers to enable people in different geographical locations to see, hear, and talk with each other. The use of 'Webcamera' (Webcam) technology on PCs has made videoconferencing via the Internet a cheaper option than investing in special equipment and facilities.

Videoconferencing has led to video mail (V-mail) in which video messages can be sent, stored, and retrieved just like e-mail.

Audio teleconferencing and videoconferencing have the following advantages:

(a) Information and views can be shared by the participants simultaneously;

(b) It enables people to conduct business meetings without the need to travel; and It eliminates the time and expense involved in travelling to attend a meeting.

SPREADSHEET

Spreadsheet is a collection of cells organized into rows and columns. Spreadsheet program is a software application for micro –computer in a form of text. It provides a facility to perform accounting and financial analysis, such as budgets, cost projections etc.

- It is possible to store data in tabular form
- It aids management decision making
- Data in spreadsheet can be displayed in variety of graphical form.

The popular spreadsheets in use are lotus 1-2-3 and Microsoft Excel. A spreadsheet is a program that creates a table of data in terms of another data within a table. It is a computerized column card. It is sometimes called worksheet. The intersection of each column and row defines a CELL.

a. USES OF SPREADSHEET

The following are some of the uses of spreadsheet:

1. It can be used to make statistical analysis most effective.
2. It is used for scientific and engineering purpose
3. It is used as tool for numeric analysis
4. They are used in business world to make a protection for the user by setting up a model to simulate the realworld.

b. TYPES / EXAMPLES OF SPREADSHEET

The following are some examples of spreadsheet package:

1. Visical C
2. Lotus 123
3. Super calc
4. Multiplan
5. Microsoft

c. FACILITIES AVAILABLE ON ELECTRONIC SPREADSHEET

1. Data Entry
2. Spreadsheet Control
3. Command System
4. Help System
5. Data Output
6. Data Worksheet
7. Data Graphic Sheet

d. COMPONENTS OF SPREADSHEET

1. Accessing the spreadsheet from the operating system
2. Saving the worksheet
3. Retrieving or creating a new worksheet
4. Printing the worksheet
5. Deleting the worksheet
6. Exiting from a worksheet and doing something else.

e. APPLICATIONS OF SPREADSHEET

The following are some of the application areas of spreadsheet:

1. Analysis performance of products, people or dealers. The spreadsheet model can compare sales or expenses by salesperson, sales or product line.

2. Exploring alternative investments:, and internal payback period, return on investments, and internal rates. One can explore the outcome under different conditions, such as charging interest rate.
3. Preparing and analysis financial statements; Models for these statements can automatically calculate operating ratios such as the current and quick ratios that reveals a business liquidity.
4. Forecasting and budgeting: Spreadsheet model can be used for forecasting and budgeting of sales, expenses or profit can be done periodically and compared with actual result so that changes and trends are revealed both in monetary value and percentage.
5. Cash Flow Projection: Cash flow projection can be done with relative ease using a given spreadsheets

3.15 INTERACTING WITH MS WINDOWS

3.15.1 Introduction

Earlier in this chapter, we learnt that the computer software is divided into System Software and Application Software. The system software is made up of the following programs:

- The Operating System (OS),
- The Utility Software,
- The Language Translators
- The Editors, and
- The Loaders that

It was pointed out, the OS is the most important element of the System Software and it allows the end-user to interface with the hardware. Also the Application packages interface with the hardware via the OS. For example, when an end user wants to print a document from a word processor, the package works with the OS to send the document to the printer.

Different companies manufacture their own operating systems which are not compatible with each other. The most common are

- Windows – manufactured by Microsoft and called MS Windows
- Mac OS – manufactured by Apply Computing and
- Linux – used for Web operations

3.15.2 MS Windows

This operating system has several versions and the newest older versions are;

- WINDOWS XP
- WINDOWS 2000
- WINDOWS 98

All these versions have almost the same capabilities, although newer versions look prettier and more robust. All, the same, they perform various system maintenance functions such as copying files and turning off the system.

3.15.3 Working Around The desktop

The major parts of the Windows desktop include

(a) Start button: This opens the start menu, which is used to open all programs and documents.

(b) Taskbar: This displays buttons of open applications and windows as well as different toolbars for different tasks.

(c) Notification Area: This is formerly called system tray and it holds the clock, volume control and icons for other utilities that run on the background of the system.

(d) Sidebar and Gadgets: This area on the right side of the desktop holds various utilities, called gadgets, that sit on the desktop and perform specific operations.

(e) Shortcut Icons: These are links to software programs installed on the desktop.

Note that a "clean" desktop includes just one icon, for the Windows Recycle Bin.

(f) Recycle Bin: This is where files to be deleted are dumped.

3.15.4 Windows Operations

To use Windows efficiently, the following simple operations, such as pointing and clicking, dragging and dropping, and right-clicking allow the end user to interact with Windows.

a). Pointing and Clicking

The most common mouse operation is pointing and clicking. To select an object on the screen, move the mouse on the desktop until the cursor is pointing to the object and then the left button on the mouse is clicked once.

Pointing and clicking is an effective way to select menu items, directories and files.

b) Double clicking

Double clicking (in rapid succession) the left hand button on the mouse will activate on operation such as, to open program groups or launch individual programs

c). Right Clicking

This is one of the secret keys to efficient Windows operation. Selecting an object on the screen and then right clicking the right button on the mouse, will give a pop-up menu. This menu, when available, contains commands that directly relate to the selected object. For example, a right click on a file icon, will pop-up commands related to the file - such as COPY, MOVE, DELETE, e.t.c.

d). Dragging and Dropping

Dragging is a variation of clicking. To drag an object, point at it with the cursor and then press and hold down the left mouse button. Move the mouse without releasing the mouse button and drag the object to a new location and then release the button to drop the object onto the new location. For example, dragging and dropping can be used to move files from one folder to another or to delete files by dragging them onto the Recycle Bin icon.

e) Hovering

When the cursor is positioned over an item without clicking the button on the mouse, this operation is called hovering. Many operations require the cursor to hover and then perform some other actions.

f) **Scrolling Through a Window**

Many windows contain more information than can be displayed at once.

For example, in a long document or web page, only the first part of the document or page is displayed in the window. To view the rest of the document or page, the window is scrolled down using the various parts of the scrollbar.

There are several ways to scroll through a window. To scroll up or down a line at a time, click the up or down arrow on the window's scroll bar

To move to a specific place in a long document, the mouse is used to grab the scroll box (which lies between the upper and down arrows) and drag it to a new position.

We can also click on the scrollbar between the scroll box and the end arrow, in order to scroll one screen at a time.

g) **Using Menus**

Many windows in Windows use a set of pull-down menus to store all the commands and operations that can be performed. The menus are aligned across the top of the window, just below the title bar, in what is called the menu bar. A menu can be opened (or pull down) by clicking the menu's name. The full menu then appears just below the menu bar. A command can be activated by clicking on it using a mouse

h) **Using Toolbars**

Some Windows programs put the most frequently used operations on one or more toolbars, typically located just below the menu bar. A toolbar looks like a row of buttons, each with a small picture (called an icon) or a bit of text. The associated command or operation is activated by clicking the appropriate button using the mouse.

3.16 WINDOW EXPLORER

(a) Start Menu

All the software programs and utilities on the computer are accessed via Windows" start menu, which is displayed by using the mouse to click the start button, located in the lower-left corner of the screen. To open a specific program or folder, click the name of the item. For example, to view a program, click on All Program arrow.

This displays a new sub-menu called the Program menu, from which various programs can be accessed, sorted by type of manufacturer.

(b) Introducing Windows Explorers

In Windows vista, all the items stored on the computer – including programs, documents and configuration settings – are accessible from special windows, called Explorers. Window explorers are used to find, copy, delete, launch and configure programs and documents.

There are many different Explorers in Windows vista. For example, clicking on the Music icon from the start menu opens the Music Explorer, which then displays all the songs stored on the computer hard disk.

(c) Documents Explorer/My Document

The most used Explorer is the Documents Explorer, which is where all documents, photo, music, and other files stored on the computer hard disk. Clicking the documents icon from the start menu opens a window full of folders. Double click a folder icon to view the contents of the folder – which could be individual files or additional folders (i.e. subfolders). To launch a program or open a document, double click that item icon. To perform other tasks (e.g. copying, deleting e.t.c. right click the icon and select an option from the pop-up menu.

(d) Computer Explorer/My Computer

The Computer Explorer (with reference to Windows Vista) or My Computer allows access to each major component of the computer and perform basic maintenance functions. For example, My Computer/ Computer Explorer allows the "Opening" of the

contents of the hard disk and then do maintenance such as copy, move, and delete individual files.

To open the Computer Explorer, click on the Computer icon in the Start menu. The Computer Explorer contains icons for each of the major components e.g. the hard disk drive, external drives, CD-ROM or DVD drive e.t.c

The content of each drive e.g. a list of files and folders is viewed by double clicking on the icon for the driver. The content of any folder is then viewed by double clicking on the icon.

(e) Control Panel

The Control Panel (another Windows Explorer reference to Windows Vista) is used to manage Windows Configuration settings. To open the Control Panel, click the Control Panel icon in the Start menu.

When the Control Panel opens, we can select any particular category, we wish to configure. Each item selected opens a window with a different set of options successive clicking leads to the specific item desired.

(f) MOUSE

A computer mouse is a small handheld device that is connected to the CPU by a cable. Most mice (plural of mouse) consist of an oblong case with a roller underneath with two or three buttons on top. When a mouse is moved along the desktop, a pointer called a cursor moves on the screen in response to the movement. When the button is clicked (i.e. pressed and released) the motion initiates an action in the program.

Recently, wireless mouse is also in operation. Mouse is considered as a pointing input device

(g) GRAPHICAL USER INTERFACE (GUI)

As pointed out in chapter three, the Operating System (OS) are stored on the hard disk and part of the OS is stored in the primary memory when the computer system boots up. After the OS is in the RAM, it begins to manage the computer and provides a user interface. Different operating systems and application software use different types of user interfaces, with the most typical being command line interface and Graphical User Interface. It is through these interfaces that the user interacts with the computer.

The command line interface requires that text commands are typed into the computer through the keyboard to perform basic operations such as DELETE. Unix is an example of an operating system that uses command line interface.The most common type of interface for the Desktop Computer (PC) is the Graphical User Interface (GUI). The GUI uses pictures, icons and menus to send instructions from the user to the computer system. Examples of Operating Systems using GUI are Windows and Mac OS.

3.17 CHAPTER SUMMARY

3.17.1 The software is divided into System Software and Application Software.

3.17.2 Some examples of System Software are Operating System (OS), Language translator, Utility Routine, Loader, Editor. Etc.

3.17.3 Operating Systems is the most important system software. There are Operating Systems for standalone computers, minis, and mainframe.

3.17.4 There are also Operating Systems for different environments such as integrated application, multiprocessing, and multiprogramming.

3.17.5 The language processor converts the source code into machine readable Form,

3.17.6 Application packages are meant for specific process and every process that runs on the computer has an associated application package.

3.17.7 The bureau plays important functions to those people or companies that could not acquire computer system or as a standby facility for those that have computer systems; and

3.17.8 Off-the-shelf packages are general application packages while bespoke software are tailored application packages.

3.17.9 There are now five generations of computer languages: Machine languages, symbolic assembly language, high-level languages, very high-level language and the fifth generation languages which are used in artificial intelligence (Al);

j) Machine and assembly languages are classified as low level languages, and they execute faster but use lengthy and difficult coding;

k) High-level languages, such as BASIC and FORTRAN, make use of programmers" spoken language and they are classified as natural languages but they execute slowly;

l) Very high-level languages, such as RPG, are non-procedural;

m) Fifth generation languages will also make use of natural languages and are used in AI;

n) The major computer operations are Arithmetic computations, comparisons, and I/O operations;

o) Program flowchart, decision table, decision tree and structured English are aids to program development.

Office automation was discussed with regards to appropriate software, hardware with references made to a few applications.

Finally we looked at the MS Windows which are an operating system for the Desktop Computer system. We identified the use of the start button and the use of the start menu. We studied the process of working around the desktop windows and the window operations both in the MS Windows, Vista and other earlier versions of MS Windows. We studied the use of mouse in the Window operations.

We studied the use of the menu as an aid to Windows operations. We also considered the functions of Window

Explorer, My Document, My Computer and Control panel.

3.18 MULTIPLE CHOICE QUESTIONS

1. Which one of the following is not a programming language?
   - (A) Machine Language
   - (B) Symbolic Language
   - (C) Narrative Language
   - (D) High-level Language
   - (E) 4GL

2. C^{++} is an example of………………………..
   - (A) Object Oriented Language
   - (B) Machine Language
   - (C) Symbolic Language
   - (D) Low level Language
   - (E) High level Language

3. Computer Operating System is…………………
   - (A) An application software
   - (B) A user application package
   - (C) A system software
   - (D) An interface
   - (E) A machine driver software

4. MS Excel is an example of………………
   - (A) Word processor
   - (B) Spreadsheet
   - (C) Presentation software
   - (D) Graphical Software
   - (E) Desktop Publishing Package

5. Multiprocessing capability can be achieved by……………
   - (A) Operating system
   - (B) Application Package

(C) User software

(D) Computer memory

(E) Language processor

6. Operating System manages the following computer resources except……………

(A) CPU Time

(B) Memory Space

(C) Cable Sharing

(D) Input /Output Devices

(E) File System

7. Which of the following is NOT a Word processing package? ……………

(A) MS Word

(B) Word Perfect

(C) Multimate

(D) Multiplan

(E) Display Right

8. A system program that converts a source program written in high-level language to machine code at a go is called? ……………

(A) ASSEMBLER

(B) COMPILER

(C) INTERPRETER

(D) LOADER

(E) EDITOR

9. Which of the following is NOT a desktop publishing package? ……………

(A) MULTIPLAN

(B) PAGE MAKER

(C) CORELDRAW

(D) ISTUDIO PUBLISHER

(E) MICROSOFT OFFICE PUBLISHER

10. All the following are examples of Utility program except? ……………

(A) LOADER

(B) TEXT EDITOR

(C) LINKAGE EDITOR

(D) SORTER

(E) ASSEMBLER

11. Sequencing, Selection and Repetition are examples of……………………..

A Computer program instruction

B System flowchart elements

C Computer program operations

D Program flowchart elements

E Process flowchart elements

12. Which of the following is **NOT** an aid to computer program construction?

A Structural Narrative Language

B Program flowchart

C Decision table

D Decision free

E Structured system Analysis and Design

13. The following are advantages of using high level languages EXCEPT?

A. It is easier to write and understand because of the use of English

B. It is problem oriented

C. It is machine dependent

D. It is a Procedure oriented language

E. It can be compiled and executed on several machines

14. A software program that is designed to perform a specific task is known as

A. Operating System

B. System Software

C. Customised Software

D. Utility Software

E. Application Software

15. Which one of the following is NOT a function performed by a system software?

A. Provision of utility services

B. Providing settings for application packages

C. Enabling the use of peripheral devices

D. Memory management

E. Providing suitable environment for program development

16. The software capable of creating, retrieving, expanding and maintaining a database is called

A. Database software

B. File management system

C. Database management system

D. Database program

E. Database library

17. An automated file for storing definitions of data elements and their characteristics such as usage
and physical relationships is known as

A. Database management system

B. Data manipulation language

C. Database language

D. Data Dictionary

E. Data definition language

18. A keypad on the keyboard that creates blank space when it is pressed is called

A. Control key

B. Shift key

C. Space bar key

D. Back space key

E. Navigation key

19. A peripheral device used to move or drag objects in a Graphical User Interface environment is

Called

A. Operating system

B. Windows

C. Desktop

D. Icon

E. Mouse

20. Which of the following is NOT a component of the menu displayed of Microsoft Word package?

A. View

B. File

C. Help

D. Data

E. Insert

21. Assembly language is in which of the following generations of computer?

A. First

B. Second

C. Third

D. Fourth

E. Fifth

22. The main purpose of program flowchart is to:

A. Create graphical illustration of the program logic

B. Clarify the logic of the algorithm

C. Beautify program logic

D. Provide an interface for user

E. Provide an interface for computing

23. Window operating system is an example of which one of the following?

A. Single-user operating system only

B. Single-user and Multi-tasking operating system

C. Multi-tasking operating system only

D. Multi-user and Multi-tasking operating system

E. Multiuser operating system only

24. In computer programming, a repetitive statement is also known as a

A. Cycle

B. Turn around

C. Loop

D. Round robin

E. Ring

25. The components of desktop windows are:

A. statusbar, background and icons

B. start botton, status bar, background and icons

C. start botton, program menu and icons

D. start menu, program menu and background

E. status bar, background and font

26. Microsoft power-point is an example of--------- package

A. Graphical

B. Spreadsheet

C. Word-processing

D. Presentation

E. Accounting

27. An application generator is an example----------

A. First

B. Second

C. Third

D. Fourth

E. Fifth

28. The following are example of electronic spreadsheet package used on microcomputers EXCEPT:

A. Excel

B. Multiplan

C. Multimate

D. Quattro

E. Supercalc

29. Which of the following is NOT an example of object oriented Language?

A. Small talk

B. Java

C. C^{++}

D. Visual Basic

E. Ada

3.19 SHORT ANSWER QUESTIONS

1. A 4GL package that enables a user or a programmer to develop a set of programs that comprise an entire application is called……………..
2. Compiler, Interpreter and Assembler are examples of…………………..
3. A data field that uniquely identifies a record is called……………………
4. The application software that enables users to create and manipulate data organised in rows and columns is known as ……………………
5. The technology capable of processing text, graphics, video, sound and animation is called ……………………
6. A collection of files, integrated and organised to provide a single comprehensive file system is known as ……………………
7. The method of batching inputs and queuing the output on the same magnetic medium is called ……………………
8. The use of several processing units (processors) linked together to perform Co-ordinated work concurrently is known as……………………
9. The software system that is responsible for the creation, expansion, maintenance and provides access to a database is called?....................................
10. Throughput is the amount of useful..................performed during a given a

period of time.

11. OMR as an input device is an example of a ....document

12. START and END are.........................instructions used in program flowchart.

13. Software is a generic term for all......................that run on the hardware system.

14. In program flowchart, less than operation is....................operation.

15. The programming language whose instructions are made up of operation codes that specifies operations to be performed and operant address that specifies the memory address of the operant is called ________________________

16. An application package that has facilities to assist Accountants in creating and editing texts. Graphics, letters, and reports is called

17. The use of television, video and sound technology together with computers to enable people at different locations to see, hear and talk with one another is called_______________________________________

18. A suite of computer programs that controls the use of the hardware and acts as an interface with application programs is called ------------------

19. The operating system that allows many users to work on one computer at the same time where each user has processing capability at is end is called-------------

20. Program solution plan expressed in a meta language, containing step-by-step actions to be taken to solve a particular problem is called------------

21. Assembly language is said to be machine dependent where as a

procedural language is said to be-----------

22. The software program that places program segments into the appropriate locations in the memory ready for execution is called---------

23. C^{++} is an example of what type of programming language?

24. The pictorial or diagrammatic representation of the steps to be followed in an algorithm is called-----

25. A collection of files, integrated and organized to provide a single comprehensive file system is called--------

26. A program that converts a source program written in high level language into machine code/object program is called-------

27. The ability of an operating system to execute users task concurrently is known as---------

28. The style of computer programming that uses the principle of object is called------

29. The two type of editors that convert input into a particular output format are text editor and -----editor

30. The application software that can be purchased from the computer vendor is called------ application

31. The use of video and sound technology together with computer to enable people in different location to see, hear and talk with each other is called----------

3.20 SOLUTIONS TO MULTIPLE – CHOICE QUESTIONS

1. C
2. A
3. C
4. B
5. A
6. C
7. D
8. B
9. A
10. B
11. A
12. E
13. C
14. C
15. E
16. C
17. D
18. C
19. E
20. D
21. B
22. A
23. D
24. C
25. B
26. D
27. D
28. C
29. E

3.21 SOLUTION TO SHORT ANSWER QUESTIONS

1. Application Generator
2. Language Translator or Processor
3. Primary key.
4. Spreadsheet
5. Multimedia
6. Database.
7. Spooling
8. Multiprocessing
9. Database management system (DBMS).
10. Work
11. Turnaround
12. I/O (Input/Output)
13. Programs
14. a Logical
15. Machine language
16. Word Processing
17. Video Conferencing
18. Operating system
19. Multi-user
20. Pseudocode
21. Problem-oriented
22. Loader
23. Object-oriented

24. Flowchart

25. Database

26. Computer

27. Multi-tasking

28. Object-oriented programming

29. Linkage

30. Off-the-shelf

31. Videoconferencing

SECTION B

1. Enumerate any FIVE requirements of a multi-user application

SOLUTION: The requirements of a multi-user application include:

a. Terminal controllers for controlling the operations of groups of terminal

b. If remote-terminal involved, there is need for MODEMS, Multiplexers and front-end-processor

c. Private leased communicator

d. A powerful processor to support the multi-user environment for polling the lines to allocate time slots.

e. Large memory capacity for storing various user program as well as high overhead required for storing operating system.

f. Protection feature for preventing system crash

g. Record/ file locking and unlocking facilities to prevent a record file being updated by another user

2a. Enumerate the source of application packages.

b. state any FIVE factors to be considered when selecting application packages.

SOLUTION: a. Sources of application packages include:

1. Mail order sources as advertised in computer magazines

2. Retail shop/stores (over the counter)
3. Dealer (vendor) of microcomputer
4. Manufacturer to computer who also develop software
5. Software house that develop software
6. Computer bureau and information center
7. In-house programmers (who develop software as part of their job)

b. Factor to be considered for selecting application package include:

1. Purchase price of the package
2. Type of hardware and operating system designed for the environment e.g Single user or multi-user
3. Integration of the package with other standard packages
4. RAM capacity of the hardware on which the package will be installed
5. Processing time and response time fast enough
6. Availability of full and clear documentation
7. Ability of the supplier/dealer to demonstrate the package
8. Ease of use and user friendliness (menu, screen prompts, help)
9. Adequacy of control (e.g passwords, data validation checks, accounting controls)
10. Provision of updating/ amending/ modifying the package
11. Support and maintenance service to be provided by the software supplier

3. High level language are written in programmer's language.

You are required to:

a. State any FIVE features of High-level languages
b. Enumerate any THREE advantages and TWO disadvantages of High- level language
c. List any FOUR examples of High-level language
d.

SOLUTION

a. Features of High-level Language include:

i. Facility to describe data to be processed, that is, specification of the data types. e.g integer, Real etc
ii. Facility to describe operators on appropriate data item e.g division, operation on integers
iii. Inclusion of allowable characters e.g upper-case and Lower- case alphabet

iv. Allowable controls (or branching) structures and the syntax used e. g logic If statement, repetition (looping) statement etc
v. Input and output statement that allow data to be read and allow information to be sent to the screen respectively
vi. Inclusion of syntax and semantic structures i.e precise specification of work and allowable operations.

b. Advantages of High-level language include:

i. It is easier to write and understand since it is written in programmer's spoken language e.g English
ii. It is machine independent
iii. It is problem oriented ie written to solve a particular problem
iv. It is a procedure-oriented language
v. It speeds up program testing and error correction.

Disadvantages of High level language include:

i. Less efficient in term of speed during execution
ii. Less efficient in the use of internal memory management

c. Examples of High level language include

i. FORTRAN (Formular Translator)
ii. COBOL (Common Business Oriented Language)
iii. BASIC
iv. PASCAL
v. PL1 (Programming Language 1)
vi. Ada
vii. C
viii. APL

4a. Enumerate the basic operation performed in a computer program.
b. List the purposes of program flowchart

SOLUTION: The basic operations are;

a. Input and output operation which allows data to be read by an input device and information to be written to screen respectively
b. Arithmetic operation which include: Addition, Multiplication, Subtraction, division and

exponentiation

c. Logical operation for comparison of two data item that results to a Boolean value: TRUE or FALSE. The operations include: less than or equal to, greater than, greater than or equal to and equal to.

d. Branching operations which are:

- Sequencing e.g READ data from a file; WRITE thus data into another file
- Selection e.g Logical IF, IF-THEN-ELSE, GOTO, CASE etc
- Repetition or looping for executing certain basic instruction several time. Looping is a sequence of instruction that are executed repeatedly until a specified condition is satisfied. e.g DO----UNTIL

b. Purposes of program flowchart include:

i. To clarify the logic of the algorithm
ii. To analyze the actions resulting from a set of condition
iii. To sort out the procedural steps in the program
iv. As an aid to program construction and coding
v. As a communicating document in program documentation

5. What is the basic function of each of the following Microsoft windows operations?

SOLUTION

a. Menu bar: located at the top left of the MS-WORD window is a drop-down menu of command used on MS-WORD files e.g creating new file, opening existing file, saving and printing

b. Toolbar is made-up of icons that serves as shortcut (using mouse) to common ms-word command

c. Start-botton is used to open all the software programs and utilities on the computer for access.

d. My computer allows access to each major component of the computer and perform basic maintenance functions such as copy, more and delete individual files

e. My document provides a means to access quickly all the documents, photo, music and other files stored on the computer hard disk

f. Control panel provide access to windows configuration settings. It also provides means to manage the setting.

CHAPTER FOUR
DATA PROCESSING

CHAPTER CONTENTS

(a) Types of files;

(b) Processing Activities;

(c) Characteristics of Files

(d) File Organisation

(e) Processing Techniques

(f) Configuration of processing

(g) The role of Microcomputers in an Accounting Environment

(h) Information Centre;

(i) Computer Service Bureau

(j) Information Processing and Electronic Business Technologies

(k) E-commerce

4.0 OBJECTIVES

After reading this chapter, the reader should be able to ;

(a) Learn the concept of computer file and file organizations;

(b) Appreciate different date processing activities;

(c) Distinguish among the types of data processing methods.

(d) Understand the role of a microcomputer in the accounting and finance environments

(e) Understand role of user departments

(f) Appreciate the functions of an information centre; and

(g) Understand the concept and services available from a computer service bureau

(h) Distinguish among various information systems

(i) Describe various e-commerce models, electronic payment systems and digitized middleman

4.1 Elements of a Computer File

An **entity** is something about which information is stored. Examples include Employee, Inventory items, customers e.t.c. The characteristics of interest in each entity is called an **attribute**, which needs to be stored. Examples are:

(a) For Employees, possible attributes are pay rate and PIN

(b) For Customers, possible attributes are Name and Address.

Generally, each type of entity possesses the same set of attributes. However, the specific data value for those attributes will differ among entities. Data values are stored in a physical space called a **Field**.

A Computer file consists of a number of records. Each record is made up of a number of fields and each field consists of a number of characters.

We now define these terms in details.

(a) Character is the smallest element in a file and can be alphabetic, numeric or special symbols. Each character, which is 1 byte is made of 8 bits in the EBDIC code system;

(b) Field is a collection of characters, e.g name, address, pay rate e.tc;

(c) Record is a collection of related fields, i.e a field is an item of data within a record. Example: A customer record consists of name, address; and

(d) Data base is a combination of files containing related data.

Considering the table below, we have four fields and three records

Table 4.1 (Employee files)

S/N	PIN	EMPLOYEE NAME	PAY RATE	SEX
1.	3501	M. O. ADE	5,000	M
2.	1152	S. A. OJO	7,000	F
3.	1005	T. J. KOFI	3,000	M

There are two common ways of viewing computer files:

(a) Logical Files are viewed in terms of what data items its records contain and what processing operations may be performed upon the files. The user of the file will normally adopt such a view.

(b) Physical file is viewed in terms of how the data is stored on a storage device such as magnetic disk and how the processing operations are made possible.

Note that a logical file can usually give rise to a number of alternative physical file implementations.

4.2 Types of Files

Three basic types of files are used to store data.

(a) **Master file** is of a fairly permanent nature and it is regularly updated to show a current position. For example, customer ledger, payroll, inventory e.t.c. are master files. Customer's order will be processed to change the balance, but the name, address e.t.c. will be static.

(b) **Transaction (or movement) file** is made up of the various transactions created from the source documents. For example, in a sales ledger application, the file will contain all the orders received at a particular time. This file will be used to update the master file and then discarded. Thus, it has a short life span.

(c) **Reference file** has a reasonable amount of permanency. Examples of data used for reference purposes are price lists, tables of rates of pay, names and addresses.

4.2.1 Primary and Secondary Keys

Primary Key:- is a unique identifier of a record. Examples include:

(a) Customer number in a customer ledger record;

(b) Stock code number in a stock record; and

(c) Employee PIN in a payroll record.

Sometimes, the primary key is made from the combination of two fields. In this case it is called a composite key or compound key. A secondary key is another field to identify a record, although it is not unique, it is used to identify a group of records and it can be used to sort records. For example, the state of origin of the customer might be a secondary key.

Note: Not only does the key fields assist in accessing records but also the records themselves can, if required, be sorted into the sequence indicated by the keys.

4.3 Processing Activities

The major processing activities are:

(a) Updating which involves changing the master file to reflect a current position. e.g updating a customer ledger record with new orders;

(b) Referencing involves access to a particular record to ascertain its content e.g access to a price file during an invoicing run;

(c) File maintenance involves addition and deletion of records in order to create a new file, thus updating a file with new records; and

(d) File Enquiry or Interrogation: This is similar in concept to referencing. It involves the need to ascertain a piece of information from a master file.

4.3.1 Characteristics of Files

We discuss four characteristics of files.

(a) **Hit Rate:-** Is used to measure the rate of processing of master files in terms of active records. It is the ratio of the number of records found and processed during a particular processing run, to the total number of records available.

For example, if 2,000 transactions are processed each hour against a master file of 20,000 records, then hit rate is 10.

Thus, Hit rate = $\frac{Nu \ldots i \ldots i}{N \ldots}$

(b) **Volatility:-** Is the frequency with which records are added or deleted from a file. If the frequency is high, the file is said to be volatile. A semi-static file has a low frequency. A static file is not altered at all.

(c) The **Size** of a file is the amount of data stored in it and expressed in terms of characters or records.

(d) **Access Time** on disk is the time interval between the moment the command is given to transfer data from disk to main storage and the moment the transfer is completed.

4.4 File Organisation:- We consider file organization on both tapes and disks. File organization refers to the way data are stored on the physical storage media.

(a) File Organisation on Tape

Organisation of a file on tape is simply placing the records one after the other onto the tape. There are two such possible arrangements.

(a) Serial: - This is achieved when records are written onto tape without any relationship between the record keys. Unsorted transaction records would form such a file.

(b) Sequential: - This occurs when records are written in sequence according to the record keys. Examples include:

(i) Master file
(ii) Sorted transactions file

(b) File Organisation on Disk

We consider four basic methods:

(i) **Serial: -** This is the same method as in tape

(ii) **Sequential: -** This is the same again as in tape

(iii) **Indexed Sequential:-** This is same as in sequential organization but with an important difference – an index is provided to enable individual records to be located. Thus, the index will determine the sequence.

(iv) **Random or Direct Access:-** Stores records in no particular order. Instead a mathematical algorithm is applied to the primary key to determine the physical address at which to store the record.

4.4.1 Factors Determining the Method of Data Processing

The common factors determining the methods of data processing are:

(a) Size and Type of Business

(b) Timing Aspect

(c) Link Between Application

- **Size and Type of Business**

  The size means the volume of transaction in the business. Business with large volume of transaction will require the use of computers, while businesses with low volume of transaction will use manual method or electro-mechanical devices like calculators.

- **Timing Aspects**

  The frequency of information will determine the methods and the equipment needed for processing. For example, information on payroll might be monthly while information on invoices are virtually all the time.

- **Link Between Application**

  Sometimes, a simple pool of data might be needed by many applications and this will determine the technique to be used. For example, the data on items sold will be needed by the price list, the stock file, the invoicing production. This can easily be done through the Data Base Management System (DBMS) unlike the manual system.

4.5 Stages of Data Processing

Whatever might be the method employed, the following stages will be followed during data processing (DP).

(a) Origination of data i.e the source of data (Source document);

(b) Preparation for data entry depending on the method, whether batch, On-line or Real-time;

(c) Input the data;

(d) Processing to get the information using appropriate software; and

(e) Output through appropriate medium.

4.6 Processing Techniques

Depending on the determining factors for data processing, transaction may either be processed singly or in batches. A batch is a number of transactions accumulated together and processed at a predetermined time as a single unit.

4.6.1 Batch Processing

Updating master files periodically to reflect all transactions that occurred during a given time period is called Batch Processing. The master file is updated at pre-determined times (e.g. daily or weekly) or whenever a manageable number of transactions are

gathered.

Note that, the transactions data can either be entered as a batch or as each transaction occurs. Data entry as each transaction occurs is called Online Batch Processing.

In Batch processing, the jobs are entered and stored on a disk in a Batch Queue before being run under the control of an operating system (OS).

Note:- The time that elapses between the submission and the return of result is called the **Turn-around** time.

Advantages of Batch Processing

1. Repeated jobs are done fast in batch systems without user interactions
2. No special hardware and system support to input data in batch systems
3. Batch systems can work offline so it makes less stress on processor
4. It is less expensive
5. It encourages proper documentation of transaction data
6. It allows enough time for independent review and authorisation of input data by responsible officer before processing
7. Computer failure and temporary breakdowns have less impact on processing
8. Specific time can be assigned for batch jobs so when the computer is idle, it starts processing the batch jobs
9. Sharing of batch systems for multiple users

Disadvantages of Batch Processing

1. There is delay in the generation of computer output
2. Accumulation of data often put pressure on the computer staff during processing of transaction
3. There is no direct access to the system by the user department
4. Computer operators must be trained for using batch systems
5. It is difficult to debug batch systems
6. If error occurs in job (batch system) then other jobs will wait for unknown time
7. Batch systems are sometime costly

4.6.2 Remote Job Entry (RJE) Processing

This refers to (batch) processing where jobs are entered at a terminal remote from the computer and transmitted to computer on-line (i.e through telecommunication links) or offline using external storage systems.

4.6.3 On-Line Processing

Online processing method is the processing of data in which data is processed from terminals connected to the central processor.

Advantages of Online Batch Processing

1. It enables data to be captured close to the place where transactions occur
2. It minimises paper work
3. It prevents delays caused by the manual transmission of data and computer output between terminal and central processor
4. It enables interactive data processing
5. It enables users to directly access view and update files maintained at the central computer
6. It makes error correction easy
7. It is less labour intensive than offline systems
8. It avoids the risk of unauthorised amendment of data and output in transit

Disadvantages

1. It is more expensive to set up and maintain than offline systems
2. It may cause the host computer to be overloaded
3. It increases the risk of unauthorised access to the computer files from remote terminals
4. Electronic data processing activities may be halted where the host computer breaks down
5. Repeated jobs are done fast in batch systems without user interactions

4.6.4 On-line Real-Time Processing

In this method, the computer captures data electronically, edits it for accuracy and completeness and immediately processes it. The processing of data is done so quickly that the results are available to influence the activity currently taking place. Note that all real-time systems are On-line but not all On-line systems are real-time. hence online batch processing is not real-time. Examples of real-time processing include:

(a) International Hotel Reservation

(b) Airline reservation and

(c) Space exploration

Note that real-time processing is used for critical systems where time delay is not allowed.

Advantages of Real-time processing

1. Computer output is instantaneously made available
2. The output from real-time processing can be used to influence the transaction
3. Avoid the use of consuming and unnecessary paper work
4. It enables users to see the cumulative effect of all transactions for decision making
5. It avoids costly and time consuming data preparation and control operations

Disadvantages of Real Time processing

1. No adequate time for the clerical checking and authorisation of the input data
2. Very complex to design, implement and maintain
3. Increases the risk of unauthorised access to the computer
4. Reliant on the continued existence and proper functioning of the computer system
5. It requires a lot of expertise
6. It is very expensive
7. The intensive light from the monitor of the computer affects the eyes of users

4.7 Configuration of Processing Methods

There are three basic ways to configure the Processing Methods i.e to determine the arrangements and locations of the computer systems.

4.7.1 Centralised Processing Method

Here, all processing are done in a single place e.g. the headquarters of the organization and results are later distributed to the various departments. In centralized processing method, all terminals and other devices are connected to a central corporate computer (called a server)

Advantages:- It provides

(a) Better control over the processing

(b) More experienced I.T staff

(c) Economics of scale that is cheaper to run

Disadvantages

(i) Greater complexity

(ii) Higher communication cost of results to the departments

(iii) Less flexibility in meeting the needs of individual departments.

(iv) No departmental secrecy

4.7.2 Decentralised Processing Method

Here, each department does its own processing using its own I.T Staff within the department. There is no connection among the departments; and even with the Headquarters.

Advantages

(a) It allows the departments to meet their needs and separate users" needs.

(b) Less communication cost associated with distribution of information

(c) Departmental secrecy is achieved since data is stored locally.

Disadvantages

(i) Complexity of coordinating data among the departments.

(ii) Increase in administrative cost

(iii) Increase in machinery/hardware costs

(iv) Greater difficulty in implementing effective control.

4.7.3 Distributed Data Processing (DDP)

This processing system is an hybrid of the centralized and decentralized systems approaches. Each location has its own computers to handle local processing and the departments are all linked to each other and the corporate server.

Advantages

(a) Since the departments are linked, they back up each other. Thus, there is less risk of catastrophic loss, since resources are in multiple locations.

(b) Since local processing are treated as module, more modules can easily be added or deleted from the system,

Disadvantages

(i) The multiple locations and varying needs complicate the task of coordinating the system and maintaining hardware, software and data consistency.

(ii) Difficulty in standardizing documentation and control, since authority and responsibility are distributed.

(iii) Multiple location and communication channels hinder adequate security controls and separation of duties.

(iv) Data duplication of multiple location creates increase in data storage costs and data inconsistency

4.8 Effects of CPU and Operating Systems

In data processing, processing jobs/tasks can be done in several ways depending on the type of CPU in use. We consider the following types;

- Time sharing
- Multi-processing
- Multi-tasking
- Multi programming

(a) Time Sharing Processing

This is the method of data processing which enables many users to gain access to centrally located computer by means of terminals. The central computer allocates equal CPU time (time slice) to each of the users to perform their jobs. The users are attended to wither on first-come first-served basis or according to predetermined priority levels.

The user with the highest priority is attended to for the time slice and on expiration of the time, the next user with the next highest priority is serviced until all users are serviced. A time slice is a brief amount of CPU time given to a process for user by the operating system

Advantages

1. The facilities may be provided either by an in-house installation or by a computer time sharing bureau

2. Each user is geographically remote from the central computer and from each other
3. The system interacts with many users, giving each of them fast individual attention on time.

Disadvantages

1. System interlocking may create disturbances.
2. Non-availability of computer resources to be shared.
3. When the system fails, it fails completely and totally.

(b) Multi-tasking Process

This is a system that allows the computer to work on more than one job or task at a time. A multitasking system used on personal computers usually support a single user running multiple programs at one time.

Multitasking is accomplished in these ways:

a) Context switching – User switches back and forth between programs.

b) Cooperative multitask – programs switch when they reach a logical breakpoint.

c) Pre-emptive multitasking – Operating system switches programs based on allocated amount of time and priority.

(c) Multi-Processing Technique

This is an act of executing several processes simultaneously by a computer with more than one Central processing unit. Computers that have more than one CPU are called multi processors.

A multi-processing system coordinates the operations of the CPU using either asymmetric or symmetric multiprocessing. With asymmetric processing, processing is assigned to a specific CPU with its own memory.

With symmetric multiprocessing, processes are assigned to whatever CPU that is available. Memory is shared among the CPUs.

Symmetric multiprocessing is more complex, but achieves a higher processing rate because the operating system has more flexibility in assigning processing to available CPUs

Advantages

1. If one processor (CPU) fails, the processing system can shift work to the remaining CPUs
2. The system provides fast throughput for jobs
3. It pays particular attention to individual tasks/jobs to give them rapid service
4. If a task/job requires more resources than are available on any of the systems, all the resources can be pooled together to serve only one process.

(d) Multi Programming

Multiprogramming is a technique that enables a number of programs (jobs) to interleave with each other such that the execution of one program is overlapped with the I/O operation of the other programs. Multiprogramming is adopted in order to reduce the idle time of the central processor. In multiprogramming environment, many jobs/tasks may be run/executed at the same time, i.e. jobs can be loaded into the memory and the processor(s) assigned to them in sequence. For efficiency, jobs to be multi programmed should be properly selected to maximize the use of the system's resources.

4.9 The Role of Microcomputers in The Accounting and Finance Environments

4.9.1 Introduction

The user-friendliness of the microcomputer and its associated software, accompanied by the low cost and ready availability of the microcomputer software make the microcomputer the preferred type of processing tool in most organisations. The activities that take place in the typical accounting and finance environments lend themselves well to the use of personal computers (microcomputers).

4.9.2 The Use of Microcomputers in the Accounting and Finance Environments

A number of personal computer (PC) accounting packages are currently available for use by the Accountant.

A number of general accounting software products such as spreadsheet and database programs exist that can be used to process accounting transactions. There are also integrated accounting packages that may be used for features like:

(a) Creation of chart of accounts,

(b) Recurring journal entries,

(c) Variance analysis reports,

(d) Payroll,

(e) Accounts payable, and

(f) Accounts receivable, etc.

4.9.3 Microcomputer Business Applications

The typical business applications facilitated by the microcomputer include payroll, stock control, purchases, invoicing, sales ledger, general ledger, etc.

The various ways in which a microcomputer will be utilised in an organisation will vary depending, among others, on the nature of the business, its organizational structure, management style, geographical dispersion of its operating units, and volume of work.

However, it is amply evident that the computer has taken over a lot of what the accountant previously used to handle manually, especially in the areas of management reports of all kinds, forecasting and modelling.

4.10 THE INFORMATION CENTRE

4.10.1 Introduction

The widespread dependence on computer-based information systems means that many individuals and organizations will have to use computer systems

However, some of these individuals may not be very knowledgeable in the use of the computer and so must necessarily depend on others for assistance. The Information Centre is there to play this role in the organisation.

4.10.2 Definition of Information Centre

An information centre (1C) is a department or office that is manned by technically skilled staff that assists the Information System (IS) department staff with regards to user requests and complaints.

A help desk is an office or a desk with staff using a number of telephones and hot lines to receive various user staff complaints and requests. These are eventually passed on to information centre for solution. This is very important because not all the user staff are likely to be IT experts, hence there will always be issues that they will need assistance in.

This arrangement ensures that Information Systems (IS) staffs have sufficient time to focus on their routine functions, thus avoiding any backlog of work. The IC staff, however, are not supposed to be usurping the powers and functions of the IS staff.

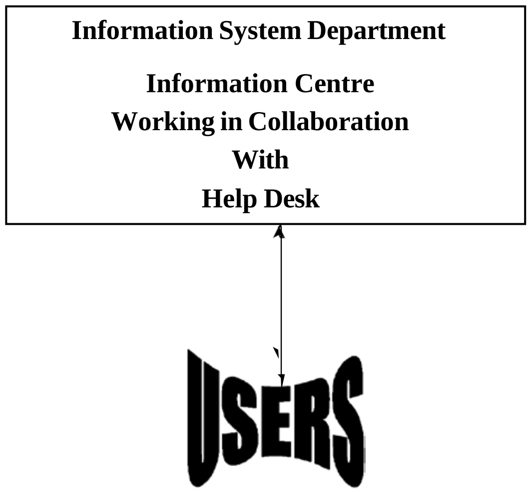


Fig. 4.~~1~~1~~6~~ Information Centre Arrangement

4.10.3 Role of User Department.

A **user** is a person who uses a computer system or network service. Users generally use a system or a software product without the technical expertise required to fully understand it.

Users are expected to play the following roles in an Information Systems environment:

a) Specify requirements. During system development and acquisition, users will specify exactly their need to the IT team.

b) Use the hardware and software responsibly for the business of the organisation

c) Report issues in the right format as agreed in the organisation.

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d) Comply with the usage policy of their organisations.

e) Report any suspicion of breach of security in their system to the appropriate quarters

f) Users are not expected to develop the software themselves, regardless of how much technical knowledge they may possess.

4.10.4 Staffing of an IT Department

The major roles available in an IT department (depending on the size of the organisation) are as follows;

a) Software engineer (application programmer, software architect, system programmer/engineer.)

The work of a software engineer typically includes designing and programming system-level software: operating systems, database systems, embedded systems and so on. They understand how both software and hardware function.

b) Systems analyst (Product specialist, systems engineer, solutions specialist, technical designer.)

Systems analysts investigate and analyse business problems and then design information systems that provide a feasible solution, typically in response to requests from their business or a customer.

c) Business analyst (Business architect, enterprise-wide information specialist.)
   Their job function involves analysing users' needs, gathering and documenting requirements and creating a project plan to design the resulting technology solution.
d) Technical support (Help desk support, operations analyst)
e) Network engineer (Hardware engineer, network designer)
   Their role involves setting up, administering, maintaining and upgrading communication systems, local area networks and wide area networks for an organisation.
f) Software tester (Test analyst, software quality assurance tester).
   Their job involves preparing test scripts and testing applications before they are released to end users.

4.11 FACILITIES MANAGEMENT

4.11.1 Introduction

Occasionally, an organisation may find itself owning its Information Systems (IS) facilities and most often, the full complement of IS staff as well. Depending on the type

of system used and the level of complexity associated with it, the organisation may be compelled to engage an outside firm to manage its IS facilities on its behalf. This is what we refer to as Facilities Management

4.11.2 Definition of Facilities Management

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Facilities Management (FM) is defined as the management and operation of part or all of an organisation's Information Systems (IS) services by an external source for a fee, at an agreed service level and for an agreed time period.

The facilities management contract may further include IT consultancy, the management of IT services, the provision of new services and ownership of hardware and software.

4.11.3 Scope of Facilities Management

Computing facilities that could be taken over by FM will include

(a) project management assistance
(b) complete control of systems development
(c) running an entire IS function.

The FM company usually takes over the employment contracts of the organisation's IT staff. The terms and conditions of employment are protected by legislation in the form of the Transfer of Undertakings, Protection of Employment (TUPE) regulations. This implies that even in the event of the FM contract being terminated, the IT staff hired by the FM company still retain their jobs.

4.11.4 Reasons for Using Facilities Management

The reasons for using facilities management include

a) the organisation may not have the staff, management time or expertise to organize a substantial part of its IS requirements

b) controlling cost; the contract for services may specify the cost in advance and extra costs may be borne by the FM company

c) economies of scale may exist where a number of organisations employ the same FM company; any research carried out by the FM company can be shared between them

d) the FM company may employ staff with specific expertise that can be shared between several customers. Once a company has handed over its IS function to another company, it is locked into the arrangement, the decision being difficult to reverse.

e) The arrangement enables the company to concentrate on its core business, without bothering on the management of its information processing system.

Should the FM Company's services be unsatisfactory, the effort and expense of the company re-building its own IS facility will be enormous.

INFORMATION SYSTEMS

Definition of Information System

Information System is an integrated set of components for collecting, storing and processing data into information, knowledge and digital products.

Information Systems are deployed by diverse organisations to achieve a wide range of objectives These include:

1. Management of internal operations;
2. Management of relationships with customers, suppliers, etc.;
3. Management of relationships with regulatory authorities, publics, etc
4. Provide effective tools of competition in the marketplace; and
5. Delivery of digital products.

Organizations that use information systems include:

1. Commercial organizations;
2. Regulatory authorities;
3. Non-Governmental Organizations (NGOs);
4. Educational Institutions; and
5. Digitized middlemen, etc.

Components of Information Systems

The following are the main components of an information system:

1. Information Technology, comprising of the following:

a. Computer Hardware

These are

- Computer CPUs
- Input and output devices
- Storage devices.

b. Computer Software

These are

i. System Software, such as operating systems which enables users to control the computer. They also manage the program files, data, hardware and other system resources.

ii. Application Software

These are programs designed to meet the specific requirements, needs or tasks of the user. They can be general purpose such as spreadsheets, word processors, etc.

c. Telecommunication networks

These are used to connect computer systems and other devices and transmit information amongst them and with the external environment. The network can be through wired or wireless media.

d. Databases and Data warehouses

A database is a collection of inter-related data arranged so that individual data or a group of data meeting specific criteria can be accessed, retrieved and processed to generate information or digital product.

Massive collection and processing of data on a subject of interest on the world wide web produces ‘Big Data’. Big Data provides general trends in the environment on which prompt decisions can be taken.

Data Warehouse is a data management system that contain large amounts of historical data derived from a wide variety of sources and designed for queries and analytics. They enable and support business intelligence.

2. Human resources

These are the skilled manpower required to manage the entire process. The human resources include:

a. IT specialists, such as systems engineers, systems analysts, programmers, etc
b. Security experts to design security systems and processes to prevent breaches
c. Management to provide resources direction of operation.
d. Uses of the system to specify the tasks to be undertaken, the problems to be solved, and the format of the solution.

3. Procedures and Processes.

These are the details of the steps that will be taken to transform input data to information or product in a secure environment

Type of Information System

As discussed earlier, information systems can be classified by the type of function they perform. These functions can be grouped into three broad categories, thus:

1. Operational Support

This class of information system perform or support the performance of different functional areas of the organisation. They include

a. Supply Chain Management (SCM)
b. Transaction Processing System (TPS)
c. Customer Relationship Management (CRM)
d. Office Information System (OIS)

2. Support for Expert (knowledge) work

This system automates decision-making process by experts such as Accountants, Lawyers, Doctors, Auditors, Engineers, etc. They are also use to facilitate collaboration amongst internal units of the organisation, and with other organizations. They include

a. Expert (Professional) Support Systems (ESS)
b. Collaboration systems
c. Knowledge Management Systems.

3. Management support

These are systems that facilitate general management decision making and discharge of other Management responsibilities. They include

a. Executive Support System (EIS)
b. Decision Support System (DSS)
c. Management Information System (MIS)

These categories may be arranged into an hierarchical structure as shown below

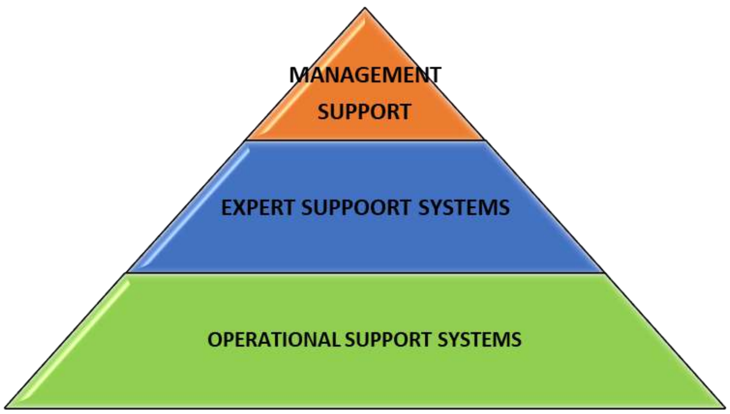


FIG.4.2 HIERARCHICAL ARRANGEMENT OF INFORMATION SYSTEMS

We shall discuss some of these systems to highlight their functions

a. Supply Chain Management (SCM)

   Supply chain management is the management of the flow of goods and services. It includes all processes that transform raw materials into final products. It involves the organising the supply side of a business to maximize customer value and gain a competitive advantage in the marketplace. The information system that handles this process is termed Supply Chain Management (SCM) System.

   Benefits of Supply Chain Management System

   1. It reduces cost of delivery of products to customers
   2. Ensure faster delivery of good and services to customers

3. It reduces incidence of product recall, hence cost.
4. It reduces incidence of lawsuits on unsatisfactory delivery of goods and services to customers.
5. It avoids shortages of raw materials, finished goods and all other required components.
6. It generates customer goodwill which gives competitive advantage in the marketplace.

Elements of SCM System

- A Supply Chain Management System comprises of the following five key element:

    - Development of a strategy
    - Procuring raw materials
    - Managing the production process
    - Managing the distribution process
    - Handling the processes of returns inwards and outwards.

b. Transaction Processing System (TPS)

A Transaction Processing System (TPS) is **a type of information system that collects, stores, modifies and retrieves the data transactions of an enterprise**. They also provide predictable response times to requests,

Benefits of TPS

- It enhances accuracy of transaction records
- It enhances speed of processing, thus reducing transaction time
- It reduced processing cost
- Makes transaction time predictable to customers

The main activities of TPS include:

Transaction processing systems generally involve the following five steps:

1) **Data entry**

2) Transaction processing

3) File and database updating

4) Document and report generation

5) Processing of inquiries

Types of TPS processing:

There are two types

- Real-time and
- Batch processing

c. Customer Relationship Management (CRM)

- telephone calls.
- Social media

New areas of CRM include cloud-based CRM systems and artificial intelligence.

Customer relationship management (CRM) refers to the principles, practices, and guidelines that an organization follows when interacting with its customers. It involves direct interactions with customers, such as sales and service-related activities, forecasting, and the analysis of customer trends and behaviours.

For our present purpose, CRM is the technology systems organizations use to manage their external interactions with their customers at all points during the customer lifecycle, i.e. from prospecting, to education, purchase, and aftersales.

Elements of CRM

Organization' s CRM may include

- company's website and emails
- mass mailings

Benefits of CRM

- It creates positive experiences with customers, thus enhancing brand loyalty.
- It provides the organization with trends in consumer behaviour.
- It provides a useful tool for generating competitive edge in the marketplace.
- It reduces marketing costs.
- It enhances after-sale services

d. Office Information System (OIS)

An office information system OIS) is **an information system that uses software, hardware, and networks to improve work flow and help communications among employees**. **It provides the technical support and service for the timely retrieval of accurate information by computerised systems to enable effective planning, operation and monitoring of services** in an organization.

Benefits of Office Information System

- Improved accuracy of records.
- Reduced costs in office administration.
- Reduced time and resources.
- Improved data storage and management.
- It provides more insights into the organization's date and hence enables management to take more informed decisions.
- Business process improvement.

(e) Executive Support Systems (ESS)

An Executive Support System (ESS) is software that allows users to transform enterprise data into quickly accessible and executive-level reports, such as those used by billing, accounting and staffing departments. An ESS enhances decision making for executives.

II facilitates and supports senior executive information and decision-making needs. It provides easy access to internal and external information relevant to organizational goals.

It is also referred to as Executive Information System.

Components of ESS

A typical ESS has four components, thus:

- hardware
- software
- user interface
- telecommun**ication**.

a. Decision Support System (DSS)

A decision support system (DSS) is a computerized program used to support judgments, and courses of action in an organization or a business environment. A DSS accesses and analyses massive amounts of data, synthesizing them into comprehensive information that can be used to solve problems and in decision-making.

Typical information used by a DSS includes target or projected revenue, sales figures or past ones from different time periods, and other inventory- or operations-related data.

Benefits of Decision Support System

Below are some benefits of Decision Support Systems

- They help in making more informed decisions.
- They are used to make actionable decisions,
- They enable production of multiple possible outcomes based on current and historical company data.
- DSS can be used to produce reports for customers that are easily digestible.
- DSS reports can easily be adjusted based on user specifications.
- They facilitate timely problem-solving,
- They provide improved efficiency in dealing with issues or operations, planning, and management.
- They are flexible, hence, are portable from one industry to another.

A **management information system** (**MIS**) is an information system used to perform management functions including decision-making, and for the coordination, control, analysis, and visualization of information in an organization.

The ultimate goal of the use of management information system in a corporate setting is to maximise the value of the firm by providing managers with timely and appropriate information allowing them to make effective decisions within a shorter period of time.

Historical Eras of MIS

Kenneth C. Laudon and Jane Laudon in their book *Management Information Systems i*dentified five eras of MIS as indicated below:

- First Era – Mainframe and minicomputer computing
- Second Era – Personal computers
- Third Era – Client/server networks
- Fourth Era – Enterprise computing
- Fifth Era – Cloud computing

The following are types of information systems used to create reports, extract data, and assist in the decision making processes of middle and operational level managers.

- Decision support systems (DSSs) are computer program applications used by middle and higher management to compile information from a wide range of sources to support problem solving and decision making. A DSS is used mostly for semi-structured and unstructured decision problems.
- Executive information system (EIS) is a reporting tool that provides quick access to summarized reports coming from all company levels and departments such as accounting, human resources and operations.
- Marketing information systems are management Information Systems designed specifically for managing the marketing aspects of the business.
- Accounting information systems are focused accounting functions.
- Human resource management systems are used for personnel aspects.

- Office automation systems (OAS) support communication and productivity in the enterprise by automating workflow and eliminating bottlenecks. OAS may be implemented at any and all levels of management.
- School Information Management Systems (SIMS) cover school administration, often including teaching and learning materials.
- Enterprise resource planning (ERP) software facilitates the flow of information between all business functions inside the boundaries of the organization and manage the connections to outside stakeholders.[10]
- Local databases, can be small, simplified tools for managers and are considered to be a primal or base level version of a MIS.

Benefits of MIS

The following are some of the benefits that can be attained using MIS:[11]

- It helps managers make better and faster decisions.
- It improves an organization's operational efficiency.
- it adds value to existing products.
- it engenders innovation and new product development.
- It facilitates managers' ability to identify their companies' strengths and weaknesses due to the presence of revenue reports, employee performance records etc.
- It helps a company improve its business processes and operations.
- It gives an overall picture of the company.
- It acts as a communication and planning tool.
- MIS can allow a company to gain a competitive advantage.

E-commerce

E-commerce (electronic commerce) is **the buying and selling of goods and services, or the transmitting of funds or data, over an electronic network, primarily the internet**.

Common areas of E commerce applications:

- Finance.
- Manufacturing.
- Retail and Wholesale.
- Online Marketing

- Online Booking.
- Online Publishing.
- Digital Advertising.

Benefits of e-commerce:

1. **Convenience:** Online commerce makes purchases simpler, faster, and less time-consuming, allowing for 24-hour sales, quick delivery, and easy returns.
2. **Personalization and customer experience:** E-commerce marketplaces can create rich user profiles that allow them to personalize the products offered and make suggestions for other products that they might find interesting. This improves the customer experience by making shoppers feel understood on a personal level, increasing the odds of brand loyalty.
3. **Global marketplace:** Customers from around the world can easily shop e-commerce sites – companies are no longer restricted by geography or physical barriers.
4. **Minimized expenses:** Since brick and mortar is no longer required, digital sellers can launch online stores with minimal startup and operating costs.

Common e-commerce models:

1. **Business to Consumer (B2C):** This an e-commerce model which involve a business transacting business directly with consumer. It usually takes the form of a sale to an ultimate consumer, e.g. buying a product from the website of a retailer.

   B2C e-commerce is the most popular e-commerce model.

2. **Business to Business (B2B):** B2B e-commerce refers to a business selling a good or service to another business, like a manufacturer and wholesaler, or a wholesaler selling to a retailer. Business to business e-commerce does not involve the ultimate consumer.

   It usually involves products like raw materials, software, or products that are combined.

   Manufacturers may also sell directly to retailers via B2B e-commerce.

3. **Consumer to Consumer (C2C):** C2C e-commerce refers to the sale of a good or service by one consumer to another consumer. Consumer to consumer sales take place on platforms like eBay, Etsy, Fivver, Jiji, etc.

4. **Consumer to Business (C2B):** Consumer to business model occurs in a situation when an individual sells his/her services or products to a business organization. C2B have examples in photographers, consultants and other professionals, freelance writers, etc offering their services to business organizations.

5. **Direct to Consumer (D2C):** Direct to consumer e-commerce is the newest model of ecommerce. D2C means that a brand is selling directly to their end customer without going through a retailer, distributor, or wholesaler. Subscriptions are a popular D2C item, and social selling via platforms like InstaGram, Pinterest, TikTok, Facebook, SnapChat, etc. are popular platforms for direct to consumer sales.

6. **Manufacturer to Consumer (M2C)**

   This is a form of D2C model of e-commerce by which manufacturers relate directly with ultimate consumers, thereby eliminating wholesalers, distributors and retailers.

E-GOVERNMENT

Governments and public enterprises deploy e-commerce models to enhance efficiency, transparency and spread their interactions with businesses, citizens and other governments and agencies.

The corona virus pandemic gave a huge boost to e-governance implementation because of the enhanced efficiency and the mandatory social and physical distancing required while delivering services.

According to **United Nations' definition**, e-government comprises three integral parts:

1. **Government-to-Government (G2G)** involves sharing data and conducting electronic communications between government agencies. This consists of intra- and inter-agency interactions at the national level and exchanges between the national, provincial, and local levels.

2. **Government-to-Business (G2B)** is a relationship between businesses and government, where government agencies of various levels provide services .. G2B is **a business model that refers to government providing services or information to business organization**. Government uses B2G model website to approach business organizations. Such websites support auctions, tenders and application submission functionalities.

The range of the G2B services is broad. Below, you can see just a few of them:

- Online information and advisory services to businesses
- Government contracting
- Digital procurement marketplaces
- Business licenses, permits, and regulation updates
- Electronic auctions
- Tax payments, and reporting
- Electronic forms
- Online application submission functionalities
- Virtual business dispute resolution
- Online companies registration

G2B refers to business-specific transactions (such as payments, selling and acquisition of goods and services, etc.) and the provision of business-focused services online.

- **Government-to-Citizen (G2C)** programs are meant to make it easier for citizens and consumers of public services to communicate with the government. This covers interactions, including the delivery of public services and participation in consultation and decision-making processes.

A newly identified category Is Government to Employees

- **Government-to-Employees (G2E)** includes maintaining personal information and employee records. It also involves e-payroll (to view paychecks, pay stubs, pay bills, and keep records for tax information) and e-learning (to keep employees informed on the important materials they need to know through the use of visuals, animation, or videos via a computer-based learning tool).

ELECTRONIC PAYMENT SYSTEMS

Electronic payments(e-payment) systems **allow customers to pay for goods and services electronically**, without the use of cheques or cash. Some common modes of e-payment are:

- debit cards
- credit cards
- direct bank deposits
- e-wallets
- cryptocurrencies.

Features of Electronic Payment system

Important characteristics for an electronic payment system include

- **ease of use –** E-payment systems are easy to implement and use.
- **security –** They provide a secure mode of payment.
- **reliability –** The technology is reliable.
- **scalability –** They are useable over wide range of scope of operation.
- **anonymity –** They provide anonymity for the transaction.
- **acceptability –** This mode of payment is widely accepted.
- **customer base –** It enhances the merchant's ability to widen its customer base by providing access to more customers.
- **flexibility –** They are very adaptable to various uses.
- **convertibility –** They allow proceeds to be easily converted to other forms liquid assets
- **efficiency –** They are efficient mode of payment, with very low transaction cost.
- ease of integration with applications – This technology and its products are easily integrated into other applications for further processing.

Benefits of Electronic Payment to the Merchant

Benefits derivable from the deployment of e-payment include:

- It saves time.
- It's more efficient.
- It takes cash out of the equation.
- It's more secure.
- It generates more revenue.
- It's easier to administer.
- There's a certainty of payment.

Automated Teller Machine (ATM)

An automated teller machine (ATM) or bank machine or cash machine is an electronic banking outlet that allows customers to complete basic transactions without the aid of a branch representative or teller.

Anyone with a credit card or debit card can access cash at most ATMs. There are also ATMs which allow cardless transactions.

No fees are charged for transactions by account holders on the ATMs of their banks, however, fees may be charged for services on the ATMs of other banks.

There are two main types of ATM, thus:

a. Basic ATM which only dispenses cash and displays balances.

b. Complex or Advanced ATM which performs other banking transactions, such as accepting deposits, transferring funds between accounts and settlement of bills.

Components of ATM

ATMs contain the following basic components:

- **Card reader**: This part reads the chip on the front of the card or the magnetic stripe on the back of the card.
- **Keypad**: The keypad is used by the customer to input information, including personal identification number (PIN), the type of transaction required, and the amount of the transaction.
- **Cash dispenser**: Bills are dispensed through a slot in the machine, which is connected to a safe at the bottom of the machine.
- **Printer**: If required, consumers can request receipts that are printed here. The receipt records the type of transaction, the amount, and the account balance.
- **Screen**: The ATM issues prompts that guide the consumer through the process of executing the transaction. Information is also transmitted on the screen, such as account information and balances.

Full-service machines now often have slots for depositing paper checks or cash

Benefits of ATM

1. They are easy to use for customers

2. They are very efficient
3. ATMs are secure modes of payment
4. Their services are available round the clock
5. They are available in more locations than the bricks and mortar banking halls
6. Services may be received by customers from ATMs of banks other than theirs.
7. It reduces transaction cost for banks
8. It reduces cost of labour for tellers.

Mobile Payment Platforms

Mobile payments (including mobile wallets and mobile money transfers) are digitally **regulated transactions that take place through mobile devices** instead of cash, cheques, or physical credit cards.

Mobile Wallet

A mobile wallet is a virtual wallet that stores payment card information on a mobile device.

- Mobile wallets are convenient for users to make in-store payments and can be used at merchants listed with the mobile wallet service provider.
- Mobile wallets are safe apps for storing financial instruments and other documents such as credit cards, bank information, and even driver's licenses.
- Many smartphones come loaded with mobile wallets.
- Mobile wallets use near-field communication technology, which requires users to be present when paying for something.
- Mobile wallets utilize many layers of encryption and security to ensure that transactions are safe.

Online Payment Platforms

The online payment platforms **allow the seller to accept payments and the buyer to send payments over the internet**. The online payment system offers electronic alternatives to traditional payment methods such as money order and cheques.

Examples of online payment companies include PayPal, Apple Pay, Stripe, Due and Square.

- Credit cards: Credit cards allow consumers to draw on a line of credit to pay for goods and services.

- Debit cards: Customers draw from existing balance on their cards to pay for products and services.
- Digital wallets: stores information on debit or credit card. This can be used to pay for goods and services.
- **Internet Banking -** This is done by digitally transferring funds over the internet from one bank account to another. This method tends to be used by smaller businesses or personal users.
- Direct debit / bank transfer

Card Payments

Payment cards are part of a payment system issued by financial institutions, such as a bank, to a customer that enables its owner (the cardholder) to access the funds in the customer's designated bank accounts, or through a credit account and make payments by electronic transfer and access automated teller machines.
They are usually either debit cards, credit cards, charge cards and prepaid cards.

names including **bank cards**, **ATM cards**, client **cards**, **key cards** or **cash cards**.

These cards are usually electronically linked to an account or accounts belonging to the cardholder. These accounts may be deposit accounts or loan or credit accounts, and the card is a means of authenticating the cardholder.

It can also be a smart card that contains a unique card number and some security information such as an expiration date or with a magnetic strip on the back enabling various machines to read and access information.

Digitized Middleman

Digitized Middleman or Digital Middleman is a company that gathers information about the companies which provide similar types of services or products and displays them on their own website so that customers can procure those products or services through their site.
They include:

Amazon

Alibaba

eBay

Uber

Jumia

Konga

Jiji

4.12 CHAPTER SUMMARY **This chapter covers the following:**

(a) The smallest unit of data is the byte which is made up of 8 bits. A character can be an alphabet, numeric, or special symbols.

(b) A field is a combination of characters while a record is a collection of related fields and a file is a collection of records.

(c) We have primary key which is a unique identifier for record.

(d) Files are organized as serial, sequential, indexed sequential and random in disks.

(e) Batch processing is the updating of master files at a pre-determined time period.

(f) On-line processing is a technique where data is entered as it occurs.

(g) (On-line) real-time processing processes data as they occur and results are obtained immediately. It is used in critical events.

(h) Configuration of processing methods to be either centralised, decentralised or distributed

(i) Types of CPU and OS also determine other forms of processing methods as multitasking, multiuser, multiprocessing and multiprogramming

(j) Staffing and roles of Information centre

(k) Information systems and electronic business technologies

(l) Ecommerce and its various models

(m) Electronic payment methodsitized middleman

4.13 MULTIPLE-CHOICE AND SHOR ANSWER QUESTIONS

1. Which **ONE** of the following is odd?

    (A) Batch Processing

    (B) On-line processing

    (C) Independent processing

    (D) Real time processing

    (E) On-line Batch processing

2. Which **ONE** of the following is odd?

(A) Updating

(B) Referencing

(C) File processing

(D) File maintenance

(E) File Enquiry

3. A type of processing method that allows tasks to be gathered over a period of time and processed at the same time is called. processing

4. A type of computer bureau formed specifically to render computing services to clients is referred to as companies

5. Which of the following facilities **CANNOT** be taken over by facilities Management?

A. Project Management Assistance

B. Taking over employment contract of IT staff

C. Redeployment of IT staff to other departments

D. Complete control of system to service other departments

E. Running the entire Information System Function

6. The following are data processing methods **EXCEPT**

A. Transaction processing

B. Batch Processing

C. On-line Processing

D. Real time Processing

E. Ring Processing

7. A transaction processing technique with severe time limitation is called.

A. Time sharing processing

B. Distributed processing

C. Real time processing

D. Multitasking

E. Multiprocessing

8. Which of the following is **NOT** an example of real-time application?
   A. Payroll
   B. Airline reservation System
   C. Credit Card System
   D. Missile Guidance System È. Stock
   Control System
9. What is the processing technique by which many processors are used to accomplish data processing?
   A. Multiple Processing
   B. Multiprocessing
   C. Multiple Processor
   D. Multiprocessing
   E. Multiple Programming
10. IT personnel in user departments are directly responsible to the.................manager.
11. Which one of the following is NOT a data processing method?
    A. Batch processing
    B. On-line processing
    C. Distributed processing
    D. Multiprogramming
    E. Direct processing
12. Data processing that is carried out by the use of large computers in a single location is described as ....
13. The use of multiple computers in different locations linked by a communication network so that a single job is shared between them is formed..............
14. Accumulating source documents into groups prior to processing is a characteristic of ....processing?
15. An information system that responds immediately to the needs of the physical system is called.............. system

16. Information systems that monitor the elementary activities and transactions of the organizations are ________ .

A. Management level system
B. Operational level system
C. Knowledge level system
D. Strategic level system
E. Enterprise level system

Ans: B

17. Projections and responses to queries are Information output characteristics associated with ________.

A. Decision Support System (DSS)
B. Management Information System (MIS)
C. Executive Support System (ESS)
D. Transaction Processing System (TPS)
E. Office Information System (OIS)

Answer: Option C

18. Summary transaction data, high-volume data, and simple models are information inputs characteristic of _________________.

A. Decision Support System (DSS)
B. Management Information System (MIS)
C. Executive Support System (ESS)
D. Transaction Processing System (TPS)
E. Office Information System (OIS)

Answer: B

19. In computer the number system of 0 and 1 is called ____.

A. octal
B. hexadecimal
C. decimal
D. binary
E. dual

Answer: D

20. OLX is an example of ________ e-commerce segment.

A. B2B

B. B2C

C. C2B

D. C2C

Answer D. C2C

21. Customers pay a fixed amount, usually monthly or quarterly or annually, to get some type of service I is known as ________E-Commerce Business Model.

A. Licensing

B. Transaction

C. Affiliate

D. Subscription

E. Fee-based

Answer: D

22. .E-commerce has _____ scope than E-Business or Digital Business.

A. Higher
B. Narrower
C. Wider
D. Deeper
E. Better

Answer B

23. Companies like Flipkart, Amazon and Myntra belong to which type of Ecommerce (EC) segment.
   A. B2B
   B. B2C
   C. P2P
   D. C2B
   E. C2C

Answer B

24. The concept of online marketing and selling of products and services through the internet is _________
   A. B2G
   B. B2C
   C. B2B
   D. B2E
   E. M2C

Answer B

25.. What is the percentage of customers who visit a Web site and actually buy something called?
A. affiliate programs

B. click-through

C. spam

D. conversion rate

E. hit rate

D. conversion rate

26. What is the process in which a buyer posts its interest in buying a certain quantity of items, and sellers compete for the business by submitting successively lower bids until there is only one seller left?
A. b2b marketplace

B. intranet

C. reverse auction

D. internet

E. electronic bidding

C. reverse auction

27. What are plastic cards the size of a credit card that contains an embedded chip on which digital information can be stored?
A. customer relationship management systems cards

B. e-government identity cards

C. fedi cards

D. smart cards

E. call cards

D. smart cards

4.14 SOLUTIONS TO MULTIPLE - CHOICE QUESTIONS

1. C
2. C
3. B
4. Independent
5. C
6. E
7. C
8. A
9. B
10. C
11. E
12. Centralised Processing
13. Distributed Processing
14. Batch
15. Real-time
16. B
17. C
18. B

19. D

20. D

21. D

22. B

23. B

24. B

25. D

26. C

27. D

4.15. SELF-ASSESSMENT QUESTIONS

1) Describe the purpose an information centre serves in an organisation.

2) What is a computer service bureau?

3) Give any two reasons to show why facilities management is beneficial to an organisation.

4) What is meant by the term 'help desk'"?

5) Give any two reasons why the accountant finds the microcomputer quite invaluable.

ANSWERS TO SELF-ASSESSMENT QUESTIONS

1) In the organisation, an information centre gives the end-users of information systems the opportunity to interact with experts in order to get their work done, without putting undue pressure on the Information Systems staff.

2) A computer service bureau is an organisation that is set up to offer computing services to individuals or other organisations that require such facilities, but are not in any position to help themselves.

3) An organisation might find out that it needs to get into a facilities management contract because of reasons that include the following:

a) The organisation might not have staff with the requisite skills or the management competence to help itself.

b) The organisation may require the needed solution more cheaply and with the highest level of expertise.

4) A help desk is an office established with at least two staff members equipped with very reliable telephone facilities. These are used to receive complaints and problems from end-users of the system and find appropriate solutions to these problems from among the staff of the information centre

5) The accountant finds the microcomputer very invaluable because of reasons that include the following:

a) The microcomputer is very user-friendly and can also be carried over to any place where the accountant may find himself working.

b) There are numerous microcomputer-based software products that the accountant can use for any job that he has to perform with a computer and these products are quite inexpensive and very user-friendly.

CHAPTER FIVE

COMPUTER NETWORKS AND DATA COMMUNICATION

CHAPTER CONTENTS

(a) Computer Networks;

(b) Local Area Network; and Topologies

(c) LAN Security Issues;

(d) WAN and MAN;

(e) Data Transmission modes and media;

(f) Protocols

(g) ntranet, Extranet and Internet

(h) Wireless networks

(i) Application of the Internet

5.0 OBJECTIVES

After reading this chapter, the reader should be able to:

(a) Understand what computer networks are;

(b) distinguish among the three major types of network (LANs, MANs and WANs);

(c) understand the issues concerned with network security;

(d) understand major applications of the Internet;

(e) understand what is meant by computer crimes and how these can be managed; and

(e) understand what computer viruses and worms are and how to deal with them.

5.1 COMPUTER NETWORKS

5.1.1 Introduction

A computer network may be defined as an interconnection of a number of computers, telephones, and other shared devices in various ways so that users can process and share information.

Networks make it possible for users to share peripheral devices, programs and data; to be engaged in better communication; to have more secure information; and to have access to databases.

5.1.2 Types of Networks

Computer networks may be categorised as follows:

(a)Wide Area Network: A wide area network (WAN) is a communications network covering a wide geographical area such as a region of a country or an entire country. Most telephone networks are typical examples of WANs.

The Internet, for example, links together several computer WANs. Most telephone networks are typical examples of WANs.

The **internet** is a global computer network providing a variety of information and communication facilities, consisting of

interconnected networks using standardized communication protocols.

The Internet is **a vast network that connects computers all over the world**. Through the Internet, people can share information and communicate from anywhere with an Internet connection to the Internet, , links together everal computer WANs.

(b)Metropolitan Area Network: A metropolitan area network (MAN) is a communications network that covers a geographical area such as the size of a town, suburb of a city, or an entire city.

(c)Local Area Network: A local area network is a privately owned communications network that operates in a confined geographical area, usually within a kilometre radius. It could be operated within a building, a number of buildings close together, or on the campus of an educational institution. Local area networks are either Private Branch

Exchanges (PABXs) which is Private Automatic Branch Exchanges) or local area networks (LANs).

A Private Branch Exchange is a private or leased telephone switching system that connects telephone extensions in-house, and often also to the outside telephone system. Apart from analog telephones, PABXs can also handle digital equipment, including computers. They often share existing telephone lines with the telephone system
Local networks, on the other hand, require installation of their own communication channels, whether by the use of wires or wireless systems. A local area network consists of a communications link, network operating system, PCs, servers, and other shared hardware devices like printers, scanners, and storage devices all connected up within a small geographical area.

5.1.3 Network Topology and Protocol

The topology (or configuration) of a network refers to the logical layout or shape of the network. It describes the manner in which the various component computers are physically connected.

On the other hand, the protocol consists of the set of rules that governs the way information is carried over the network.

Our focus from this point on will be on local area networks.

5.1.4 Components of a LAN

Local area networks are made up of several standard components. They include the following:

(a) Connection or cabling - LANs are either wired or wireless. Wired networks may use twisted-pair wires, coaxial cables, or fibre-optic cables. The wireless networks use infra- red or radio waves;

(b) Network interface cards – Each computer on the network requires a network interface card in order to send and receive messages on the LAN;

(c) Network operating system - This software manages the activities on the network;

(d) Other shared devices - Other devices like printers, fax machines, scanners, and storage devices may be added to the network as necessary and shared by all users; and

(e) Bridges, Routers and Gateways - A LAN may stand alone or be connected to other networks. Various hardware and software devices may be used as interfaces for these connections.

A bridge or router will facilitate communication between similar networks, while a gateway makes it possible for dissimilar networks to communicate (e.g. a LAN with a WAN).

5.1.5 Types of LAN

LANs are of two basic types - Client/server and Peer-to-peer.

(a) A Client/server LAN consists of requesting PCs, called clients, and devices that provide a service, called servers. The various devices are connected to the file server, A file server is a powerful computer that stores the programs and data shared by all users on a LAN. A database server is a computer on a LAN that stores data (but not programs) for use on the LAN. A print server is a computer on a LAN that controls one or more printers. It stores the print- image output from all the PCs on the network and sends the output to the printer(s) one document at a time in a sequence.

(b) A Peer-to-peer LAN is one in which all the PCs on the network communicate directly with one another and there is no server. This is less expensive than the Client/server type and is quite effective for up to 25 (twenty-five) PCs; beyond this number, the network tends to be slow and quite ineffective.

5.1.6 LAN Topologies

At this point, we shall consider some key LAN topologies.

Network topology describes **the physical and logical relationship of nodes in a network. It is the schematic arrangement of the links and nodes, or some hybrid combination thereof**.

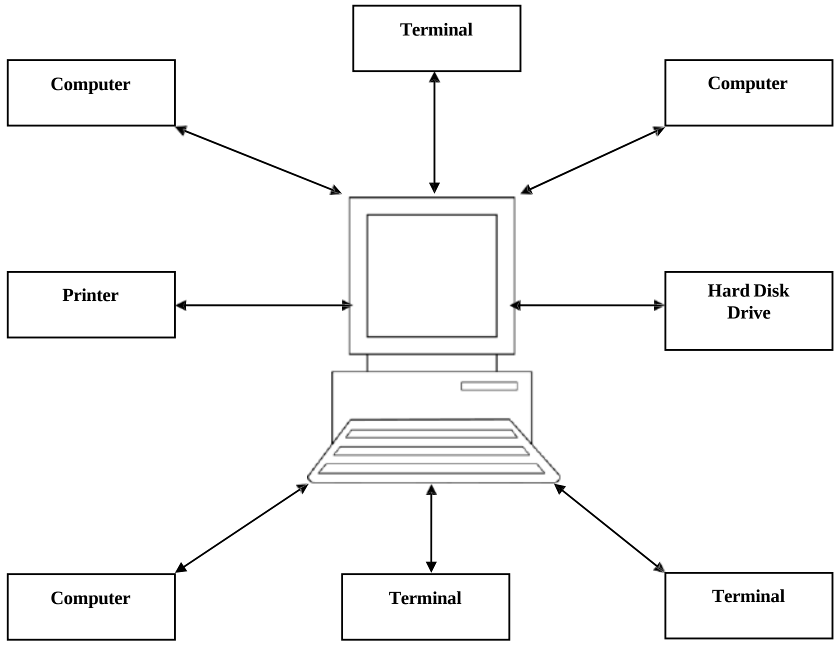
Network topology is the representation of the structure of a network and may be depicted physically or logically. It is an application of graph theory therein.

(a) Star Network

On the star network, all the PCs and other communications devices are connected to a central server. This is a typical example of a Client/server LAN. No client is allowed to communicate directly with other clients. Electronic messages are routed through the server to their various destinations. The server monitors the flow of traffic. The advantages are that the server prevents collision of messages and also if a connection is broken between any communications device and the server, the rest of the devices on the network will continue to function. The main disadvantage is that a breakdown of the server renders the network inoperative.

A PBX system is an example of a star network.

Fig. 5.1 - Star Local Area Network

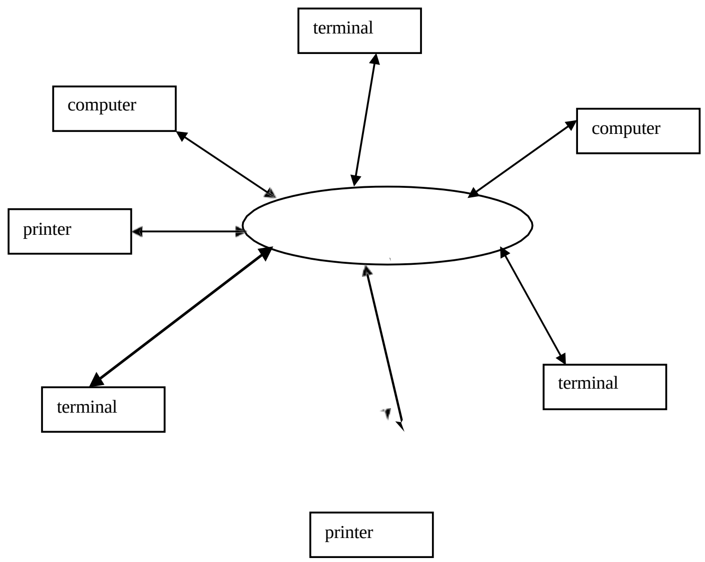


Commented [TA1]: Add Client Server annotations on the diagram

(b) Ring (or Loop) Network

In a ring network, all the PCs and other communications devices are connected in a continuous loop. This is a typical peer-to-peer LAN; there is no server. Messages flow in only one direction and there is, therefore no danger of collision. However, if a connection is broken, the entire network may stop working. A user, who intends to send information, is required to be allocated a "bit token" (0 or 1) indicating permission to send or otherwise.

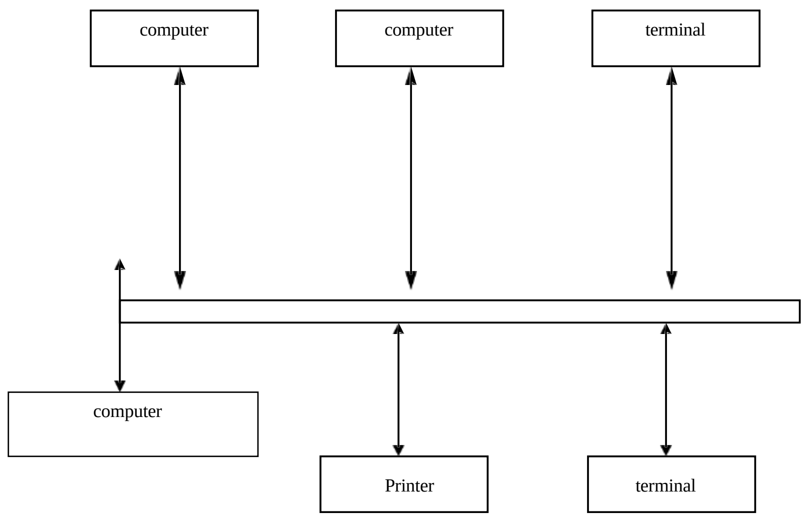
Fig. 5.2 Ring Local Area Network



(c) Bus Network

In a bus LAN, all the communications devices are connected to a common channel. If a connection is broken, the network may stop working. This type of network structure may be organised as a client/server or peer-to-peer network. A signal from any communications device moves in both directions to the ends of the bus. Any imminent collisions of messages are detected by the protocol, Carrier Sense Multiple Access/Collision Detection (CSMA/CD), which delays the messages and later allows the devices concerned to retransmit.

Fig. 5.3 - Bus Local Area Network



5.1.8 METROPOLITAN AREA NETWORK (MAN)

This is a wide Area Network that is limited to the area surrounding a city or town. MANs cover a large group of buildings in a city which are up to 50km in diameter. By interconnecting smaller networks with a large geographical area, information is easily disseminated throughout the network. Examples of MAN is Guaranty Trust Bank in Lagos that connects all GTB branches in Lagos area to a centralised server at the head office using dedicated telephone lines, coaxial cable and wireless communication.

5.1.9 Advantages and Disadvantages of Networks

(a) Advantage

The following are key advantages of networks:

(i) Sharing of peripheral devices: Several users on the network are able to share printers, scanners and disk drives connected to the network in order to keep cost down;

(ii) Sharing of programs and data: Network users are able to share a common database on a shared storage device, as well as common software.

It is much easier to update files when these are stored on a server than when they are stored on separate computers;

(iii) Better communications: On the network, information may be shared in real time, Electronic mailing is facilitated;

(iv) Security of information: Information is more readily backed up on networked storage media just as data integrity is easily ensured when a central database is used. An item of data is easily updated with a single input; and

(v) Access to databases: It is possible to tap into other external databases, whether private or public

(b) Disadvantages of Networks

(i) There is duplication of data on files of different computers on the network
(ii) There is difficulty in administration and control especially for large combination
(vi) Maintenance cost may be prohibitive
(vii) There is the need for compatibility of equipment in the network
(viii) Failure of the server may lead to total breakdown of the entire network.
(ix) Cable break may stop the entire network.

5.2 LAN SECURITY ISSUES

5.2.1 Introduction

The complexity of LANs makes it possible for a number of breaches to be committed. We shall now consider the following areas of concern:

(a) passwords and unauthorised access;
(b) computer viruses ; and
(c) encryption

5.2.2 Passwords and Unauthorised Access

A password may be defined as a sequence of characters to be entered into a computer system in order to gain access to the system or some other parts of it.

The use of passwords should be properly monitored and controlled to ensure that passwords are not leaked to or copied by other people. Passwords should also be changed regularly (possibly monthly).

The use of passwords has the objective of restricting access to the LAN or resources on it to only authorised users; that is, unauthorised access is prevented.

5.3 Security During Data Transmission

5.3.1 Cryptography

Information security uses cryptography to transform usable information into a form that renders it unusable by anyone other than the authorised user. This process is called encryption. The encrypted information can be transferred back to its original usable form by an authorised user who possesses the cryptographic key- a process called decryption.

Cryptography is used in information security to protect information from unauthorised or accidental disclosure, while the information is in transit or in storage.

5.3.2 Encryption and Decryption

Encryption is the technique of disguising information in order to preserve its confidentiality during transmission and when stored. The encrypted information can only be transformed back to its original form by an authorised user who has the key; a process known as decryption.

The process of encryption and decryption comprises of an algorithm and a key; the key is used to control the algorithm. The algorithm is the operation itself which transforms the data into cipher and the key controls the algorithm. Changing the value of the key can alter the effect of the algorithm so that the conversion for each key value is completely different. Using appropriate software, the sending computer encrypts the message and at the receiving end, the computer decrypts the message. Anyone intercepting the message will not have the key to decipher it and thus will not find it meaningful.

Hence, this is the technique of disguising information in order to preserve its confidentiality during transmission and when stored. The process of encryption and decryption comprises an algorithm and a key.

5.4 PROTOCOLS

Protocol is the set of rules and procedures for exchanging information between computers on the network. Protocols define how the communication link is established, how information is transmitted and how errors are detected and corrected. Using same protocols, different types and makes of computers can communicate with each other.

5.4.1 Examples of protocols

A list of some of the widely used protocols are given below;

S/N	PROTOCOL	DESCRIPTION
1	Ethernet	Most widely used protocols for LANs
2	Token ring	Uses electronic token to avoid transmission conflict by allowing only one device to transmit at a time
3	FDDI	Fibre Distributed Data Interface. High speed fibre optic protocol
4	TCP/IP	TCP (Transmission Control Protocol) and IP (Internet Protocol). Used to carry out the basic operations of the internet.
5	ATM	Asynchronous Transfer Mode – Protocol developed for transmitting voice data and video over any type of media
6	IPX	Internet Packet Exchange: Used for NOVEL NETWARE networks
7	UDP	User Data Protocol. This protocol is used together with IP when small amounts of information are involved.

8	ICMP	Internet Control Messages Protocol. This protocol defines a small number of messages used for diagnostic and management purposes.
9	HTTP	Hypertext Transfer Protocol. Used to access and download contents from Web pages. HTTPS is a secured HTTP.
10	POP	Post Office protocol – for exchange of emails
11	SMTP	Small Mail Transfer Protocol: The most common protocol for sending mail is Simple Mail Transfer Protocol (SMTP)
12	FTP	File Transfer Protocol – This provides a method for copying files over a network from one computer to another.

5.4.2 The Internet Protocol

The Internet Protocol, the standard language of the Internet, Transmission Control Protocol/Internet Protocol (TCP/IP), has been available since 1983. It is the standardised set of guidelines (protocol) that allows different computers on different networks to communicate with each other efficiently, no matter how they gained access to the Net.

5.4.3 The 7 layer OSI Model

The Open Systems Interconnection **model** (**OSI model**) is a conceptual **model** that characterizes and standardizes the communication functions of a telecommunication or computing system without regard to their underlying internal structure and technology.

The model defines a networking framework to implement protocols in seven layers.

Layer Name	Description	Examples
Application	User Level Processing	Telnet, FTP, Mail
Presentation	Data Representation & Syntax	ISO Presentation
Session	Sync Points and Dialogs	ISO Session
Transport	Reliable End to End	TCP
Network	Unreliable Thru Multi-Node Network	X.25 Pkt, IP
Link	Reliable Across Physical Line	LAPB, HDLC
Physical	Unreliable Wire, Telco Line	RS232, T1, 802.x

Description of the layers

Physical (Layer 1)

OSI Model, Layer 1 conveys the bit stream - electrical impulse, light or radio signal through the network at the electrical and mechanical level. It provides the hardware means of sending and receiving data on a carrier, including defining cables, cards and physical aspects.

Data Link (Layer 2)

At Layer 2, data packets are encoded and decoded into bits. It furnishes transmission protocol knowledge and management and handles errors in the physical layer, flow control and frame synchronization.

Network Layer (Layer 3) This layer provides the addressing services and error handling

Transport (Layer 4) - OSI Model, Layer 4, provides transparent transfer of data between end systems, and ensures complete data transfer.

Session (Layer 5) - This layer establishes, manages and terminates connections between applications.

Presentation (Layer 6*)-*. The presentation layer works to transform data into the form that the application layer can accept.

Application (Layer 7) - OSI Model, Layer 7, supports application and end-user processes. This layer provides application services for file transfers, e-mail, and other network software services.

5.5 THE INTERNET

The internet is a network of networks; a series of networks using very precise rules that allow any user to connect to, and use, any available network or computer connected to it.

Created by the US Department of Defense in 1969 under the name ARPAnet (ARPA stands for Advanced Research Project Agency). The Internet was built to serve two purposes:

The first was to share research among military, industry and university scholars.

The second was to provide a system for sustaining communication among military units in the event of nuclear attack.

5.5.1 Using the Internet

There are no formalised rules about how to behave on using the Internet. Over the years, however, a code of conduct, sometimes referred to as network ethics has evolved.

Rules that govern the Internet rest with the Internet Society (a voluntary organisation) that, through the Internet Architecture Board (IAB), sets the standards as well as the rules for accessing and using addresses.

The addressing system for the Internet uses a process called the 'Domain Name System' (DNS). Internet addresses are numerical and are called 'IP Addresses' (e.g. 128.116.24.3). However, most users never see or use IP addresses directly because the DNS provides a more meaningful and easier-to-remember name. The host computer converts a DNS to an IP address in the background, so the user doesn't need to know or remember the numbers.

A DNS name is made up of a domain and one or more sub-domains. For example, www.ed.ati.edu uses the domain edu (educational institution) and has three sub-domains, ati, ed, and www. Each sub-domain identifies a particular computer or network. Reading the address backwards, it is the educational institution Accountancy Training Institute (ati), using the education (ed) computer, which is available on the web (www).

The DNS is specific to a computer. Popular domains are:

.com or **.co** commercial

.edu or **.ac** educational (university)

.gov governmental
.mil military

.org organisation

.net network

Because the Internet is worldwide, some addresses include the country in addition to the network type, e.g. .ng (for Nigeria) **.us** (for the US), **.uk** (for the UK), and **.gh** (for Ghana).

The web consists of an interconnected system of sites, or places, all over the world that can store information in multimedia form - sounds, photos, video, as well as text. The sites share a form consisting of a hypertext series of links that connect similar words and phrases.

'Hypertext' is a system in which documents scattered across many Internet sites are directly linked, so that a word or phrase in one document becomes a connection to an entirely different document.

In particular, the format used on the web is called 'Hypertext Mark-up Language' (**HTML**) and swaps information using 'Hypertext Transfer Protocol' (**HTTP**).

To find a particular website, one needs its **URL** (Uniform Resource Locator), which is an address that points to a specific resource on the web.

To get to this address, one needs a web browser software that helps one get information required by clicking on words or pictures on the screen.

Popular web browsers include Netscape Navigator, **Microsoft Edge, Internet Explorer, Google Chrome, Mozilla Firefox, and Apple Safari and Brave**.

Searching the Internet is done by the use of a **search .engine** such as **Google, Yahoo, etc.**

The user simply types in a word or phrase to find a list of related websites.

The **Wireless Application Protocol (WAP**) allows the use of mobile phones for a wide range of interactions with the web.

5.5.2 Current Uses of the Internet

The scope and potential of the Internet are immense, and they include the following:

a) Dissemination of information;

b) Product/service development;

c). Transaction processing - both business-to-business and business-to-consumer;

d). Relationship enhancement; e).

Recruitment and job search; f). Entertainment;

g). Education; and

h). Religion.

5.5.3 Internet Security Issues

Establishing organisational links to the Internet brings numerous security risks. Some of these risks are listed below:

(a) A virus on a single computer can easily spread through the network to all the organisation's computers;

(b) Disaffected employees can deliberately cause damage to valuable corporate data or systems because the network could give them access to parts of the system that they are not really authorised to use;

(c) Where the organisation is linked to an external network, outsiders may be able to gain access to the company's network, either to steal information or damage the system;

(d) Employees may download inaccurate information or imperfect or virus-ridden software from external networks;

(e) Information transmitted from one part of the organisation to another may be intercepted. ***(Encryption may*** be used to check this). Encryption involves scrambling the data at one end of the line, transmitting the scrambled data, and unscrambling it at the receiver's end of the line); and

(f) The communication link itself may break down or distort data.

5.6 INTRANET AND EXTRANET

5.6.1 Introduction

An intranet is an internal corporate network that uses the infrastructure and standards of the Internet and the World Wide Web. An intranet can connect all types of computers in an organisation.

5.6.2 Intranet Security

One of the greatest considerations of an intranet is security.

The fact that the network is connected to other external networks means that outsiders without access rights may easily gain access to the corporate network, and this must be checked.

The means of doing this is the installation of security software called a 'firewall'.

A firewall is a security program that connects the intranet to external networks, such as the internet. It blocks unauthorised traffic (including unauthorised employees) from entering the intranet.

5.6.3 Extranet

An extranet is a type of intranet that is accessible to outsiders, but limited to only those with valid user identification numbers.

5.6.4 Accessing the Extranet

For outsiders to gain access to the extranet, there is the need for some form of identification. Any prospective user is therefore required to enter a valid identification number before access can be granted.

5.7 DATA TRANSMISSION MEDIA

Transmission media are the physical materials and non-physical means used to establish a communication through which data is transmitted from one computer/device to another computer/device. There are two categories of transmission media, namely:

a. Physical cabling media and

b. Wireless media

5.7.1 Examples of Physical cabling Media

i. **Twisted- pair cable** which consists of pairs of plastic-coated copper wires that are twisted together to reduce electrical interference. Two types exist which are shielded twisted pair cable and unshielded twisted pair cable. They are inexpensive transmission medium that can be easily installed; it is commonly used for telephone lines.

ii. **Coaxial cable -** is a high-quality communication line that consists of a copper wire conductor surrounded by insulator. It is not susceptible to electrical interference and transmits data faster over long distances. It is often used with computer networks.

iii. **Fibre-optic cable** - uses smooth hair-thin strands of glass or plastic to transmit data as pulses of light. The major advantages of fibre-optic cable over wire cables are:

- Substantial weight and size savings;
- Reduced electrical and magnetic interference; and
- Increased speed of transmission.

However, fibre optic cable costs more than twisted pair and coaxial cables and can be difficult to install and modify. It is used for high-capacity telephone lines.

5.7.2 Examples of wireless media

i. Microwaves - are radio waves that can be used to provide high speed transmission of both voice communication and digital signal. Microwaves are limited to line-of-sight transmission which means that they must be transmitted in a straight line.

ii. Carrier - connect radio is used to transmit data between devices that are in the same area.

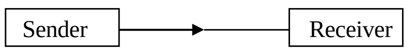
iii. Infrared light – Infrared light beams are used to transmit data between personal computer devices without connecting them with a cable.

However, while the above local wireless systems provide flexibility and portability, they are slower and more susceptible to inference than wired connections.

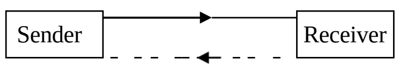
5.8 MODE OF TRANSMISSION

5.8.1 Simplex transmission: this is the transmission of data through a channel in only one direction. Examples of such transmission can be seen in Radio and Television transmission

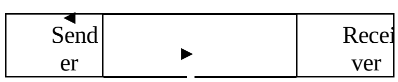
Channel



5.8.2 Half Duplex Transmission – signals are allowed to pass through the channel in both directions, but in one direction at a time. Example of such transmission is found in walkie-talkie or radiophony.



5.8.3 Duplex Transmission: This mode allows signals to pass through the channel in both directions at the same time. Examples of such type of transmission are those found on computers.



5.8.4 Synchronous Transmission: High-speed digital transmission between sending and receiving stations at constant rate. The synchronisation of transmitting and receiving terminals is maintained by a clock which keeps the devices in step with each other.

5.8.5 Asychronous Transmission: Mode of transmission using start and stop signals between blocks of characters rather than individual characters. One character is sent at a time and is economical and efficient but cannot cope with large quantities of data.

5.9 **Data Transmission Equipment**

5.9.1 Introduction

These are the equipment used during communication of data and signals from one station to another. The following are some of the common types of communication equipment:

5.9.2 **Modems** – A communication equipment that performs the conversion of computer's digital signals to analog signals as well as analog signals to digital signals. Modem comes from a combination of the words: Modulate – to change into analog signal and demodulate - to convert an analog signal to digital signal. Modems are needed at both the sending and receiving ends of a transmission channel for data transmission to occur.

5.9.3 **Multiplexers (or Multiplexor) (MUX)** – A multiplexer combines two or more input signals from several devices into a signal stream of data and transmits it over a communications channel. By combining the individual data streams into one, a MUX increases the efficiency of communications and reduces the cost of using individual communications channels

5.9.4 **Front End Processor (FEP)** – A Front End Processor is a small computer attached to the central computer and dedicated to handling communication requirements of the central computer. Relieved of this tasks, the central computer can be dedicated to processing data, while the FEP communicates the data. Other tasks of the FEP include:

- Polling (check the attached terminals for data to be sent);
- Error-checking and correction; and
- Ensuring access security

5.9.5 **Network Interface Card (NIC) –** This is a circuit card that fits in an expansion slot of a computer or other device such as a printer, so that the device can be connected to a network. Most NICs require a cable connection and have connectors on the card for different types of cable. NIC has circuits that coordinate the transmission and receipt of data and the error-checking of transmitted data.

5.9.6 **Hub/Switch –** A hub is a communication device used to connect a computer to the network. The function of a hub is to direct information around the network, facilitating communication between all connected devices. However, new installation now use switch instead of hub as they are more effective and provide better performance. A switch (also called concentrator) is a device that provides a central connection point for cables from workstations, servers and peripherals. For examples, in a star topology, twisted pair wire is run from each workstation to a central switch. Because switches are inexpensive, new networks are now built with switches that makes transmission of data in the network faster.

5.9.7 Bridges – A bridge is a combination of hardware and software that is used to connect similar networks. For example, a company with similar but separate LANs of personal computers in its accounting and marketing departments, the network could be connected with a bridge. A bridge monitors the information traffic on both sides of the network so that it can pass packets of information to the correct location. It can accommodate connection of different types of cabling.

5.9.8 Routers – A router is an intelligent network connecting device that sends or routes communication traffic directly to the appropriate networks. It can translate information from one network to another. It selects the best path to route a message based on the destination address and origin. Routers are smart enough to implement several routing protocols. In case of partial network failure, routers are smart enough to determine alternate routes.

5.9.9 Gateway – This is a combination of hardware and software that allows users of one network to access the resources on a different type of network. A gateway is a device that allows incompatible systems to exchange data by performing the necessary protocol conversions.

5.9.10 Repeaters – These are devices used to regenerate (amplify or restore) signals in a communication links. In other words, a repeater electrically amplifies the signal it receives and rebroadcasts it. Since a signal loses strength as it passes along a cable it is often necessary to boast the signal with a repeater (or amplifier). Repeaters help to overcome attenuation,

5.10 OTHER APPLICATIONS OF THE INTERNET

5.10.1 Electronic Mail (e-mail)

Electronic mail systems are intended to replace the movement of paper messages with the electronic transmission of coded, graphic or textual information. A mail can be sent to or received by several people at different locations and within different time zones using computers or telephones.

Typically, the information is 'posted' by the sender to a central computer which allocates disk storage as a 'mailbox' to each user. The information is subsequently 'collected' by the receiver from the mailbox using e-mail software. Each person - the sender and receiver(s) will require an e-mail address like mustapha@yahoo.com that must be used to send or receive the mail.

Each user will typically have a password for protecting access to his own inbox, outbox and filing system.

5.10.2 Advantages of e-mail

E-mail has the following advantages:

a) Speed - Since transmission is electronic, it is almost instantaneous, barring any delays over the Internet;

b) Economy - e-mail is reckoned to be several times cheaper than fax or the ordinary post.

c) Efficiency - A message is prepared once but can be transmitted to several different people at different locations and time zones;

d) Security - Access is generally restricted by the use of passwords; and

e) Attachments can be used to send documents and reports as well as memoranda.

5.10.3 Shortcomings of e-mail

In spite of its advantages, e-mail may not always be the best medium of communication. Possible shortcomings are:

a) Nature of the medium is such that the full import of a message may not be felt. Users tend to be very informal and casual;

b) The nature of a message may demand detailed discussion of a problem but email is best suited to short messages;

c) Here is the likelihood of information overload. People easily become obsessed with the idea of using the facility, thereby sending information when this is even not required; and

d) E-mails over the Internet may be unduly delayed while virus infection is very common.

5.11 SOCIAL AND BUSINESS COMMUNICATION ON THE NET

5.11.1 Websites, Web pages, Blogs.

A website is a collection of related web pages, including multimedia content, typically identified with a common domain name, and published on at least one web server.

A **website** is a collection of **web** pages (documents that are accessed through the Internet.)

Web page

A **web** page is what you see on the screen when you type in a **web** address, click on a link, or put a query in a search engine.

5.11.2 Interacting with the internet through browsing, surfing, uploading and downloading

(a) Browsing: This is a service provided on the internet for viewing information and document from various sources

(b) Surfing: Surfing also known as web surfing describes the act of browsing the internet by going from one page to another using hyperlinks

(c) Uploading: This is the process through which users or organisations send files and document to the interest for authorised users to access.

(d) Downloading: This is the process extracting or getting information, files and documents from the internet for use e.g downloading of messages sent to one’s e-mail.

5.11.3 Electronic Commerce (e-Commerce)

Electronic commerce may be defined as 'trading on the Internet', that is, the 'use of the Internet and Websites in the sale of products or services'.

It is the application of advanced technology to increase the effectiveness of commercial practices.

The use of the Internet allows businesses to reach potentially millions of consumers worldwide and extends trading time to seven days, around the clock.

For established companies, e-commerce reduces expensive sales and distribution workforces, and offers new marketing opportunities.

The Internet can be used to get certain products directly into people's homes. Anything that can be converted into digital form can simply be placed into the seller's site and then downloaded onto the customer's PC at home. The Internet thus offers huge opportunities to producers of text, graphics/video, and sound-based products. A large number of computer software products are now distributed this way.

Besides its usefulness for tapping into worldwide information resources, businesses are also using it to provide information about their own products and services.

For customers, the Internet offers a speedy and impersonal way of getting to know about the services that a company provides.

For businesses, the advantage is that it is much cheaper to provide the information in electronic form than it would be to employ staff to man the phone on an enquiry desk.

Websites can provide sound and movement and allow interactivity so that the user has the opportunity to drill down to obtain further information, watch a video of the product in use, or get a virtual reality experience of the product or service.

There is the need to collect information about customers. Customers who visit a site for the first time are asked to register, which typically involves giving a name, physical address, e-mail address and possibly other demographic data such as age, job title and income bracket.

When customers come to the site on subsequent occasions, they either type their (self chosen) username and password or more usually now, if they are using the same computer, the website recognises them using a 'cookie', which is a small file containing a string of characters that uniquely identifies the computer.

As users visit the site more often, more is learned about them by recording what they click on, since this shows what they are interested in. These are known as 'klickstreams',

5.11.4 Electronic Banking (e-banking)

Electronic banking (or e-banking) describes the technique of engaging in banking activities by means of computers and telecommunications. A bank may provide its customers with software and telecommunication facilities, including modems, and special codes to be used to identify themselves online.

Without moving to the premises of the bank, customers can request the balances on their accounts, advise on transfers to be made from their accounts to others, and discuss account status online. The feature is available on cellular phones, making it possible to have online information on one's account wherever one finds oneself.

5.11.5 Electronic Data Interchange (EDI)

EDI is the direct electronic exchange of standard business documents such as purchase orders, invoices and shipping documents between organisations' computer systems.

To use EDI, organisations must have compatible computer systems between them. EDI may be used in situations where a firm engages in business activities like purchases and sales with other companies and engages in electronic communication rather than communicating using paper documents.

EDI places a great burden on auditors because electronic transactions are difficult to verify.

5.11.6 Telecommuting

Telecommuting involves employees working from their homes or other locations outside their offices.

The disadvantages to employers include:

a) difficulty in controlling employees;

b) less security of data and confidential information;

c) higher communication costs.

For the employees, advantages include

(i) less time and expense travelling to and from work;

(ii) more flexibility in working times;

(iii) spending less on office space and furniture

(iv) depending on the home environment, there may be fewer interruptions; and

(v) the opportunities to engage workers who may not find full time employment feasible

Disadvantages to the employees include the following:

- comfort in the home is compromised;
- some social rewards available from the office setting may be lost;

5.11.7 The Virtual Office

The virtual office is a non-permanent and mobile office run with computer and communications technology. Using pocket pagers, portable computers, fax machines, and various phone and network services, employees work from their homes, cars, and
other new work sites rather than a central office.

5.11.8 Teleconferencing

Using teleconferencing, employees or business associates at different locations hold joint meetings by means of video, audio, and data communications.

One application of teleconferencing of interest is teaching, in which lecturers are able to both lecture and answer questions from remote locations.

Teleconferencing enables companies to save on transportation costs and reduce lost productivity. It also enables a manager to interact with different branches simultaneously.

Major drawbacks include set-up costs and the increased risks of electronic eavesdropping.

The use of teleconferencing platforms assumed a most prominent dimension globally with the advent of the corona virus pandemic, which necessitated the imposition of social and physical distancing in all interactions in virtually all jurisdictions around the world.

This led to the meteoric rise in prominence of such teleconferencing platforms such as,

- Zoom,
- Microsoft Teams,
- Google meet,
- Google classroom, and
- Webex.

5.11.9 Social Media Platform - FACEBOOK

We shall now discuss features of some popular social media plat forms.

Facebook is a popular free social networking website that allows registered users to create profiles, upload photos and video, send messages and keep in touch with friends, family and colleagues.

5.11.10 Social Media Platform – TWITTER

Twitter is a free social networking microblogging service that allows registered members to broadcast short posts called tweets. ...

Tweets, which may include hyperlinks, are limited to 140 characters, due to the constraints of **Twitter's** Short Message Service (SMS) delivery system. **Twitter** is a service for friends, family, and co-workers to communicate and stay connected through the exchange of quick, frequent messages.

5.11.11 Social Media Platform - WhatsApp

WhatsApp Messenger is a cross-platform instant messaging application that allows iPhone, BlackBerry, Android, Windows Phone and smartphone users to exchange text, image, video and audio messages for free.

Social Media Platform - LinkedIn

LinkedIn – this a professional social media platform. Its main area of focus are professional relationships, training and development. It is relatively more secure than most social media platforms. It has a free version and a professional version which attracts a fee.

Advantages and Disadvantages of Social Media to Business

a. **Advantages**

i) Increased Exposure/Brand Awareness: Social media will expose your company or service to new eyes.

ii) Learn About Your Audience/Target Consumer: Organisations can use social media to understand what their customers are saying.

iii) Customer Service: Social media provides an avenue for businesses to interact with their customers and provide top notch service.

iv) Feedback: A fast medium for feedback to organisations from customers is the social media space.

v) New Opportunities: It creates new opportunities to acquire new customers.

vi) Competition Analysis: By visiting competitors' social media pages, organisations will understand the edge their competitors have over them.

b. Disadvantages of Social Media to Business

i) If not properly monitored, employees may be wasting their employers' time by using social media to chat with friends during office hours.

ii) It exposes organisations to the prying eyes of their competitors.

iii) Fraudsters can attack an organisation's network through their social media pages.

5.12 STORAGE ON CARDS

5.12.1 Magnetic-Stripe Cards

A magnetic-stripe card has stripes of magnetically encoded data on its reverse side and is encoded with data specific to a particular use.

Examples are ATM cards and credit cards. The information they contain may be name, account number, personal identification number (PIN), etc. of the holder.

The conventional magnetic-stripe card has a capacity for about half an A4 page of data.

5.12.2 Smart Cards

A smart card is a wallet-type card that contains a microprocessor and memory chip that can be used to input data. As a common use, users may buy telephone debit cards that can then be used to make telephone calls. The duration of a call is automatically calculated on the chip inside the card and the cost deducted from the balance.

In some countries, the smart card may also be used as bank cards and as medical history cards that patients may carry about.

The smart card can conveniently hold the equivalent of about thirty (30) A4 pages of information.

5.12.3 Optical Cards

The optical card is a plastic, laser-recordable, wallet-type card used with an optical-card reader. The optical cards have the following data capacities:

- Blue ray disc --- 2555 GB
- DVD – 4.77 GB
- CD – 700 MB

An optical card may be used as a health card for an individual and may hold not only the person's medical history and health-insurance information, but also digital images such as X-rays, electrocardiograms, etc.

The volume of details on the card means that adequate backups must be ensured otherwise the loss of the card will result in incalculable loss of information.

5.13 CLOUD COMPUTING

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5.13.1 Introduction

Cloud computing is an internet-based computing whereby shared resources, software and information are provided to computers and other devices on-demand, like a public utility. It allows consumers and business to use applications without installation and access their personal files at any computer with internet access. This technology allows for much more efficient computing by centralised storage, memory, processing and bandwidth.

The services provided by cloud computing are broadly divided into three categories namely: Infrastructure – as – a – service (IaaS), Platform-as-a-service (PaaS) and Software-as-a-Service (SaaS). It is sold on demand, typically by minute or hour. A user can have as much or as little of a service as they want at any given time; and the service is fully managed by the provider (consumers only need a computer and internet services).

5.13.2 Cloud Computing Technologies

There are three technologies used in cloud computing which are:

a. **Software as a Service (SaaS) -** In the past, the end-user would generally purchase a license from the software provider and then install and run the software directly from on-premise servers. Using on-demand service, the end-user pays the software a subscription fee for the service. The software is hosted directly from the software provider servers and is accessed by the end-user over the internet.

Some of the companies that offers SaaS business include: Sales force.com, Google, Netsuite, Info Technologies, Canada software.net.

b. **Platform as a Service (PaaS)** – The platform segment of cloud computing refers to products that are used to deploy applications. Platforms servers as an interface for users to access applications provided by partners or in some cases the customers. Examples of platforms are salesforce.com platform, Netsuite, Amazon, Google, Sun Oracle, Microsoft etc.

c. **Infrastructure as a Service (IaaS)** – The backbone of the entire concept; the vendors provide the physical storage space and processing capabilities that allow for all the services described above. Major infrastructure vendors are:

i. Google – managed hosting, development environment
ii. International Business Machine (IBM) – managed hosting
iii. Terremark – managed hosting
iv. Amazon.com – cloud storage
v. Rackspace Hosting – managed hosting and cloud computing

Cloud can be private or public. A public cloud sells services to anyone on the internet (e.g Amazon Web Services which is the largest public cloud provider). A private cloud is a proprietary network or a data center that supplies hosted services to a limited number of people. When a service provider uses public cloud resources to create their private cloud, the result is called virtual private cloud.

The goal of cloud computing (whether private or public) is to provide easy, scalable access to computing resources and IT services. Traditional business applications are too complicated and expensive which requires the need for data center with office space, power, cooling,

bandwidth, networks, servers and storage, team of experts to install, configure and run them and so on. When these headaches are multiplied across dozens or hundreds of applications, we can see why the biggest companies with the best IT departments are not getting the applications they need. Cloud computing is a better way to run business. Instead of running your application yourself, they run on a shared data center
– just login, customize it and start using it.

5.13.3 Advantages of Cloud Computing

i. It cost less because you don't need to pay for all the people, products and facilities to run them.

ii. The services are more scalable, more secured and more reliable than most application software.

iii. It is simple and has a huge impact on any business.

iv. it is easily upgraded and get security and performance enhancements with new features

v. Cloud application don't eat up your valuable IT resources.

vi. Cloud computing users can avoid capital expenditure on hardware, software and services when they pay a provider for what they use.

vii. There is immediate access to a broad range of applications

viii. It enables users to access systems using a web browser regardless of their locations or what device they are using.

ix. Security is better than the traditional systems as provider are able to devote resources to solving security issues that many users cannot afford

5.13.4 Disadvantages of Cloud Computing

The disadvantages of Cloud Computing include:

i. Downtime is one of the worst lapses of cloud computing

ii. No cloud provider, even the best, would claim immunity to service outages

iii. Cloud computing systems are internet-based, which means your access is fully dependent on internet connection

5.13.5 Cloud Clients

A cloud client consists of computer hardware and/or computer software that relies on cloud computing for application delivery i.e cloud services. Examples of such hardware and software are computers, phones and other devices, operating system and browsers.

5.14 CHAPTER SUMMARY

In this chapter we dealt with the issues of computer networks, office automation, and computer crime.

We began the chapter with the concepts of computer networks, and looked at some major network configurations, while discussing the various protocols that go with these configurations.

Office automation was also discussed, with references made to a few key applications. There has been a discussion on computer crime that includes virus and worm.

5.15 **Multiple Choice Questions (MCQ)**

1. Which of the following is **NOT** true for an extranet?

A. Network links that use internet technology

B. Can connect intranet of business with intranet of customers, suppliers or business partners

C. Make use of a browser

D. All internet users are allowed access

E. Enable company to offer new kinds of interactive web-enabled service to their business partners

2. A type of Network topology that is combination of some other network types is called............

A. Hybrid

B. Star

C. Hierarchical

D. Bus

E. Ring

3. Two or more people may engage in on-line interactive conversation over the internet through the use of:

A. Usenet

B. Hypermedia language

C. Chat room

D. News group

E. Contact streaming

4. In connection to the Web, the meaning of the acronym HTML is

A. Hypertext Mark up Language

B. Hypertext Makeup Language

C. Hypertest Markup Language

D. Hypertest Makeup Language

E. Hypertext Make Language

5. Which of the following is **NOT** a network conguration?

A. Star Network

B. Ring network

C. Circuit network

D. Bus network

E. Tree Network

6. Data transmission Phenomenon where data is transferred regularly with clock signal is called

A. A synchronous data transfer

B. Simplex data transfer

C. Duplex data transfer

D. Synchronous data transfer

E. Regular data transfer

7. A cheaper alternative to the MODEM which makes it possible to use an

ordinary telephone handset for binary data transfer is known as:

A. Modulator

B. Demodulator

C. Concentrator

D. Multiplexer

E. Acoustic coupler

8. The process of visiting different websites and not looking for anything of particular importance is called

A. Web visiting

B. Web surfing

C. Web searching

D. Web going

E. Web journeying

9. Which of the following is **NOT** an advantage of duplicating evidence in computer forensic investigation?

A. Additional step is being added into the forensic process

B. Ensure that original document is not subjected to alteration

C. Ensure that original document is in the best possible state

D. Allow examiners to apply various techniques in cases where the best approach is not clear

E. It permits multiple forensic computer specialist to work on data at the same time.

10. The network protocol used to exchange and manipulate files over a computer network is known as

A. SOAP

B. HTTP

C. IMAP

D. SMTP

E. FTP

11. The reduction in the strength of signals during data transmission is called

A. Sales force.com service

B. Desktop Services

C. Amazon Service
D. Attenuation
E. Bureau Service

12. In cloud computing, the various computer servers and data storage systems that create the computing services is referred to as:

A. Backend

B. Cloud system

C. Frontend

D. Users hardware

E. User software

Commented [TA3]: Cloud computing move chapter 6

13. Which of the following is **NOT** a factor to consider when selecting a data transmission system?

A. Speed of transmission required

B. Length of the transmission system

C. Accuracy and reliability required

D. Cost of each type of data transmission

E. System protocol that is available

14. An internal organisation network that provides access to data across enterprises as well as selected outsiders is known as:

A. Internet

B. Intranet

C. Extranet

D. Law

E. WAN

15. A device that provides a central connection point for cables from workstations, servers and peripherals in a network

A. Bridge

B. Gateway

C. Switch

D. Multiplexor

E. Modem

16. A network hardware device used for segmenting a large network into two ot more efficient network is called ....

A. Gateway

B. Bridge

C. Switch

D. Hub

E. Multiplexor

17. Which of the following is **NOT** a transmission media?
    A. Twisted pair cable
    B. Coaxial cable
    C. Radio wave
    D. Fibre optic
    E. Switch

5.16 Short Answer Questions

1. An Electronic device that allows a single communication channel to carry simultaneously data transmission from many terminal is called................
2. A global network of multimedia internet sites for information, education, e-commerce etc is known as...............................
3. A technology model in which any or all resources, such as application software, processing power, data storage, etc are delivered as a set of services via the internet is called ....
4. The electronic device that can be used to capture digital video to be uploaded to the web is called ....
5. A network topology where each end-user is linked to a central computer on which all other devices are depended is called ....
6. A protocol which enables Web servers to communicate with each other over a network is called ....
7. An Internet based application used to search for information from any website on the internet is known as.....................
8. A small piece of text stored on a user's computer by a web browser to capture user's details is known as ....
9. Business-to-Business buying and selling of goods and services on the internet is one of the forms of.....................
10. A computing technology where one computer system renders services to other computer systems is called......................

11. The technology that facilitates the transfer of electronic data/information from one place/person to another place/person is known as...................

12. A communication system which provides connection for systems with compatible protocol is called ....

13. A network that make use of radio waves to transmit data/information from one node to another is called ....

14. SaaS is an acronym for ....

5.17 SOLUTIONS TO MULTIPLE CHOICE QUEASTIONS

1. D
2. A
3. C
4. A
5. C
6. D
7. E
8 B
9. A
10. E
11. D
12. A
13. B
14. C
15. C
16. B
17. E

5.18 SOLUTION TO SHORT ANSWER QUESTIONS

1. Multiplexor/Multiplexer
2. World Wide Web/WWW
3. Cloud Computing
4. Webcam/Digital Camera
5. Star
6. Hyper Text Transfer Protocol/HTTP
7. Search Engine
8. Cookie/Spyware
9. Electronic Commerce/E-Commerce
10. Client – server
11. Electronic mail/e.mail
12. Router
13. Wireless Network
14. Software as a service

5.19 SELF-ASSESSMENT QUESTIONS

(1) What is a 'computer network?

(2) Distinguish between a computer network topology and a computer network protocol.

(3) Explain briefly the term 'office automation'.

(4) What is videoconferencing?

(5) Define the term 'computer virus

(6) Explain briefly the term 'Internet protocol'.

(7) What is an extranet?

(8) Define the term 'telecommuting'.

(9) Describe two uses of a smart card.

(10) What is an electronic mail (e-mail)?

(11) Differentiate between Client- to -Server and Peer-to-Pear LAN

5.20 ANSWERS TO SELF-ASSESSMENT QUESTIONS

1. A computer network is an interconnection of a number of computers and other shared devices such as printers, scanners and disc controllers for the purposes of information processing and dissemination.

   Depending on the geographical dispersion of the devices making up the network, we may have a wide area network (WAN), where the devices are spread over a wide area such as a country or continent. We may also have a metropolitan area network (MAN), where the devices are spread over a smaller area like a suburb of a city, or a local network, where the devices are spread over a limited area such as a building or a small campus of an institution.

   (Note that a local-area network, LAN, is one type of a local network).

2. The topology (or configuration) of a network is determined by the manner in which the devices making up the network are physically connected together. The physical connection is very important because it is possible to have a visual picture of a type of topology whereas the actual one is entirely different.

   However, a network protocol consists of the set of rules and guidelines that govern the manner in which messages are passed round on the network.

3. Office automation involves the use of computers, micro-electronics and telecommunications technology to manage information resources automatically.

The whole purpose of office automation is to integrate some, if not all, of the departmental functions in the organisation. The terms 'electronic office' or 'paperless office' are often used to describe the modern office environment.

The implication is that more use is now made of varied office equipment in the office than used to be the case in the past, leading to the minimal, if at all, use of paper. For example, organisations now use electronic mail for both internal and external communication. The computer is used in many different ways to handle almost all office routines.

4. Videoconferencing makes use of television video and sound technology together with computers to enable people in different geographical locations to see, hear, and talk with each other. The use of 'Web camera' (Webcam) technology on PCs has made videoconferencing via the Internet a cheaper option than investing in special equipment and facilities.

Videoconferencing has led to video mail (V-mail) in which video messages can be sent, stored, and retrieved just like e-mail.

5. A computer virus is a type of infectious coding or malicious coding designed to damage or compromise computer systems.

The coding is parasitic in nature. Once it finds a host (which might be a PC), it is released and replicates itself very quickly.

A virus will typically infect the memory and/or backing storage. Some viruses may cause no visible harm to a computer system but others are such that they cause extreme havoc immediately they get onto the computer.

6. By 'Internet protocol' is meant the standard language of the Internet, Transmission Control Protocol / Internet Protocol (TCP/IP), which has been available since 1983. It is the standardised set of guidelines (protocol) that allow different computers on different networks to communicate with each other efficiently, no matter how they gained access to the Net.

7 . An extranet is a type of intranet that is accessible to outsiders, but limited to only those with valid user identification numbers.

Any prospective user is required to enter a valid identification number before access can be granted.

8. Telecommuting involves employees working from their homes or other locations outside their offices.

The advantages of telecommuting include the opportunities to engage workers who may not find full-time employment feasible as well as spending less on office space and furniture.

9 A smart card is a wallet-type card that contains a microprocessor and memory chip and it can be used to input data.

One of its uses is that of a telephone card, where users buy telephone debit cards that are used to make telephone calls. The duration of a call is automatically calculated on the chip inside the card and the cost deducted from the balance.

The smart card may also be used as medical history cards that contain patients' medical information that the patients may carry about.

10. An electronic mail is intended to replace the movement of paper messages with the electronic transmission of coded, graphic or textual information. An electronic mail can be sent to or received by several people at different locations and within different time zones, using computers or telephones.

Typically, the information is 'posted' by the sender to a central computer which allocates disk storage as a 'mailbox' to each user. The information is subsequently 'collected' by the receiver from the mailbox using e-mail software. Each person - the sender and receiver(s) - will require an e-mail address.

11. A Client – to – Server LAN consists of requesting computers called the clients and devices that provide a service called servers. The clients are connected to the server which is a powerful computer that stores the programs and data is a powerful computer that stores the programs and data shared by users (clients) on a LAN. A database server on a LAN store data for the use of the LAN. While a print server is a computer on a LAN that controls one or more printers. The print server stores the print image output from all the computers on the network and sends the output to the printer(s) one document at a time.

A Peer – to – Peer LAN is a network in which all the computers on the network communicate directly with each other and there is no server. It is less expensive than the client/server and is quite effective for up to 25 computers. Each peer administers its device and resources in it. All the computers are equal and there is no dedicated server. Each computer functions as both client and a server and there is no administrator responsible for the network. Security is also managed by the user of the each computer.

CHAPTER SIX

SYSTEMS DEVELOPMENT AND ISSUES IN MANAGEMENT OF INFORMATION

CHAPTER CONTENTS

(a) Systems Development Life Cycle;

(b) Prototyping;

(c) Joint Applications Development (JAD);

(d) Rapid Application Development (RAD);

(e) Outsourcing

(f) Cyber crimes

(g) Computer Security

(h) Computer forensics

(i) Big Data

(j) Cloud computing

(k) Artificial intelligence and machine learning

(l) Internet of Things

(m) Distributed ledgers – blockchain technology

(n) Computer robotics and business automation

(o) Drone technology

6.0 OBJECTIVES

After reading this chapter readers should be able to

(a) Understand what is meant by the development of a computer-based system;

(b) Understand the cycle of stages that the development of a typical system goes through;

(c) Understand the importance of uses involvement in the development of a system;

(d) Appreciate the concept of prototyping and its importance;

(e) Understand the concept and application of outsourcing.

(f) Understand the crimes committed by internal users of computer.

(g) Understand the definition and application of computer forensics in legal issues.

(h) Understand the concept of Big Data.

(i) Understand cloud computing.

(j) Appreciate disruptive technologies and their impact on business.

6.1 SYSTEMS DEVELOPMENT LIFE CYCLE

6.1.1 Introduction

New computer systems frequently replace existing systems and this process of replacement is often organised into a series of stages. The whole process is called the system life cycle. The system life cycle is the traditional method for developing new systems, but there are newer alternative methods, which attempt to improve upon the traditional approach and overcome some of its limitations.

Thus, a system study is broken down into a number of stages that constitute a system life cycle. After reading this chapter, you should have a good understanding of how to carry out a system study of an organisation's information systems issues.

Our discussion in this manual will emphasize the role of the computer in information systems. Not all systems studies, however, will go through the entire set of stages we are going to discuss.

It is important to note that a number of models have been developed that can be used to develop systems. As with the models, a number of systems development methodologies are also available for use in developing systems. An organisation will normally decide on a particular mode or methodology when it has to study and develop a system.

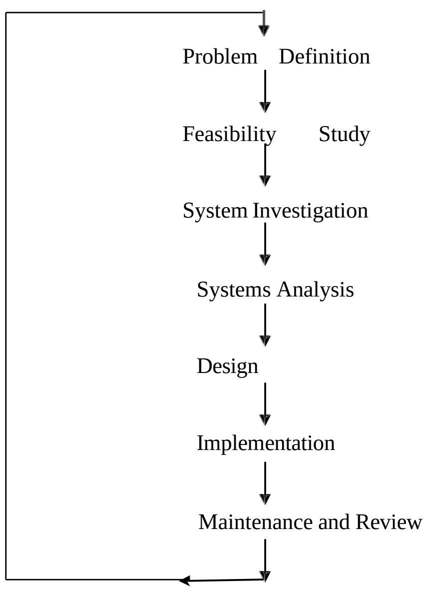
Our discussion will focus particularly on the traditional method called Systems Development Life Cycle (SDLC) developed by the National Computing Centre (NCC) in the UK in 1960.

6.1.2 Stages of the Systems Development Life Cycle

The stages of the development of any system constitute the systems development life cycle (SDLC), which is shown in the diagram below.

Figure 6.1 Stages on SDLC

Commented [TA4]: Redraw SLDC Stages



6.1.3 Problem Definition

This stage involves an analysis of the system (or sub-system) in conjunction with users, so that their actual requirements can be identified, rather than their likely requirements.

6.1.4 Feasibility Study

This is a formal detailed study to decide what type of system can be developed which meets the needs of the organization. The goal of a feasibility study is to identify, as quickly as possible, whether the benefits of a proposed project appear to outweigh its expected cost and disruptions based on what is already known.

Since early feasibility estimates may be overly optimistic, it is usually a good idea to conduct feasibility study at various times throughout all the phases of the Systems

Development Life Cycle (SDLC) to determine whether to continue the project, revise the specification, or abandon it altogether.

6.1.5 Systems Definition (or Systems Specification)

The systems specification is the detailed documentation of the proposed new system. It serves two main purposes:

(a) Communication: It serves as a means of communicating all that is required to be known to all interested parties, such as;

- (i) Management for final approval,
- (ii) Programmers to enable them to write the programs necessary for implementation,
- (iii) Operations staff, detailing all necessary operating procedures, and
- (iv) Users, as they will ultimately be responsible for running the new system; and they must therefore be fully aware of the contents of the specification and their agreement is essential.

(b) Record: A permanent record of the system in detail is necessary for control. It will be used for evaluation, modification and training purposes.

6.1.6 Terms of Reference

This will be set up by a steering committee or management and might comprise the following:

a) Investigate and report on an existing system, its procedures and costs;

b) Define the system's requirements;

c) Establish whether these requirements are being met by the existing system;

d) Establish whether they could be met by an alternative system;

e) Specify the performance criteria for the system;

f) Recommend the most suitable system to meet the system's objectives;

g) Prepare a detailed cost budget within a specified budget limit;

h) Prepare a draft plan for implementation within a specified time scale;

i) Establish whether the expected benefits could be realized;

j) Establish a detailed design, implementation and operating budget;

k) Compare the detailed budget with the cost of the current system;

l) Date by which the study team must report back to the steering committee; and

m) Operational managers who may be approached by the study group.

6.1.7 Criteria for Project Selection

There are four (4) key areas in which a project must be feasible,, if it is to be selected. These areas (criteria) are:

a) Technical Feasibility:- The system requirements as defined in the feasibility study must be technically achievable. This means that any proposed solution must be capable of being implemented using available hardware, software and other resources. The requirements may include:

i) Transaction volumes;

ii) Storage capacity;

iii) Response times; and

iv) Number of users

b) Operational Feasibility:- Any option worth considering should not lead to inefficiencies or ineffectiveness in the operations of the organization. In other words, any operational changes resulting from the option must result in enhancing attainment of business objectives, otherwise it lacks operational feasibility.

c) Social Feasibility:- An assessment of social feasibility should address issues like

i) Personnel problems;

ii) Job enrichment;

ii) Threats to industrial relations;

iv) Expected skills requirements; and

v) Motivation.

d) Economic Feasibility:- A system which satisfies all the foregoing criteria must still be economically feasible; in other words it must be a good investment. It should be possible to recover the amount invested and realise some profits.

6.1.8 Costs and Benefits

The cost of an Information System (IS) project may be considered under the following:

a) One-off costs:

i) Cost of hardware, software and other equipment 4 project team costs;

ii) Cost of producing documentation;

iii) Training cost; and

iv) Cost of installing the system.

b) Running (Operating) Costs:

i) Staff salaries;

ii) Overheads;

iii) Training;

iv) Maintenance;

v) Utilities and consumables; and

vi) Insurance and financing;

The benefits will include both quantitative and non-quantitative (or qualitative) components, for instance:

- better decision-making;
- fewer delays;
- better services; and
- competitive advantage.

There will also be quantitative or tangible benefits, for example:

- reduction in waste
- increase in revenues

6.1.9 Cost - Benefit Analysis

This is complicated by the fact that a number of the benefits are rather qualitative and non-quantifiable.

A number of approaches are available to do this, including:

a) Payback Period Method:- This calculates the length of time a project will take to recoup the initial investment - in other words, how long a project will take to pay for itself. The method is based on cash flows and has obvious disadvantages In particular, it does not consider the present values of future inflows. This shortcoming is resolved by the next method we are going to consider.

b) Discounted Cash Flow (DCF1):- This method may use two approaches:

(i) Net Present Value (NPV), which considers all relevant cash flows associated with the project over its life and adjusts those occurring in future years to "present value" by discounting at a rate called the "cost of capital".

If the NPV has a positive value, the project is feasible.

Where the NPV is negative, the total discounted cash outflows exceed the total discounted cash inflows and so the project is not feasible.

A zero value for the NPV reflects a break-even situation and the project should not be embarked upon.

ii) Internal Rate of Return (IRR), involves comparing the rate of return expected from the project calculated on the discounted cash flow basis with the rate used as the cost of capital. Projects with IRR values higher than the cost of capital are worth undertaking.

6.1.10 Cost- Benefit Ratio

Where cash is a constraint, a decision based on NPV alone may be misleading. In such circumstances, we use the cost benefit ratio, also known as the profitability index or NPV per N initial outlay, given by NPV / Initial outlay.

6.1.11 The Feasibility Study Report

This formal report is normally written by the project manager and submitted to the project Steering Committee, asking for agreement to proceed. It will include the following as contents:

(a) Executive summary - A short (possibly one-page) summary of the contents of the entire report;

(b) Terms of reference - A restatement of the terms of reference to facilitate an understanding of the report;

(c) Current system issues - All the good and bad sides of the current system that came up during the study;

(d) Evaluation of each option - Details of how each option was assessed in terms of its strengths and weaknesses;

(e) Description of the options - A thorough account of the various options, showing why each was selected;

(f) Feasibility - Analysis of how each option met the selection criteria;

(g) Conclusion - A clear statement of what the team finally arrived at, in terms of its choice; and

(h) Recommendation - This is to the appointing authority seeking permission to continue with the project.

6.1.12 Systems Investigation

This fact-finding exercise investigates the existing system to assess its problems and requirements and to obtain details of data volumes, response times and other key indicators.

The steps involved are

(a) *Fact-finding,* by means of interviews, questionnaires, observation, and organisation charts, etc;

(b) *Fact recording,* using flowcharts, decision tables, narrative descriptions, organisation and responsibility charts; and

(c) *Evaluation,* assessing the strengths and weaknesses of the existing system.

At this point, we will consider the following main fact-finding methods:

i) Questionnaires

A questionnaire is required when collecting information from widely dispersed respondents. It may be used in advance of an interview, to save the time of the analyst and employees.

A questionnaire is used to:

- ensure consistency of approach;
- achieve a logical flow of questions;

- ❖ avoid omissions; and
- ❖ ensure that data are collected in a form suitable for tabulation and analysis.

A questionnaire should:

- Not contain too many questions. This might make the prospective respondents unwilling to co-operate;
- Be organised in a logical sequence. This is likely to attract a free flow of logical and meaningful responses;
- Include an occasional question to the answer which corroborates the answers to previous questions. This will enable the analyst to find out which responses are realistic and honest and could be relied upon;
- As much as possible, be designed with dichotomous questions. These are questions that attract only one of two answers (e.g. yes/no);
- Be tested independently before being issued to the actual respondents. This will reveal if the questions are simple, unambiguous and can be easily answered by the target group; and
- Take into account the sensitivity of individuals in respect of their job security. As much as possible, the identities of respondents should not be asked for, if honest responses are solicited;

ii) Interviews

During an interview, the analyst meets face-to-face with the staff or interviewee in order that the analyst might obtain the vital information he needs.

If properly conducted, an interview should enable the analyst to break through any fears and resistance to change that may be felt by the employees, in addition to finding out essential facts about their work.

The analyst must be able to adapt his approach to suit the individual interviewee, rather than follow a standard routine.

The analyst should plan the interviews well and ask the types of questions that will attract the most useful responses.

Above all, the analyst must have ready and convincing answers to any of the questions that the interviewees may have in connection with how the project might affect them in the future.

The analyst may find the following useful checklist of what to do and what to avoid during the conduct of interviews:

Table 6.1 Interview Guidelines

DO	DON'T
Plan for the interview	Be late (lateness will disturb interviewee‟s schedule of work)
Make appointments and be committed to meet them	Be too formal or too casual (in order to identify with group)
Identify the right people to answer questions	Interrupt (in order to help in the free flow of information)
Listen carefully since the exercise is meant to be used to learn about system in use	Use technical jargon (this ensures that all questions are well understood and answered)

Use the local terminology appropriate to the type of job	Confuse opinions with facts
Accept ideas and hints from interviewee	Jump to conclusions (since this is a learning process)
Hear from all people who join efforts to complete a task	Argue (this might offend the interviewee)
Collect documents/forms. These may be required for use in a future system	Criticise
Check the facts back to ensure correctness of Information	Suggest (any suggestion might distort the real Issues

Part pleasantly, showing appreciation, since there might be the need for a repeat visit.

iii) Observation

Once the analyst has some understanding of the methods and procedures used in the organisation, he should be able to verify his findings and clarify any problem areas by an observation of operations. Observation is a useful way of cross checking with the facts obtained by interviews or questionnaires.

Very reliable results will be obtained if the maximum co-operation is sought from those being observed, since staff may act differently from normal, if they know they are being observed.

Long periods should also not be devoted to any particular staff since the exercise can make the person being observed nervous and may also easily make the observer feel sleepy, since the entire exercise may be very boring. A good approach will consist of shifting from person to person during the exercise in order to remain active and stay awake.

6.1.13 System Analysis

This is the stage where a thorough and detailed description of the current system is carried out in the form of a documentation showing its strengths and weaknesses and why it works the way it does. Identifying the strengths, the analyst will ascertain what role (if any) they may have in future processing activities.

This stage examines why current methods are used; what alternatives might achieve the same, or better results; what restricts the effectiveness of the system and what performance criteria are required from the system.

6.1.14 System Design

This is a technical stage that considers both computerised and manual procedures, addressing, in particular, inputs, outputs, program design, file design and security. This leads to the detailed specification of the new system. This detailed description on paper is also referred to as the 'logical design' of the system.
It is the process of creating alternative solutions to satisfy the feasibility study goals, evaluating the choices, and then drawing up the specifications for the chosen alternative.

During the system design stage, designers must decide on how to produce an efficient (economical) and effective (relevant and useful) system.

A number of approaches are adopted at this stage. One that is adopted by all analysts/designers to ensure they obtain a system that meets users' exact requirements is what is referred to as 'design reviews and walkthrough', or 'user validation' -described next.

6.1.15 Design Reviews and Walkthroughs (or User Validation)

This is a very crucial approach adopted by designers when they are designing systems. The analyst breaks down the process into a number of sections (called 'milestones'). At each milestone, the resulting output ('deliverable') is presented to users for their approval.

Periodic sessions are held so that interested users can 'walk through' the input and processing operations to describe the handling of data.

Users are encouraged to look for errors and to make comments. It does not serve any purpose for the designer or the users themselves if a honest review is not done in order to ensure corrections are effected where necessary. There must be a formal sign-off on the section before work on the next can commence - this is what gives the designer the confidence and right to proceed.
At the end of this exercise, any changes that become necessary should be due to changes

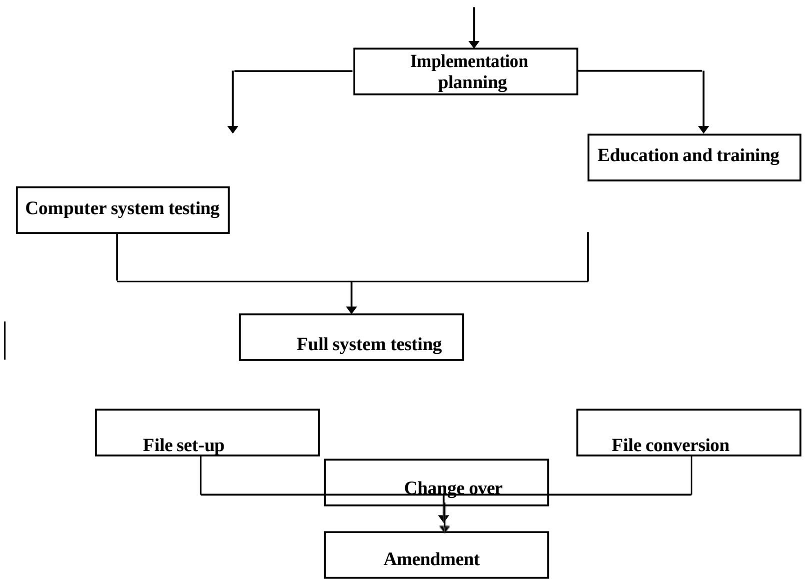
in user requirements which were not anticipated earlier, granted that all those involved in the process did what was expected of them.

6.1.16 System Implementation

This stage carries development from design to operations. It involves acquisition (or writing) of software, program testing, file conversion, file set-up, education and training, acquisition and installation of hardware, and changeover.

This stage of turning the theoretical design (logical design) into a working system (the physical design) comprises the following steps (in the form of a flow chart):

Table 6.2 Steps of implementation



a) System Testing

This is aimed at ensuring that the system works accurately and efficiently before live operations commence. Tests of hardware, software and staff should be arranged in a live operating environment or a simulated one. The objective is to prove that the computer and clerical procedures are understood and that they produce the required results.

b) **Education and Training**

Education involves creating the right atmosphere and motivating user staff. It should be established first at the senior level and then it is more likely to be more effective with lower levels of management and other staff.

Education helps overcome the resentment that may be caused by the computer seeming to take away responsibility from individuals. It also helps to allay fears of staff being made redundant which may eventually lead to job loss.

Training should be aimed at equipping staff with the changeover procedures as well as the new system procedures. It should be noted that training at this stage is not what is required for staff to be able to operate the new system.

c) File Conversion

This involves the conversion of the old file data into the form required by the new system. It usually involves the conversion of live files (e.g. stock files and customer files). This poses major organisational and scheduling difficulties, since incoming data (e.g. stock issues/receipts or payments) are continually being used to update the files.

The conversion of large files may be done by first separating and converting the static data part of each record on the files and converting the dynamic contents as late as possible. These parts are then merged to make up complete records and complete new files.

d) File Set-Up

This is the process of creating the new computer files from the converted computer-acceptable data. Usually special programs are required to carry out some 'once-only' conversion processes.

The major problems associated with the process are the accuracy of the conversion and the error detection procedures. It is essential that at the end of file set-up, the users should be satisfied with the new files. It is vital that the data content of master files at changeover are accurate.

Incorrect data may arise

i) as errors in the original source document;

ii) during clerical transcription;

iii) during data entry; and

iv) from a conversion program.

e) Changeover

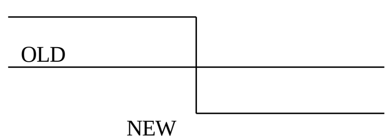
The changeover from the old to the new system may take place when:

(i) the system has been proved to the satisfaction of the analyst and the other preceding implementation activities have been completed;

(ii) users and managers are satisfied with the results of the system test, staff training and reference manuals

(iii) the operations manager is satisfied with the performance of equipment, operations staff and the timetable; and

(iii) the target date for changeover is due. The main approaches are:



Direct Changeover

The old system is suddenly replaced with the new. This is a very bold approach that should only be attempted during slack periods. Conditions under which this method may be adopted include;

- ❖ previous success of new system in a similar situation.
- ❖ no basis for comparison by virtue of both systems being substantially different.
- ❖ no-extra staff to oversee parallel running.
- ❖ Parallel Running

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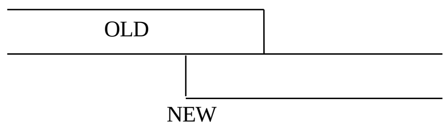


This method runs both the old and new systems together for a period of time, both processing current data. Results from both systems are checked for consistency. Where the results do not agree, the reasons may be attributed to

- errors in the new system, or
- errors in the old system, or
- sabotage of the new system, or
- wrong handling of the new system although it is error-free.

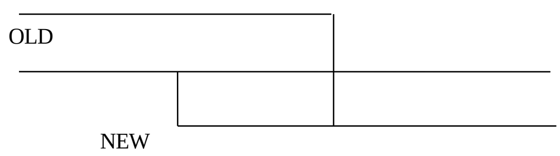
This method provides a degree of safety but it is expensive in terms of the duplication of efforts and resources used.

The method should be properly planned to cater for

- a firm time limit on parallel running
- details of the type of results to be checked .
- instructions on how errors are to be dealt with

- instructions on how to cope with major problems in the new system
- simulation of period-end processing (e.g. year-end),

Pilot Operation

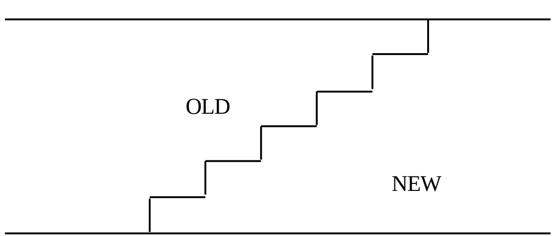


This is cheaper and easier to control than parallel running, and provides a greater degree of safety than does a direct changeover. There are two types:

- *Retrospective Parallel Running*, in which the new system operates on data previously processed by the old system. The existing results are available for checking with results from the new system without the problems of staffing and disruption caused by parallel running.

- *Restricted Data Running* involves a complete logical part of the system file being chosen and it is run as a unit on the new system. If that is shown to be working well, the remaining parts are then transferred. Gradually, the entire system can be transferred in this piecemeal fashion.

Staged / Phased Changeover



This is best suited to very large or complex projects. The first stage is implemented using the parallel approach and, thereafter, it is a series of discrete direct changeovers.

Where this approach is adopted, care must be taken to control any systems amendments incorporated in the later stages in order to ensure that the overall system remains totally compatible.

Note carefully that the difference between this approach and the restricted data running approach discussed above is that this approach looks at implementing the entire new system in stages while the restricted data running considers the implementation of part of the entire system in a piecemeal fashion.

6.1.17 Post-Implementation Review

This is an investigation to review the performance of an operational system; to compare actual with planned performance; to verify that the stated objectives of the system are still valid in the present environment and to evaluate the achievement of these objectives.

The investigation also examines the level of control in the system. The initial review provides the opportunity to check whether the objectives and benefits forecast in the feasibility study have been achieved. Subsequent reviews, carried out as part of regular reviews of systems (mostly annually) will be concerned with the continued achievement of benefits, any deviations from the master system specification, and opportunities for improvement.

6.2 THE IMPORTANCE OF THE LIFE CYCLE

6.2.1 Impact of the Life Cycle

The systems development life cycle has had a very positive effect on the standards of computer systems. Its systematic approach means that the quality and efficiency of the systems developed will be substantially enhanced.

The feasibility study establishes whether the new system can be justified. Proper analysis and design increase the chances that the new system will meet users' requirements. The cycle also recognises that the implemented system should be continually monitored and updated as necessary.

6.2.2 Disadvantages of the Cycle Approach

There are some drawbacks associated with the system development life cycle approach. It leads to very limited and restricted attitudes to the development of systems.

Users tend to be relegated to a passive role in the development process. The definition of their requirements is technical and it relies more on the abilities of the analysts. Often this has led to the information needs of managers being ignored, leading to poorly defined user requirements, and a lack of involvement of users in the development process.

Another disadvantage is that most systems were developed independently of each other.

A number of other models are available that ensure better user participation during systems development. These models which include the waterfall model, b model, spiral model, etc are, however, not discussed in this manual.

6.2.3 Structured Methodologies

The introduction of other ways of developing systems (notably the methodologies) helped to reduce the effects of many of the drawbacks of the systems development life cycle.

A system development methodology is a collection of procedures, techniques, tools and documentation aids which help system developers in their effort to develop and implement a new system.

The methodologies help in the following ways:

(a) involve users more closely in the development process;
(b) analyse user needs in a more fundamental way;
(c) allow flexibility of systems; and
(d) produce easily understood documentation;

6.2.4 Advantages of Methodologies

The advantages of these methodologies include the following:

a) detailed documentation is produced;

b) standardised methods make it easier and cheaper to apply;

c) leads to improved system specifications;

d) systems developed in this way are easier to maintain and improve;

e) users are involved with development work from an early stage and are required to sign off each stage;

f) use of diagrams makes it easier for relevant parties, including users, to understand the system than if it were merely descriptive; and

g) a logical design is produced that is independent of hardware and software.

6.2.5 Disadvantages of Methodologies

a) it may be inappropriate for information of a strategic nature that is collected on ad-hoc basis;

b) some methodologies may be limited in scope, being too concerned with systems design and not with their impact on actual work processes or the social context of the systems;

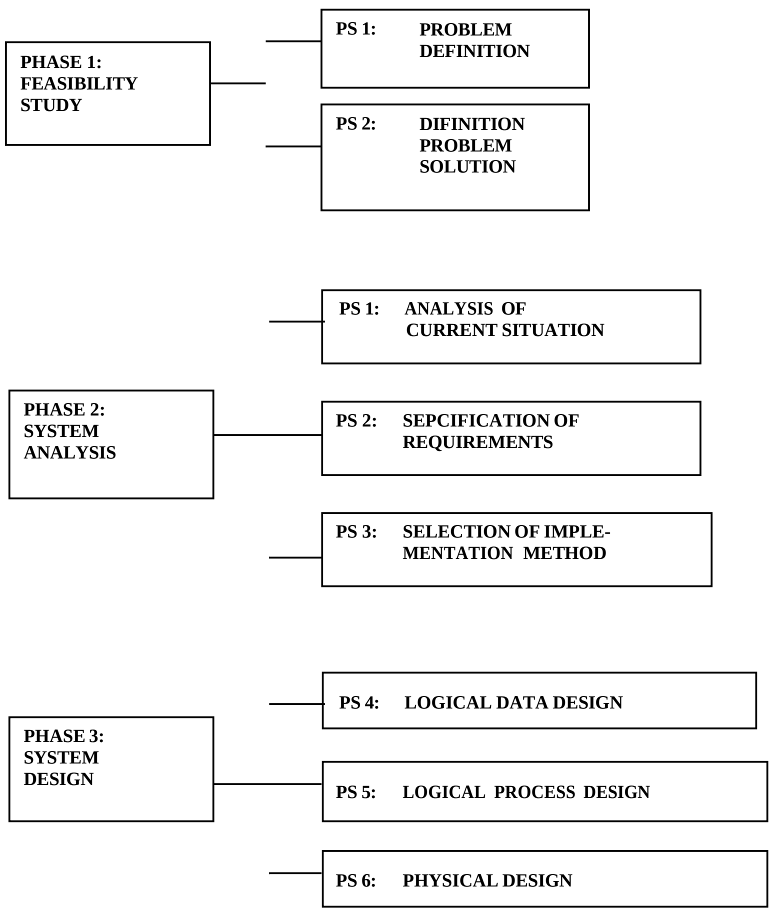
c) it may encourage excessive documentation and bureaucracy and may be just as suitable for documenting bad design as good.

As our example, we shall consider the Structured Systems Analysis and Design Methodology (SSADM), which is a very popular type. It is discussed in the following block diagram:

6.2.6 Stages of SSADM

STRUCTURED SYSTEMS ANALYSIS AND DESIGN METHODOLOGY (SSADM)

Fig: 6:3 Overline of the stages of the structured Systems Analysis and Design Methodology



SSADM is a structured methodology with the following features:

a) it describes how a system is to be developed;

b) it reduces development into phases, with each phase reduced into stages (sub-phases). Each stage contains a number of steps which contain tasks, inputs and outputs; and

c) it is self-checking and can be tailored to a number of applications.

i) PHASE 1 – FEASIBILITY STUDY

The feasibility study phase, although not mandatory in many SSADM projects, is meant to examine the 'case' for undertaking a particular project in terms of its technical feasibility and cost benefit.

- **FS1:** The basic requirements and terms of reference are set out and initial investigations carried out.

- **FS2:** A number of ways of satisfying the requirements of the system are identified and costed.

ii). **PHASE 2 – SYSTEM ANALYSIS covers stages 1 to 3**

- **STAGE 1:** The current situation is investigated by the Analyst, who will identify and document the current processes, data flows and any problems currently encountered or anticipated.

- **STAGE 2:** User needs are identified and laid down in detail. If there are a number of different needs which may be conflicting or compete for resources, priorities will be established.

- **STAGE 3:** The information should now be available to specify a number of hardware and software options. The best option is recommended by the Analyst and agreed to by management.

iii) PHASE 3 – SYSTEM DESIGN covers stages 4 to 6

- **STAGE-4:** A relational data analysis is carried out, with the data being normalised, if required. (Normalisation of data is beyond our scope and so is not treated in this study manual).

- **STAGE 5:** The different processes that are required to produce a relevant output are specified and crosschecked with the data design in stage 4 above.

- **STAGE 6:** The logical data and process designs are combined into a definition of how the system will be written and implemented.

6.3 PROTOTYPING

6.3.1 Introduction

During the development of a new system, there is the need to ensure that the exact needs of users are developed and that developers just do not 'dump' on users what they think is appropriate. Thus, it is necessary to ensure that end-user inputs are solicited for during the development of a system.

Prototyping is meant to afford users the opportunity to play this vital role in the development process.

6.3.2 Definition

Prototyping is a fourth-generation language (4GL) development tool that is used to allow users to quickly produce a simulation of the output required from a completed system. The prototype of a system or program is a smaller version of the system or program and is supposed to have the appearance of the final completed working system/program. It may be tested and subjected to experimentation by users on the way to reaching what they desire.

Users are better able to clarify their requirements, which may be refined through the subsequent evolution of the prototype. The prototype may become part of the specification of the system.

6.3.3 Stages of prototyping

Based on the knowledge of the form of the final product, a prototype of it is created. This is subjected to reviews, tests and amendments. As long as users indicate that the current product is not exactly what is required, there has to be an amendment, followed by further tests and amendments, where necessary, for user's approval.

This iterative process ensures that user's needs are exactly catered for and avoids the possibility of handing over a failed system to users. User ownership of the system developed is also ensured.

When the prototype is agreed on as representing the final outcome, prototyping software may then be used to develop the final application.

The stages may be summarised using the following sketch:

Figure 6.4 **Stages of Prototyping**

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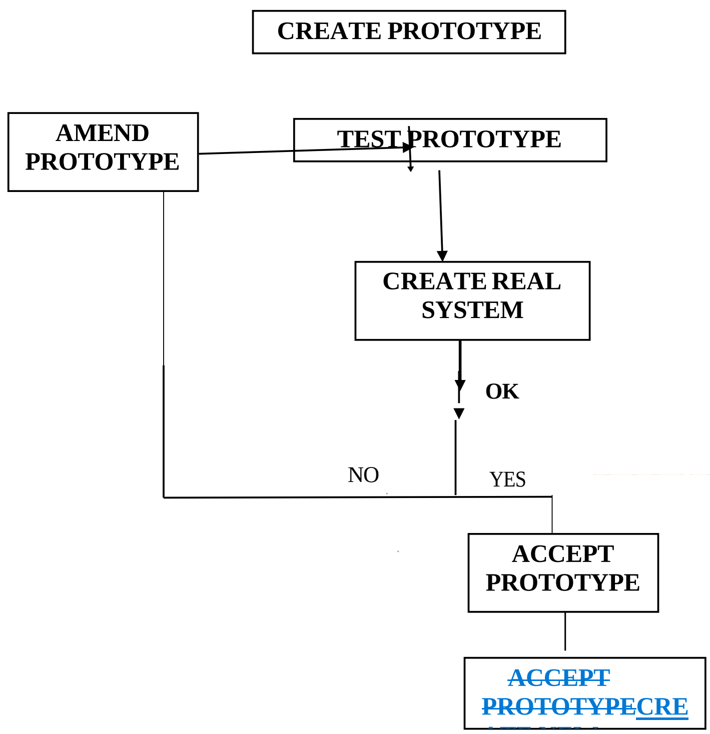


6.4 COMPUTER FORENSIC

It is important to note that the prototype

a) is a live working application which can perform actual work;

b) may eventually become the actual application or be replaced by another; and

c) is used to test out assumptions about users' requirements and about system design.

When the final version is ready, prototyping software may then be used to develop the final system.

6.4.2 Advantages of Prototyping

a) The user is able to judge the prototype before things get too far to be changed;

b) It makes it more economical for users to get custom-built application software; and

c) A prototype does not necessarily have to be written in the language of what it is prototyping.

6.4.3 Disadvantages of Prototyping

a) Many prototyping software tools assume that the user is only about to computerise an application for the first time. This might not be the case;

b) Programs produced may be tied to a particular hardware platform or database system;

c) Prototyping tools may be inefficient in the programs they produce; and

d) Not all prototyping tools allow programmers to insert hand-written codes into a program when this becomes necessary.

6.5 JOINT APPLICATIONS DEVELOPMENT (JAD)

6.5.1 Introduction

Just as prototyping affords end-users the opportunity to ensure that their exact system requirements are met, JAD seeks to bring users and the systems team together so that they collaborate during the process of developing the new system. This will obviously also ensure that the required system is produced.

6.5.2 Definition of JAD

Joint Applications Development (JAD) describes the partnership between users and systems developers during the process of developing a system.

6.5.3 Benefits of JAD

JAD has the following potential benefits:

a) It creates a pool of expertise made up of interested parties from all relevant functions.

b) (b) Reduces risk of systems being imposed on users.

c) Increases user ownership and responsibility for systems solution; and

d) Emphasises the information needs of users and their relationships to business needs and decision-making.

This shift of emphasis to application development by end users needs to be well managed and controlled, and one approved means of having this done well is by the establishment of an information centre, with a help desk.

6.6 RAPID APPLICATIONS DEVELOPMENT (RAD)

6.6.1 Introduction

There are certain situations when a particular system needs to be developed very quickly because end-users and, by and large, the. organisation itself, cannot afford to wait unduly for the completion of the development of the system. Such situations call for the use of novel approaches to the development process. RAD is one such approach.

6.6.2 Definition of RAD

Rapid Applications Development (RAD) is a quick way of developing software, and combines a managed approach to systems development with the use of (modern) software tools such as prototyping and modelling. RAD involves end-users heavily in the development process. The RAD team should be made up of highly motivated people with at least one person very skilled in the use of advanced tools. This will ensure that any such tools employed will eventually be used effectively.

6.6.3 When is RAD appropriate?

RAD is especially appropriate for the following situations:

a) If users are not clear about their requirements, RAD can quickly help them find Out;

b) If there is the culture of user involvement in systems development, the RAD team can work productively;

c) Where there is a need for faster delivery than conventional development can provide;

d) Where the target system is limited in scope; and

e) Where the target system is not expected to be implemented on a new platform.

6.7 OUTSOURCING

6.7.1 Introduction

Owing to the ever-increasing competition amongst organisations, managements often device means by which they can carry out their functions more efficiently. Outsourcing is one way by which certain non-key functions of an organisation could be offloaded to other external expert firms to manage for a fee.

6.7.2 What Outsourcing is All About

Outsourcing involves purchasing from outside the organization, the services required to perform certain business functions. Outsourcing covers facilities management, types of services and a range of contracts with more intangible benefits. It is the ultimate expression of a buyer's attitude to a supplier as an extension of in-house resources. Facilities or functions that were provided in-house are instead performed by external contractors working very closely with the buying organisation. It includes such services as computer centre operations, network operations and applications management as well as systems integration. Outsourcing is often closely related to downsizing and/or divesting in order to concentrate on key business competencies. The management logic of outsourcing comes from lowering costs, reducing the dilution of management attention or covering temporary skill gaps.

A company is not expected to outsource any of its key operational functions. The reason for this is that the company stands the chance of losing any competitive advantage it enjoys if the outsourcing vendor is also a vendor to any of the company's competitors.

6.7.3 Types of Outsourcing

There are a number of types of outsourcing, they include the following:

a) Body Shop Outsourcing: This is where management uses outsourcing to meet short term IS/IT demand. For example, getting outside assistance in the area of programming, where the expertise required is temporarily not available within the firm;

c) Project Management Outsourcing: This is used for all or part of a particular IS project, for example the development of a new system; and

d) Total Outsourcing: This is where an organization chooses to outsource more than 70% of its IS capability to a single outsourcing vendor.

6.7.4 Ensuring the Success of Outsourcing

Gary J Zenz provides a worthwhile analysis of steps which managers should take to ensure the success of outsourcing. These are

a) Managers should establish a strategy for the proper balancing of management, contracting and consulting;

b) Managers should establish a strategy to deal with possible reductions in staff;

c) Managers should closely integrate the external suppliers; and

d) Managers should provide appropriate communication channels.

6.8 COMPUTER SECURITY

6.8.1 Introduction

An information technology crime may be defined as an illegal act carried out on computers or telecommunications or it may be the use of computers or telecommunications to accomplish an illegal act.

These crimes could include hardware or software theft, stealing of computer time and stealing of information or money.

6.8.2 Theft of Hardware

This may be associated with the smaller PCs and is usually rampant at airports and hotels as well as on campuses. With the desk-tops, thieves may often decide to steal the system unit and leave the peripheral devices.

In an organisation, these hardware devices must be properly documented in the stock registers and labelled with specific codes that indicate their sites and other identification marks to discourage people from taking them out.

6.8.3 Theft of Software

A number of ways could be devised to make this unrewarding. For instance, the software developers may decide that before the program runs on any computer, there must be a valid key (or code) on the computer. This key should include the serial number of the computer's processor. This ensures that the same program will not run on a different computer, thus making it not worth the while to pirate the program.

6.9 COMPUTER VIRUSES AND WORMS

6.9.1 Introduction

A computer virus is a small program which has the ability to infect a whole computer system.

6.9.2 Definition of Computer Viruses

A **computer virus** may also be referred to as infectious coding or malicious coding. It is any software designed to damage or compromise computer systems.

The coding is parasitic in nature. Once it finds a host (which might be a PC), it is released and replicates itself very quickly, possibly infecting the memory and back-up storage media.

The commonest way that viruses are spread is through e-mail, usually in the form of attachments. Viruses can also be carried by diskettes, flash disks, networks, CD's and in software downloaded from the Internet. It is even possible to pick up a virus by chatting on-line, visiting a website, or playing computer games.

Many viruses are designed to exploit vulnerabilities in commercial software and to sneak in through unprotected "back doors" (digital holes in commercial software). Reports indicate that there are more than 57,000 individual viruses around that could infect computers and networks. Some of these are merely mischievous (that is, they may just drop a cheeky message onto your screen) but others are designed to infiltrate sophisticated computer systems.

6.9.3 Examples of Viruses

Examples of viruses include:

a) **The Jerusalem Virus,** which slows down the operation of the computer so much that it becomes virtually unusable; and it deletes files;

b) **Cascade** causes characters on the screen to fall to the bottom of the screen and may even reformat the hard disc, an action that results in the deletion of everything on the hard disk;

c) **Casino** displays a one-armed bandit game on the screen; if the user fails to win the jackpot, the hard disc is wiped clean;

d) **Love Bug** attacks the operating system;

e) **The Boot Sector Virus** replaces boot instructions with some of its own; once the system is turned on, the virus is loaded into main memory before the operating system - from there it is in a position to infect files;

f) **Time Bomb** is a piece of software that is executed at a specific date/time;

g) A logic bomb will be triggered into action on the occurrence of an event.

h) **Trojan Horse** is a type of virus. It is a code hidden within an authorised program to carryout illegal processing.

6.9.4 Computer Worms

A **worm** is that type of high-tech maliciousness, program that copies itself repeatedly into memory or a selected medium, until no more space is left. Most worms, having made copies of themselves, release a "pay load", an action designed to disrupt your system e.g. the Magistrate worm hides itself in the hard disc, moving around in your main address book and then mailing itself to people you interact electronically with.

Examples of worms include

(i) Blaster

(ii) Slammer

A worm is like a virus except that it is a program rather than a code segment, hidden in a host program. It usually does not live very long, but it is quite destructive while it is alive.

6.9.5 Detection and Prevention of Viruses and Worms

Viruses and worms may be detected by the use of effective anti-virus software installed on the network or stand-alone computer. Examples of these are:

(a) Norton Anti-Virus;
(b) Dr Solomon's;
(c) AVG Anti-virus;
(d) Kaspersky Anti-virus Personal;
(e) PC-Cillin;
(f) Windows Live OneCare;
(g) McAfee Virus scan; and
(h) Panda
(i) Bitdefender
(j) Avira
(k) Avast
(l) SmadAV

The software scans the computer's main memory and media to detect viruses and, if possible, destroy them.

You need to note that, depending on the type of worm or virus, a particular antivirus software may be ineffective. In such a situation, there is the need for a more effective (powerful) type of anti-virus.

6.9.6 How to Avoid Viruses and Worms

The following steps may be taken to avoid viruses and worms.

(a) Go for the right anti-virus software and ensure regular backups;

(b) Update the anti-virus software regularly (through the internet);

(c) Guard your e-mail in-box, especially attachments;

(d) Download materialss from well-known and reputable sources only

(e) Contact your ISP about virus scanning; and

(f) Establish rules on media that may be used on the network or PC.

6.10 Cyber Crimes

Sometimes, criminals are more interested in abusing or vandalising computers and telecommunications systems than in profiting from them.

There are a number of devices, principally involving programming tools, for entering into computer systems and wreaking havoc. Some of these computer crimes are:

6.10.1 Warez trading: Exchanging or selling pirated software.

6.10.2 Super zapping: Bypassing all security systems by means of specialized software tools.

6.10.3 Data leakage: Removing copies of confidential information within a system without any trace.

6.10.4 Carding: Obtaining, using, or selling other people's credit card numbers.

We now give more computer crimes and abuse techniques:

(i) Cracking is an unauthorised access to and use of computer systems, Usually by means of a PC and a telecommunication network. Crackers are hackers with malicious intentions;

(ii) Data dialling is changing data before, during, or after it is entered into the system in order to delete, alter or add key system data;

(iii) Data leakage is unauthorised copying of company data such as computer files;

(iv) Denial of service attack: Attacker sends e-mail bombs (hundreds of messages per second) from randomly generated false addresses. Internal service provider's e- mail server is overloaded and shuts down;

(v) Eavesdropping is listening to private voice or data transmission, often using a wiretap;

(vi) E-mail forgery is sending an e-mail message that looks as if it were sent by someone else;

(vii) E-mail threats involve sending a threatening message to try and get recipients to do something that would make it possible to defraud them.

(viii) Hacking is unauthorised access to and use of computer systems, usually by means of a PC and a telecommunications network. Hackers do not intend to cause any damage but to gain access for the sake of doing it;

(ix) Internet misinformation involves using the internet to spread false or misleading information about companies;

(x) Internet Terrorism is using the internet to disrupt electronic commerce and to destroy company and individual communications;

(xi) Logic Time Bomb is a program that lies idle until some special circumstances or a particular time triggers it. Once triggered, the bomb sabotages the system by destroying programs and/or data;

(xii) Masquerading or Impersonation involves a perpetrator gaining access to the system by pretending to be an authorised user; enjoys same privileges as the legitimate user;

(xiii) Password cracking involves an intruder penetrating a system's defences, steals the file containing valid passwords, decrypts them, and then uses them to gain access to system resources such as programs, files and data;

(xiv) Piggybacking involves tapping into a telecommunication line and latching on to a legitimate user before he logs into the system. Legitimate user unknowingly carries perpetrator into the system;

(xv) Round-down involves computer rounding down all interest calculations to two decimal places. Remaining fractions of a cent is placed in an account controlled by perpetrator;

(xvi) Salami Technique: Here tiny slices of money are stolen over a period of time (Expenses are increased by a fraction of a per cent; increments are placed in a dummy account and later pocketed by the perpetrator);

(xvii) Scavenging involves gaining access to confidential information by searching corporate records. Scavenging methods range from searching trashcans for printouts or carbon copies of confidential information to scanning the contents of computer memory;

(xviii) Social Engineering. Here a perpetrator tricks an employee into giving out the information needed to get into a system;

(xix) Software piracy is copying computer software without the publisher's permission;
,

(xx) Spamming involves e-mailing the same message to everyone on one or more UseNet newsgroup or LISTSERV lists;

(xxi) Super-zapping involves unauthorised use of special system programs to bypass regular system controls and perform illegal acts;

(xxii) Trap Door. Here perpetrator enters the system using a backdoor that bypasses normal system controls and perpetrates fraud;

(xxiii) Trojan Horse involves unauthorised computer instructions in an authorised and properly functioning program;

(xxiv) Virus as stated before; and

(xxv) War dialling involves programming a computer to search for an idle modem by dialling thousands of phone lines. Perpetrator enters the system through the idle modem, captures the personal computer attached to the modem and gains access to the network to which the PC is attached.

6.11 Computer Privacy and Security

Information privacy includes the rights of individuals to know that recorded personal information about them is accurate, pertinent, complete, up-to-date and reasonably secured from unauthorised access. The concept of information privacy includes the right of the individual to influence the kind, quantity and quality of information contained in the system which is readily identifiable to the individual. Regardless of whether this information is open to the view of the general public or specifically required to be confidential by law, these privacy guidelines should be observed by all operators and users of information systems.

Data security is neither a social nor a legal issue; rather it is a procedural matter which involves the way organizations protect their information from unauthorized or accidental modification, destruction and disclosure. There is no such thing as perfect security and most organizations can achieve a level of protection appropriate to their needs. The objective of a data security program is to cut the risk and probability of loss to the lowest affordable level, and also to be capable of implementing a full recovery program if a loss occurs.

The first step in providing an effective security program is that all levels of management must become aware of the importance of information management and its consequences. Once management has made the commitment to security procedures, a plan must then be developed and put into action.

6.11.1 Security Concerns

IT requires vigilance in security. Four areas of concern are:

a) Identification and access

b) Encryption

c) Protection of software and data

d) Disaster recovery planning

a) Identification and Access

Computer systems try to authenticate user's identity by determining

i. what the user has e.g. card, key, signature, badge etc;

ii. what the user knows e.g. PIN, password, digital signature; and

iii. who the user is e.g. by the use of biometrics?

A digital signature is a string of characters and numbers that a user signs to an electronic document being sent by his or her computer.

The receiving computer performs mathematical operations on the alphanumeric string to verify its validity.

b) Encryption

This is the technique of disguising information in order to preserve its confidentiality during transmission and when stored. The process of encryption and decryption comprises an algorithm and a key.

The algorithm is the operation itself which transforms the data into cipher and the key controls the algorithm. Changing the value of the key can alter the effect of the algorithm so that the conversion for each key value is completely different.

,

c) Protection of Software and Data

Measures taken will include educating staff on back-up procedures, protection against viruses etc. Other security procedures include

i. Control of access, using physical and logical access control.

ii. Audit controls: These track the programs and servers used, the files opened, etc. and create audit tails.

iii. Staff controls: These include screening of job applicants, segregation of duty, manual and automated controls and the destruction of all printouts, printer ribbons and other wastes that may yield passwords and trade secrets to outsiders.

d) Disaster Recovery Plans

These are methods used to restore information processing operations that have been halted by destruction or accident. It includes arrangements for alternative locations, which may be Hot or Cold sites.

A Hot site is a fully equipped computer centre with everything needed to quickly resume functions. This does not necessarily have to be owned by the company that needs it.

A Cold site is a building or other suitable environment where a company can install its own computer systems. An installation will take place when there is a mishap that renders continued operations impossible.

6.11.2 System Security

A Computer System is said to be secured against a particular threat (e.g. fire), if counter-measures have been taken to reduce to an acceptably low level the amount of loss, which the threat may be expected to cause over a given period of time.

There are three types of loss, from which an organization will not want its computer system to suffer. These are

(i) Loss of availability - this means that for some reasons, the system is not available for use.

(ii) Loss of integrity (accuracy) - a virus attack, for instance, may bring this about. This relates to the integrity of its outputs.

(iii) Loss of confidentiality - this occurs when the system can be easily accessed by unauthorised people.

A threat to a computer system is any event which occurrence will adversely affect one or more of the assets or resources (hardware, software, network, media and data, etc.), which make up the system.

Threats may be grouped into two broad types:

a) Physical Threats; comprising fire, water, the weather and the physical environment.

b) Human Threats; made up of damage, theft, strike actions, etc.

6.12 WORKPLACE SECURITY AND HEALTH ISSUES

6.12.1 Workplace Security

Since an average employee of an organisation spends more than one-third of his working day in a workplace, the security of such an employee is very paramount. Though, majority of the hazard and dangers in workplace are preventable, this section draws the reader's attention to the hazards and dangers commonly found in the workplace (office) and the preventive measures that can reduce or eliminate them.

It is a legal obligation of employers to provide a healthy and safe workplace to their employees as enacted in the occupational safety and Health Act 2012 which mandate all employers to:

1. Promote safe and healthy workplace for employees and protect them from injury and illness;
2. Make provision for protecting others against risks to safety in connection with the activities performed by the employees;
3. Provide preventive mechanisms in respect of injury or accidents in the workplace;
4. Ensure provisions of occupational safety and health services to all workers;
5. Develop consultations between employers and employees on the safety, health and welfare of workers at the workplace;
6. Develop and promote public awareness and enlightenment on the measures to prevent accidents and injuries;

7. Provide a legal basis for national policy on occupational safety and health; ander
and
8. Provide regulatory framework for compliance with safety and health standards by employers, their agents and employees in workplaces.

The use of computers and communications technology can have some adverse effects on our health. It is important to have some knowledge about some of these health issues in order to protect yourself adequately against them.

6.12.2 Repetitive strain injuries

Repetitive strain injuries (RSIs) consist of wrist, hand, arm, and neck injuries resulting when muscle groups are forced through fast, repetitive motions. These often affect people such as journalists, data-entry staff, postal workers, pianists, etc.

RSIs may cover a number of disorders, some of which may be easily curable, and others that may be very damaging. Included in the latter is the carpal tunnel syndrome (CIS), which is a debilitating condition caused by pressure on the median nerve in the wrist, producing damage and pain to nerves and tendons in the hands. This may require surgery.

6.12.3 Eyestrain and Headaches

In most instances, users of computers are compelled to read from the screen at very short distances and this affects the eyesight.

Computer vision syndrome (CVS) presents with eyestrain, headaches, double vision, and other problems caused by improper use of computer monitor screens. This could be reduced by keeping the screen at a good distance, using a screen with good resolution and installing screen shields.

6.12.4 Back and Neck Pains

These result from using improper furniture or positioning keyboards and display screens in improper ways. Users have to adapt to the right type of furniture and equipment in order to avoid or minimise this. Also users are expected to sit straight-up when using the system.

Introduction and Definition

Computer forensics (also called digital forensic) is a branch of forensic science pertaining to legal-evidence found on computers and digital storage media

The reasons for computer forensics include:

a. In legal cases, computer forensics techniques are frequently used to analyse computer systems belonging to defendants (in animal cases) or litigants (in civil cases)
b. To recover data in the event of hardware or software failures
c. To analyse a computer after a break-in e.g. to determine how the attackers gain access and what the attackers did
d. To gather evidence against an employee that an organisation wishes to terminate
e. To gain information about how computer systems work for the purpose of debugging, performance optimisation and so on.

6.13 Forensics Processes/Techniques

There are five basic steps or techniques involved which include:

a. Preparation of investigator note data
b. collection of the data
c. Examination of data
d. Analysis of data
e. Reporting

The investigator must be properly trained to perform the specific kind of investigation that is at hand. Tools to be used to generate report should be validated.

Collection of digital evidence: Digital evidence can be collected from sources such as computers, cell phones, digital cameras, hard drives, CD-Rom, USB memory devices and so on. Digital evidence must be handled with care because most digital information is easily changed and once changed, it is usually impossible to detect that a change has taken place, unless other measures have been taken.

Most valuable information obtained in the course of forensic examination comes from the computer user. An interview with the user can yield valuable information about the system configuration, applications, encryption keys and methodology.

Forensic analysis is much easier when analyst have the user's pass phrases to access encrypted files, containers and network servers.

BIG DATA

6.14 Definitions

Big Data is defined as extremely large data sets that may be analysed computationally to reveal patterns, trends, and associations, especially relating to human behaviour and interactions.

Big Data is also defined as **data that contains greater variety, arriving in increasing volumes and with more velocity**. This is also known as the three Vs definition of Big Data. Put simply, big data is larger, more complex data sets, especially from new data sources.

Big Data may be classified into three, thus:

- Structured Data: These are data have regular formats. They follow particular trends and patterns.
- Unstructured Data: These data do not follow identifiable patterns.

Semi-structured Data: Part of these data follow regular patterns while other parts do not.

Big data is a combination of structured, semi-structured and unstructured data collected by organizations that can be mined for information and used in machine learning projects, predictive modelling and other advanced analytics applications.

Systems that process and store Big Data have become a common component of data management architectures in organizations, combined with tools that support big data analytics. Big data is often characterised by the three V's:

- the large volume of data from many environments;

- the wide variety of data types frequently stored in big data systems; and
- the velocity at which much of the data is generated, collected and processed.

These V's may be increased to six by the addition of other characteristics such as

- Value: The value or worth of the information to the company. This is determined by the relevance of the data to the company.
- Veracity: This refers to the accuracy of the data. This determines its reliability.
- Variability: This is the rate of change in the structure of the data.

Big data deployments often involve terabytes, petabytes and even exabytes of data created and collected over time.

6.14.1 Benefits of Big Data

Companies use big data in their systems to

- improve operations,
- provide better customer service as they follow the trend of customer behaviour more closely and accurately.
- Create personalised marketing campaigns as the companies have more comprehensive knowledge of customer behaviour.
- Enable the company to take actions that ultimately increase revenue and profits.
- give competitive advantage in the marketplace to businesses that use it effectively as they are able to take faster and more informed business decisions.

6.14.2 Application of Big Data in organizations

Here are some examples of how big data is used by organizations:

- In medical research for disease diagnosis and identification of risk factors.
- In tracking threats and outbreaks of diseases such as witnessed in the corona virus pandemic.
- In the energy industry, big data helps oil and gas companies identify potential

drilling locations and monitor pipeline operations;

- Electricity generating, transmission and distribution companies use it to track electrical grids.
- Financial services firms use big data systems for risk management and real-time analysis of market data.
- Manufacturers and transportation companies rely on big data to manage their supply chains and optimise delivery routes.
- Government establishments use big data in emergency response, crime
- prevention and smart city initiatives.

6.14.3 Big Data Analytics

To get valid and relevant results from Big Data analytics applications, data scientists and other data analysts must have a detailed understanding of the available data and the expectations from them. That makes data preparation, which includes

- profiling,
- cleansing,
- validation, and
- transformation

of data sets a crucial first step in the analytics process.

Once the data has been gathered and prepared for analysis, various data science and advanced analytics disciplines can be applied to run different applications, using tools that provide big data analytics features and capabilities. These disciplines include:

- machine learning and deep learning,
- predictive modelling,
- data mining,
- statistical analysis,
- streaming analytics, and

- text mining.

6.14.4 Big data management technologies

Hadoop, an open source distributed processing framework used to be the centre of many big Data architecture, but now, Big data platforms and managed services offered by IT vendors combine many technologies in a single package, primarily for use in the cloud. Currently, those packages normally include the following:

- Amazon EMR (formerly Elastic MapReduce);
- Cloudera Data Platform;
- Google Cloud Dataproc;
- HPE Ezmeral Data Fabric (formerly MapR Data Platform); and
- Microsoft Azure HDInsight.

6.14.5 Tools for Big Data Deployment

For organizations that want to deploy big data systems themselves, either on their premises or in the cloud, the technologies that are available to them in addition to Hadoop and Spark include the following categories of tools:

- **storage repositories** such as the Hadoop Distributed File System (HDFS) and cloud object storage services that include Amazon Simple Storage Service (S3), Google Cloud Storage and Azure Blob Storage;
- **cluster management frameworks** like Kubernetes, Mesos and YARN, Hadoop's built-in resource manager and job scheduler, which stands for Yet Another Resource Negotiator, but is commonly known by the acronym alone;
- **stream processing engines** such as Flink, Hudi, Kafka, Samza, Storm and the Spark Streaming and Structured Streaming modules built into Spark;

- **NoSQL databases** that include Cassandra, Couchbase, CouchDB, HBase, MarkLogic Data Hub, MongoDB, Neo4j, Redis and various other technologies;
- **data lake and data warehouse platforms** among which are Amazon Redshift, Delta Lake, Google BigQuery, Kylin and Snowflake; and
- **SQL query engines** like Drill, Hive, Impala, Presto and Trino.

6.14.6 Challenges to implementing Big data

Challenges that may confront organizations in their bid to implement big data solutions include the following:

- Big Data analytics require high computer capacity.
- Big data must be tailored to the specific needs of the organization.
- The IT and data management teams must put together a customised set of technologies and tools to be deployed.
- It requires acquisition of new skills by database management teams.

Above challenges may be addressed by using a managed cloud service, which will provide all these requirements.. This however involves high costs and the process of migrating in-house data and work processes into the cloud which must be managed.

Other challenges in managing big data systems include making the data accessible to data scientists and analysts, especially in distributed environments that include a mix of different platforms and data stores. To help analysts find relevant data, data management and analytics teams are increasingly building data catalogues that incorporate metadata management and data lineage functions. The process of integrating sets of big data is often also complicated, particularly when data variety and velocity are prevailing factors.

6.14.7 Strategy for effective Big Data Implementation

In an organization, developing a Big Data strategy requires an understanding of business goals and the data that is currently available for use, plus an assessment of the need for additional data to help meet the objectives. The next steps to take include the following:

- prioritising planned use of cases and applications;
- identifying new systems and tools that are needed;
- creating a deployment roadmap; and
- evaluating internal skills to see if retraining or hiring are required.

To ensure that sets of Big Data are clean, consistent and used properly, the following must be in place:

- a data governance programme;
- data quality management processes;
- management and analysis of Big Data must include focusing on business needs for information over the available technologies; and
- using data visualisation to aid in data discovery and analysis.

6.15 Disruptive Technology

6.15.1 Definition

Disruptive technology is an innovation that significantly alters the way that consumers, industries, or businesses operate. A disruptive technology sweeps away the systems or habits it replaces because it has attributes that are recognisably superior.

Recent disruptive technology examples include e-commerce, online news sites, ride-sharing apps, and GPS systems.

In their own times, the automobile, electricity service, and television were disruptive technologies. They changed the way humans lived, worked and played.

In today's world there are many disruptive technologies re-shaping customer behaviour and demand pattern which inform the way businesses are planned, structured and operated. Disruptive technologies are so pervasive in the corona virus pandemic era that we now have 'new normal' situations directing our ways of life. We shall however limit our discussion of disruptive technologies to the following:

- Artificial intelligence and machine learning;
- Internet of things;
- Distributed ledgers – blockchain technology;
- Computer robotics and business automation; and
- Drone technology.

6.15.2 Artificial Intelligence and Machine Learning

6.15.3 Definitions

Artificial intelligence refers to systems or machines that mimic human intelligence to perform tasks and can iteratively improve themselves based on the information they collect.

AI manifests in a number of forms. A few examples are:

- Chatbots use AI to understand customer problems faster and provide more efficient answers
- Intelligent assistants use AI to parse critical information from large free-text datasets to improve scheduling.
- Recommendation engines can provide automated recommendations for TV shows based on users' viewing habits.

Artificial intelligence (AI) is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence.

Artificial intelligence (AI) **is intelligence demonstrated by machines, as opposed to the natural intelligence displayed by animals including humans.**

AI also draws upon computer science, psychology, linguistics, philosophy, and many other fields. The field was founded on the assumption that human intelligence "can be so precisely described that a machine can be made to simulate.

AI is much more about the process and the capability for superpowered thinking and data analysis than it is about any particular format or function. Although AI brings up images of high-functioning, human-like robots taking over the world, AI is not intended to replace humans. It is intended to significantly enhance human capabilities and contributions. That makes it a very valuable business asset.

AI adds value to almost every function, business, and industry. It includes general and industry-specific applications such as:

- Using transactional and demographic data to predict how much certain customers will spend over the course of their relationship with a business (or customer lifetime value).
- Optimising pricing based on customer behaviour and preferences.
- Using image recognition to analyse X-ray images for signs of cancer.

6.15.4 How Enterprises use AI

According to the Harvard Business Review, enterprises are primarily using AI to:

- Detect and deter security intrusions;
- Resolve users' technology issues;
- Improve production management work; and
- Evaluate internal compliance in using approved vendors.

6.15.5 Drivers of AI adoption

Three factors are driving the development of AI across industries:

Affordable, high-performance computing capability is readily available. The abundance of commodity compute power in the cloud enables easy access to affordable, high-performance computing power. Before this development, the only computing environments available for AI were non-cloud-based and hence, cost prohibitive.

- **Large volumes of data are available for training.** AI needs to be trained on lots of data to make the right predictions. The emergence of different tools for labelling data, plus the ease and affordability with which organizations can store and process both structured and unstructured data, is enabling more organizations to build and train AI algorithms.

- **Applied AI delivers a competitive advantage.** Enterprises are increasingly recognizing the competitive advantage of applying AI insights to business objectives and are making it a business wide priority. For example, targeted recommendations provided by AI can help businesses make better decisions faster. Many of the features and capabilities of AI can lead to lower costs, reduced risks, faster time to market, and much more.

6.15.6 The benefits and challenges of operationalising AI

There are numerous success stories that prove AI's value. Organizations that add machine learning and cognitive interactions to traditional business processes and applications can greatly improve user experience and boost productivity.

Benefits of AI - AI success stories

AI is the driving factor behind some significant success stories:

- According to the Harvard Business Review, the Associated Press produced 12 times more stories by training AI software to automatically write short earnings news stories. This effort freed its journalists to write more in-depth pieces.
- Deep Patient, an AI-powered tool built by the Icahn School of Medicine at Mount Sinai, allows doctors to identify high-risk patients before diseases are even

diagnosed. The tool analyses a patient's medical history to predict almost 80 diseases up to one year prior to onset, according to insideBIGDATA.

Ready-to-use AI is making operationalizing AI easier

The emergence of AI-powered solutions and tools means that more companies can take advantage of AI at a lower cost and in less time. Ready-to-use AI refers to the solutions, tools, and software that either have built-in AI capabilities or automate the process of algorithmic decision-making.

Ready-to-use AI can be anything from autonomous databases, which self-heal using machine learning, to prebuilt models that can be applied to a variety of datasets to solve challenges such as image recognition and text analysis. It can help companies achieve a faster time to value, increase productivity, reduce costs, and improve relationships with customers.

Challenges to deployment of AI

However, there are some stumbling blocks. Few companies have deployed AI at scale, for several reasons.

- For example, if they don't use cloud computing, AI projects are often computationally expensive.
- They are also complex to build and require expertise that's in high demand but short supply.
- Knowing when and where to incorporate AI, as well as when to turn to a third party, will help minimize these difficulties.

6.15.7 Impediments to realising AI's full potential in an organization

Despite AI's promise, many companies are not realizing the full potential of machine learning and other AI functions.

- Inefficient workflows can hold companies back from getting the full value of their AI implementations.

- Data scientists may face challenges getting the resources and data they need to build machine learning models. They may have trouble collaborating with their teammates. And they have many different open-source tools to manage, while application developers sometimes need to entirely recode models that data scientists develop before they can embed them into their applications.

- With a growing list of open-source AI tools, IT ends up spending more time supporting the data science teams by continuously updating their work environments. This issue is compounded by limited standardization across how data science teams like to work.

- Senior executives might not be able to visualize the full potential of their company's AI investments. Consequently, they don't lend enough support and resources to creating the collaborative and integrated ecosystem required for AI to be successful.

6.15.8 Creating the right culture for AI in an organization

Making the most of AI and avoiding the issues that are holding successful implementations back means implementing a team culture that fully supports the AI ecosystem. In this type of environment:

- Business analysts work with data scientists to define the problems and objectives.
- Data engineers manage the data and the underlying data platform so it is fully operational for analysis.
- Data scientists prepare, explore, visualize, and model data on a data science platform.

- IT architects manage the underlying infrastructure required for supporting data science at scale, whether on premises or in the cloud.
- Application developers deploy models into applications to build data-driven products.

6.15.9 Adaptive intelligence

A new term, Adaptive Intelligence, is evolving from Artificial Intelligence. Adaptive intelligence applications help enterprises make better business decisions by combining the power of real-time internal and external data with decision science and highly scalable computing infrastructure.

These applications essentially make the business smarter. It empowers the business to provide customers with better products, recommendations, and services—all of which bring better business outcomes.

6.16 MACHINE LEARNING

Machine learning is a data analytics technique that teaches computers to do what comes naturally to humans and animals: learn from experience. Machine learning algorithms use computational methods to "learn" information directly from data without relying on a predetermined equation as a model. The algorithms adaptively improve their performance as the number of samples available for learning increases. Deep learning is a specialized form of machine learning.

Importance of Machine Learning

With the rise in big data, machine learning has become a key technique for solving problems in areas, such as:

- **Computational finance**, for credit scoring and algorithmic trading
- **Image processing and computer vision**, for face recognition, motion detection, and object detection
- **Computational biology**, for tumor detection, drug discovery, and DNA sequencing

- **Energy production**, for price and load forecasting
- **Automotive, aerospace, and manufacturing**, for predictive maintenance
- **Natural language processing**, for voice recognition applications

6.16.1 Application of Machine Learning

Machine learning is deployed when an organization is faced with a complex task or problem involving a large amount of data and lots of variables, but no existing formula or equation.

6.16.2 Techniques of Machine Learning

Machine learning uses two types of techniques: **supervised learning**, which trains a model on known input and output data so that it can predict future outputs, and **unsupervised learning**, which finds hidden patterns or intrinsic structures in input data.

Supervised Learning

Supervised machine learning builds a model that makes predictions based on evidence in the presence of uncertainty. A supervised learning algorithm takes a known set of input data and known responses to the data (output) and trains a model to generate reasonable predictions for the response to new data. Supervised learning is used when there are known data for the output one is trying to predict.
Supervised learning uses classification and regression techniques to develop machine learning models.

Classification techniques predict discrete responses—for example, whether an email is genuine or spam, or whether a tumour is cancerous or benign. Classification models classify input data into categories. Typical applications include medical imaging, speech recognition, and credit scoring.

Classification is used if the data can be tagged, categorised, or separated into specific groups or classes. For example, applications for hand-writing recognition use classification to recognise letters and numbers.

Common algorithms for performing classification include support vector machine (SVM), boosted and bagged decision trees, k-nearest neighbour, Naïve Bayes, discriminant analysis, logistic regression, and neural networks.

Regression techniques predict continuous responses—for example, changes in temperature or fluctuations in power demand. Typical applications include electricity load forecasting and algorithmic trading.

Regression techniques are used when working with a data range or if the nature of the response is a real number, such as temperature or the time until failure for a piece of equipment.

Common regression algorithms include linear model, nonlinear model, regularization, stepwise regression, boosted and bagged decision trees, neural networks, and adaptive neuro-fuzzy learning.

Using Supervised Learning to Predict Heart Attacks

Suppose clinicians want to predict whether someone will have a heart attack within a year. They have data on previous patients, including age, weight, height, and blood pressure. They know whether the previous patients had heart attacks within a year. So the problem is combining the existing data into a model that can predict whether a new person will have a heart attack within a year.

Unsupervised Learning

Unsupervised learning finds hidden patterns or intrinsic structures in data. It is used to draw inferences from datasets consisting of input data without labelled responses.

Clustering is the most common unsupervised learning technique. It is used for exploratory data analysis to find hidden patterns or groupings in data. Applications for cluster analysis include gene sequence analysis, market research, and object recognition.

For example, if a cell phone company wants optimize the locations where they build cell phone towers, they can use machine learning to estimate the number of clusters of people relying on their towers. A phone can only talk to one tower at a time, so the team uses clustering algorithms to design the best placement of cell towers to optimize signal reception for groups, or clusters, of their customers.

Common algorithms for performing clustering include k-means and k-medoids, hierarchical clustering, Gaussian mixture models, hidden Markov models, self-organizing maps, fuzzy c-means clustering, and subtractive clustering.

6.16.3 Choice of Machine Learning Algorithm

Algorithm selection depends on the size and type of data one is working with, the insights one wants to get from the data, and how those insights will be used

Here is a simple guideline for choosing between supervised and unsupervised machine learning:

- S**upervised learning** is chosen when one needs to train a model to make a prediction, for example, the future value of a continuous variable, such as temperature or a stock price, or a classification, for example, identify makes of cars from webcam video footage.
- **Unsupervised learning** is chosen when one needs to explore data and wants to train a model to find a good internal representation, such as splitting data up into clusters.

6.17 INTERNET OF THINGS

6.17.1 Definition

The **Internet of things** (**IoT**) describes physical objects (or groups of such objects) with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks

6.17.2 Enablers of IoT

Development of IoT has been encouraged by the following:

- the convergence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems,
- machine learning
- embedded systems,
- wireless sensor networks,
- control systems,
- automation (including home and building automation),

independently and collectively enable the Internet of things.

6.17.3 **Applications**

The extensive set of applications for IoT devices is often divided into consumer, commercial, industrial, and infrastructure spaces as follows:

1. Consumer applications

These are IoT devices created for consumer use. They include

connected vehicles – vehicles with autonomous attributes.

home automation, - smart homes e.g. iPhone controlling devices in the home.

wearable technology – wearable devices which monitor various parameters.

connected health – appliances which connect patients to the hospital directly without human intervention, in cases of emergency. These are appliances with remote monitoring capabilities

2. Organizational Applications

a. Medical and Healthcare

The **Internet of Medical Things** (**IoMT**) is an application of the IoT for medical and health related purposes, data collection and analysis for research, and monitoring. It is described as the technology for creating a digitized healthcare system, connecting available medical resources and healthcare services. It is also used in remote health monitoring and emergency notification systems, wearable heart monitors and point-of-care medical diagnostics, where portability and low system-complexity is essential.

The application of the IoT in healthcare plays a fundamental role in managing chronic diseases and in disease prevention and control.

b. Transportation

Digital variable speed-limit sign

The IoT can assist in the integration of communications, control, and information processing across various systems. Including:

- smart traffic control,
- smart parking,
- electronic toll collection systems,
- logistics and fleet management,
- vehicle control,
- safety, and road assistance, and
- vehicular communication systems - vehicle-to-everything communication (V2X) which consists of three main components: vehicle to vehicle communication (V2V), vehicle to infrastructure communication (V2I) and vehicle to pedestrian communications (V2P). V2X is the first step to autonomous driving and connected road infrastructure.

c. Building and Home Automation

IoT devices can be used to monitor and control the mechanical, electrical and electronic systems used in various types of buildings (e.g., public and private, industrial, institutions, or residential) in home automation and building automation systems.

6.17.4 **Industrial applications**

Also known as IIoT, industrial IoT devices acquire and analyse data from connected equipment, operational technology (OT), locations, and people. Combined with operational technology (OT) monitoring devices, IIoT helps regulate and monitor industrial systems.

a. Manufacturing

The IoT can connect various manufacturing devices equipped with sensing, identification, processing, communication, actuation, and networking capabilities. Network control and management of manufacturing equipment, asset and situation management, or manufacturing process control allow IoT to be used for industrial applications and smart manufacturing IoT intelligent systems enable rapid manufacturing and optimization of new products, and rapid response to product demands.

Digital control systems to automate process controls, operator tools and service information systems to optimize plant safety and security are within the purview of the IIoT. IoT can also be applied to asset management via predictive maintenance, statistical evaluation, and measurements to maximize reliability. Industrial management systems can be integrated with smart grids, enabling energy optimization. Measurements, automated controls, plant optimization, health and safety management, and other functions are provided by networked sensors.

In addition to general manufacturing, IoT is also used for processes in the industrialization of construction.

b. Agriculture

There are numerous IoT applications in farming, such as collecting data on temperature, rainfall, humidity, wind speed, pest infestation, and soil content. This data can be used to automate farming techniques, take informed decisions to improve quality and quantity, minimise risk and waste, and reduce the effort required to manage crops.

c. Maritime

IoT devices are used in monitoring the environments and systems of boats and yachts. Many pleasure boats are left unattended for days in summer, and months in winter, so such devices provide valuable early alerts of boat flooding, fire, and deep discharge of batteries.

6.17.5 **Infrastructure Applications**

Monitoring and controlling operations of sustainable urban and rural infrastructures like bridges and railway tracks is a key application of the IoT. The IoT infrastructure can be used for monitoring any events or changes in structural conditions that can compromise safety and increase risk.

The IoT can benefit the construction industry by cost-saving, time reduction, better quality workday, paperless workflow and increase in productivity. It can help in taking faster decisions and save money with Real-Time Data Analytics. It can also be used for scheduling repair and maintenance activities in an efficient manner, by coordinating tasks between different service providers and users of these facilities. IoT devices can also be used to control critical infrastructure like bridges to provide access to ships. Usage of IoT devices for monitoring and operating infrastructure is likely to improve incident management and emergency response coordination, and quality of service, up-times and reduce costs of operation in all infrastructure related areas. Even areas such as waste management can benefit from automation and optimization that could be brought in by the IoT.

a. Metropolitan scale deployments

There are several planned or ongoing large-scale deployments of the IoT, to enable better management of cities and systems. For example, Songdo, South Korea, is the first of its kind fully equipped and wired smart city, Much of the city is wired and automated, with little or no human intervention.

b. Energy management

Significant numbers of energy-consuming devices (e.g. lamps, household appliances, motors, pumps, etc.) already integrate Internet connectivity, which can allow them to communicate with utilities not only to balance power generation but also helps optimize the energy consumption as a whole.[51] These devices allow for remote control by users, or central management via a cloud-based interface, and enable functions like scheduling (e.g., remotely powering on or off heating systems, controlling ovens, changing lighting conditions etc.).

c. Environmental monitoring

Environmental monitoring applications of the IoT typically use sensors to assist in environmental protection[93] by monitoring air or water quality,[94] atmospheric or soil conditions,[95] and can even include areas like monitoring the movements of wildlife and their habitats.

6.17.6 **Military Applications**

The Internet of Military Things (IoMT) is the application of IoT technologies in the military domain for the purposes of reconnaissance, surveillance, and other combat-related objectives. It involves the use of sensors, munitions, vehicles, robots, human-wearable biometrics, and other smart technology that is relevant on the battlefield.

a. Internet of Battlefield Things

The **Internet of Battlefield Things** (**IoBT**) is a project that focuses on the basic science related to the IoT that enhances the capabilities of soldiers.

b. Ocean of Things

The **Ocean of Things** project is a DARPA-led program designed to establish an Internet of things across large ocean areas for the purposes of collecting, monitoring, and analysing environmental and vessel activity data. The project entails the deployment of about 50,000 floats that house a passive sensor suite that autonomously detect and track military and commercial vessels as part of a cloud-based network.

6.17.7 Product Digitalization

There are several applications of smart or active packaging in which a QR code or NFC tag is affixed on a product or its packaging. The tag itself is passive, however, it contains a unique identifier (typically a URL) which enables a user to access digital content about the product via a smartphone. The term "Internet of Packaging" has been coined to describe applications in which unique identifiers are used, to automate supply chains, and are scanned on large scale by consumers to access digital content. Authentication of the unique identifiers, and thereby of the product itself, is possible via a copy-sensitive digital watermark or copy detection pattern for scanning when scanning a QR code, while NFC tags can encrypt communication.

6.17.8 Architecture of IoT

IoT system architecture consists basically of three tiers, thus:

- Tier 1: Devices

Devices include networked things, such as the sensors and actuators found in IoT equipment, particularly those that use protocols such as **Modbus**, **Bluetooth**, **Zigbee**, or proprietary protocols, to connect to an Edge Gateway.

- Tier 2: The **Edge** **Gateway**

The Edge Gateway layer consists of sensor data aggregation systems called Edge Gateways that provide functionality, such as pre-processing of the data, securing connectivity to cloud, using systems such as Web Sockets, the event hub, and, even in some cases, edge analytics or **fog computing**. Edge Gateway layer is also required to give a common view of the devices to the upper layers to facilitate in easier management.

- Tier 3: The Cloud.

The final tier includes the cloud application built for IoT and inherently secure in nature using HTTPS/**OAuth**. It includes various **database** systems that store sensor data, such as time series databases or asset stores. The cloud tier in most cloud-based IoT system features event queuing and messaging system that handles communication that transpires in all tiers.

6.18 Distributed Ledger Technology

6.18.1 Definitions of Distributed ledger

Distributed ledgers are databases shared across a network and spread over various geographical locations. A ledger is a collection of financial accounts. In this instance, distributed means spread out and controlled globally. Thus, distributed ledgers are held and reorganized by multiple parties in different locations and institutions.

Distributed ledgers can be assessed by the participants at each network node. The participants can obtain an identical copy of the recordings shared across the network. In case the ledger is edited or appended, the changes are replicated and copied to the participants. In order to make sure that the database is accurate, it is synchronized.

Distributed ledger technology

Distributed ledger technology refers to a digital system that records transactions related to assets. The transactions and other details are simultaneously recorded at numerous places. The database recorded through distributed ledger technology does not include an administration facility or central data storage. Instead, the database exists among several participants or across different geographical locations.

Distributed ledger technology allows users to record, share, and synchronize data and transactions across a distributed network consisting of numerous participants. It can also be understood as a range of technologies with comparable structures but can be executed in various ways with different rules.

Distributed ledger technology can be classified as either public or private, depending on the accessibility of the ledgers to anyone or devices (also called nodes). It can also be categorized as permissioned or permissionless, based on whether participants require permission from a certain entity to edit the ledgers.

6.18.2 Importance of Distributed Ledger Technology

The importance of distributed ledger technology can be appreciated by the following contributions:

- Distributed ledger technology can make the finance sector more resilient, efficient, and reliable. The technology can be used to improve features of the finance sector, such as processing transactions without third-party involvement and cross-border payments. It can also help make finance accessible to the unbanked population, which is presently outside the traditional reach of finance.
- The distributed ledger technology can also be applied to various other industries, such as government financial systems, clean energy, and manufacturing, and can help to improve the prevalent processes.
- Distributed ledger technology removes the requirement of a central authority; hence, it can increase the speed of transactions.
- It can reduce transaction costs.
- In addition, since the records are held at each network node, manipulating or successfully attacking the system is very difficult, hence, distributed ledger technology is believed to be a more secure way to handle records.
- As the information is shared and viewed across a network, distributed ledger technology provides a more transparent means of handling records.
- Distributed ledger technology can be utilised
  - to distribute social benefits,
  - to transfer property deeds,
  - for tax collection, and
  - voting procedures.
- It can also be used for processing and executing legal documents.

- The technology may be used by individuals to hold and control their personal information better and share selective pieces of information when required.

6.18.3 **Distributed Ledgers Process**

Distributed ledgers are held, reorganized, and controlled by individuals called nodes. The database is constructed independently by each node. Every transaction occurring on the network is processed, and a conclusion on the development of the database is created by each node.

Based on the transaction, voting is carried out on the changes completed on the database. All nodes participate in the voting, and if at least 51% of them agree, the new transaction is accepted on the database. Afterward, the nodes update the versions of the database so that all the devices or nodes will be of the same version. The new transaction is written onto a block on the blockchain.

Nodes in Proof-of-Work blockchain are also called miners. When a miner successfully puts a new transaction into a block, s/he receives a reward. It requires a dedicated 24×7 computer power. It is the responsibility of miners to compute the cryptographic hash for new blocks. Whoever, among the miners, successfully finds the hash first, gets the reward.

Miners who dedicate more computational power to finding the hash will be more successful. However, as blocks keep generating, it becomes more difficult to find subsequent hash scales. The goal is to keep a constant speed of generating the blocks.

6.18.4 Benefits of Distributed Ledgers

1. Highly transparent, secure, tamper-proof, and immutable

In distributed ledgers, the entries happen in the database without third-party involvement. After records are written into distributed ledgers, they cannot be altered by any other party. Hence, until the ledgers are distributed, the records cannot be tampered with.

2. The need for a third party is eliminated

Distributed ledgers are usually operated without a third party to save a lot of money and time. In the supply chain business, results can be written directly by sensors to the blockchain without the need for a third party. It saves a considerable amount of money, effort, and time.

3. Inherently decentralized

The distributed ledgers' inherently decentralized nature adds another layer of security. As the database is spread globally, it is difficult to attack.

4. Highly transparent

Distributed ledgers have a high level of transparency. They allow all the stored information to be freely and easily viewable. It provides a significant amount of transparency desired by many industries.

6.18.5 Examples of Distributed Ledger

Bitcoin is a highly popular example of a distributed ledger. It is a virtual currency that can be used for payments on a network that enables users to make non-reversible payments with transaction fees less than conventional online payment methods.

Ethereum is a popular distributed ledger that enables the developers to create their own applications. It is very popular because it introduced smart contracts. The smart contracts are self-executing and are triggered if certain pre-set, real-world conditions are fulfilled, and related data is entered into the blockchain.

Ripple is another example of a distributed ledger that is an open-source ledger focusing on payments, especially cross-border transactions. It was originally intended for banks.

6.19 Blockchain

6.19.1 Definition

Blockchain is a list of records called blocks that store data publicly and in chronological order. The information is encrypted using cryptography to ensure that the privacy of the user is not compromised and data cannot be altered.

Information on a Blockchain network is not controlled by a centralized authority, unlike modern financial institutions. The participants of the network maintain the data, and they hold the democratic authority to approve any transaction which can happen on a Blockchain network. Therefore, a typical Blockchain network is a public Blockchain.

As long as you have access to the network, you have access to the data within the Blockchain. If you are a participant in the Blockchain network, you will have the same copy of the ledger, which all other participants have. Even if one node or data on one particular participant computer gets corrupted, the other participants will be alerted immediately, and they can rectify it as soon as possible.

6.19.2 **Blockchain techniques**

Blockchain is a combination of three important technologies –

- cryptographic keys,
- a peer-to-peer network, and
- a digital ledger.

The cryptographic keys are of two types - private key and public key. Each individual or node has both of these keys and they are used to create a digital signature. This digital signature is a unique and secure digital identity reference. The digital signature is the most important aspect of blockchain technology. Every transaction is authorized by the digital signature of the owner.

A deal or transaction is authorized by a mathematical verification in a peer-to-peer network. This peer-to-peer network is a large group of individuals who act as authorities to reach a consensus on transactions, among other things.

All of these transactions are stored in a structure known as the digital ledger. The digital ledger works like a spreadsheet containing all the numerous nodes in a network and has the history of all purchases made by each node. The information contained in the digital ledger is highly secure and the digital signature safeguards it from being tampered with. The most interesting part about this ledger is that anyone can see the data, but no one is able to corrupt it.

6.19.3 **Features of Blockchain**

These are the four features of Blockchain which we are going to talk about in details:

- It is a public distributed ledger, which works using a hashing encryption.
- Every block has a hash value, which is the digital signature of the block.
- All the transactions are approved and verified on the Blockchain network using a proof-of-work consensus algorithm.
- The Blockchain network utilises the resources of the miners, who are there to validate the transactions for rewards.

6.19.4 Public Distributed Ledger

A public distributed ledger is a collection of digital data that is shared, synchronized, and replicated around the world, across multiple sites, countries, and institutions. If someone tries to alter data in one of the blocks, everyone in the network can see the alteration, because everyone in the network has a copy of the ledger. In this way, data tampering is prevented.

6.16.5 **Hash Encryption**

Blockchain uses cryptography to ensure that all the data in the blocks is kept secure from unauthorised access and is not altered. Blockchain uses SHA-256 for encryption. SHA-256 is one of the strongest hash functions available. This cryptographic hash algorithm generates an almost unique 256-bit signature for a text. Blockchain also uses digital signatures to validate users.

Each user has a public and private key. The public key is used to identify the user uniquely, and the private key gives the user access to everything in the account. In the process from the sender's side, the sender's message is passed through a hash function; then, the output is passed through a signature algorithm with the user's private key, then the user's digital signature is obtained. In the transmission, the user's message, digital signature, and public key are transmitted.

In the process on the receiver's side, the message is passed through a cryptographic function to get a hash value. That hash value is compared with the hash output obtained bypassing the digital signature and public key through a verification function.

As mentioned, each block in a blockchain uses SHA-256 to encrypt and therefore secure the data. Every block has four fields:

- Previous hash—this field stores the hash of the previous block in the Blockchain.
- Transaction details—this field contains information regarding several transactions.
- Nonce—this field contains a random value (the nonce value) whose sole purpose is to act as a variate for the hash value.
- Hash address—this field contains the unique identification of the block; it is a hex value of 64 characters, both letters, and numbers, obtained by using the SHA-256 algorithm

The first three values (previous hash, transaction details, and nonce) are passed through a hashing function to produce the fourth value, the hash address of that particular block.

6.20 Proof of Work

Proof of work is a piece of data that is very hard to produce (meaning it takes a lot of time or costs a lot of money) but can be easily verified by others, and it satisfies specific requirements. With bitcoin, proof of work is a competition among miners who want to add a block to the Blockchain—meaning they have to find the nonce value for the block by solving a mathematical puzzle. Once a miner discovers a nonce value, he or she spreads the word throughout the network, and if other miners validate the claim, the miner is rewarded with 12.5 bitcoins or another form of compensation. Finding a nonce value also adds that block to the Blockchain.

Choosing a nonce value is the primary objective of miners. They have to find a value that is less than the target value. If they find a value greater than the target, then their mining effort is rejected. But if they can successfully generate a hash value using the nonce that is less than the target value, then their effort is accepted. This is where the entire computational power of the miner is used—to generate the hash value.

Finding a nonce value requires a lot of time, money, and resources. When the nonce value is found, the miner spreads the word about finding this value, other miners attempt to validate the claim, and if it is verified, the miner gets the reward. So a miner is rewarded for being the first one to find the nonce, and that adds a block to the Blockchain.

As mentioned, as of today, the reward is 12.5 bitcoins. Every four years, the amount of bitcoin a miner can earn is reduced by half. Mining is the only way new bitcoins can be generated, and it ensures that there's a limit to how many bitcoins can exist in the market.

6.21 Miners

Mining is the process of a miner being rewarded for finding the appropriate nonce first. Miners get paid in Bitcoins, and a successful verification is the only way the Bitcoins get added to the network. That is the concept of mining, and when a miner has completed the proof of work consensus, he is rewarded.

6.21.1 **Uses of Blockchain**

The use of blockchain goes far beyond cryptocurrency and bitcoin. Here are some of the most common uses of blockchain in different industries:

- Anti-money laundering tracking system
- NFT marketplaces
- Original content creation
- Real-time IoT operating systems
- Advertising insights
- Music royalties tracking
- Cross-border payments
- Voting mechanism

- Supply chain and logistics monitoring
-

6.21.2 Other Fields That Use Blockchain

The financial services industry uses blockchain technology extensively for the following

- Provision of healthcare,
- crowdfunding, and
- ride-sharing.

Travel

- Tracking luggage, especially with multiple flights in one itinerary and international flights
- Identifying passengers, saving time, and reducing lines and wait times
- Making and accepting payments for services

Music

Blockchain can:

- Help prevent piracy (illegal sharing) of music files.
- Be used to compensate artists for purchased songs and album**s.**

Cyber Security

Blockchain can:

- Help secure sensitive data, thanks to its cryptography feature
- Eliminate the need for passwords, because users and devices can be authenticated using the public and private keys

Human Resources

Blockchain technology

- Eliminates the need to run individual verification cheques on potential employees—blockchain transactions can store data regarding identity and employment history.
- Tracks payments and expenses, making things like paying taxes much easier for both employers and employees.

6.21.3 Comparison of Distributed Ledger Technology and Blockchain Technology

- Blockchain and distributed ledger technology are frequently used as synonyms. However, both are quite different. Blockchain uses many technologies for its application, and distributed ledger technology is one of the
- Blockchain is a type of distributed ledger technology that uses cryptography, making it difficult to manipulate. It is an unchangeable and distributed ledger used for recording transactions, transferring ownership, and tracking assets. Blockchain ensures security, transparency, and trust in different types of transactions involving digital assets.
- In blockchain technology, as the name suggests, data is organised and stored in packages known as blocks, and the blocks are chained together. The blocks in the chain cannot be edited, as blockchain technology allows only the addition of more blocks of data.
- Blockchains are usually public, implying that transaction histories can be viewed by anyone. In a blockchain, anyone can become a node and participate in the operations. Thus, blockchain is permissionless.
- Not all distributed ledger technologies necessarily use chains of blocks. However, they still use cryptographic validation. Distributed ledger technology creates a ledger in a decentralized way for obtaining consensus from the participants who distrust each other. Hence, new information is added only when all the participants consent to the action.
- Unlike blockchain, distributed ledger technology usually imposes restrictions on its access, use, and who is permitted to be a node. Also, it uses a cryptographic signature to timestamp a new entry automatically.
- Distributed ledger technology provides both public and private features. Also, it can be both permissioned and permissionless.

6.22 Cryptocurrency

A cryptocurrency is a form of digital currency that can be used to verify the transfer of assets, control the addition of new units, and secure financial transactions using cryptography.

One of the cryptocurrencies' most important advantages over normal (fiat) currencies is that they are not controlled by any central authority. Without a central point of failure or a "vault," the funds cannot be hacked or stolen.

The shared and distributed nature of cryptocurrencies keeps everyone on the same page. Therefore, the transparency and distributed nature of blockchain technology are what make cryptocurrencies (at least those that use the blockchain) secure.

6.22.1 Types of Cryptocurrency

There are several cryptocurrencies available in the market right now. Some of the more popular ones are:

- Bitcoin
- Litecoin
- Ethereum
- Z Cash
- Dash
- Ripple
- Monero
- NEM
- Stellar

There are close to 3,000 cryptocurrencies in the market—a market that has become nearly saturated with options. Most experts say the vast majority of these options will eventually fail as users begin to gravitate around just a few.

6.23 CRBA

6.23.1 Introduction to Robotics and Automation

Robotics is a branch of engineering concerned with the design and perpetration of robots, as well as the use of computers to manipulate and reuse them.

IIn manufacturing, robots are utilised to speed up the process. Robotic Process Automation)RPA) is used in large firms with huge human resources, IT, and finance departments since it automates labour-intensive workflow, infrastructure, and back-office procedures. Robotics is a sub-category of industrial automation because a robot is only a set of sensors and processors with which it can accomplish an industrial task. Software robots, also known as workstation automation or robotic process automation, are computer programs that automate virtual operations instead of physical ones.

Software automation is a software program that is programmed to perform repeated chores using the same logic that humans use when using computer applications. To speed up production operations and assemble a product faster, a robot might be able to help. Software-driven process automation would be more suited if we wanted to make repetitious administrative activities more efficient. Controlling and maintaining physical processes is at the heart of industrial automation. A common example is Amazon's fully automated manufacturing. Amazon's warehouse has robot which may explain why its shipping times are so short.

6.21 BPA

Business Process Automation (BPA) refers to the use of technology to execute recurring tasks or processes in an organization where manual effort can be replaced. It is done to minimize costs, increase efficiency, and streamline processes.

6.23.1 Business Process Automation examples

For a better understanding of business process automation, here are a couple of examples:

1. Employee engagement

Hiring employees involves multiple tasks, such as

- Filling out employee information forms,
- setting up induction sessions,

- arranging training sessions,
- setting up bank accounts,
- collecting relevant documents, and
- assigning supervisors.

Without automation, the entire process can become chaotic and result in:

- Endless paperwork;
- Missing out on some tasks;
- Employee dissatisfaction; and
- Low productivity.

Applying business process automation to employee engagement will ensure smooth transitions from one task to the next, keeping relevant employees in the loop and providing visibility into the status of the process.

2. Purchase Orders (PO) processing

Purchase order requests are recurring processes in most organizations. The requesting team fills out a form and sends it to the purchasing team. The approving authority then examines the request and rejects the request in case information is inadequate or if there are budgetary constraints. It is then sent back to the requesting team. If approved, a purchase order is created, and copies are sent to the supplier as well as the inventory team.

Without automation, the following issues could crop up:

- Delayed Purchase Order approval;
- Impacted productivity;

- Incomplete records;
- Errors in the Purchase Order; and
- Errors while taking delivery of the supplies

Business process automation can help improve accountability, transparency, and enable accurate data recording, which can be accessed by relevant stakeholders when necessary. It will also retain all process-related communication within the workflow to make execution easier and faster.

6.23.2 Benefits of BPA

Here are some compelling reasons to automate business processes.

1. **Stepping stone to digital transformation**

Digital transformation can seem like a lofty but overwhelming goal to organizations that are not on that path. Business process automation can be a stepping-stone to adopting that culture of continuous transformation. One can start with a few processes that are clearly in need of course correction and gradually work one's way up.

2. **Business process clarity**

Automation demands a certain amount of clarity about the process right at the designing stage. If you don't know the tasks involved and the people responsible for running the process, you cannot design and automate the workflow effectively.

Further, process mapping can provide clarity to all employees and serve. as a training resource as well. The insights gained from analysing an automated process can clearly show the gap between the process as is and as it should ideally be.

3. Streamline processes

One of the accomplishments of a process automation system is streamlined processes. Clear accountability, customisable notifications, valuable insights, and faster turnaround times make it easier to eliminate wasteful activities and focus on enhancing tasks that add value.

4. Get compliance records

With business process automation, every detail of a particular process is recorded. This information can be presented to demonstrate compliance during audits.

1. Standardi*se* operations

When a business process is automated, one can expect a consistent standard of outcomes every time. Standardization helps position the organization as being reliable, which in turn can help increase customer base.

2. Increase customer satisfaction

Customer satisfaction is a key differentiator in any industry. Focusing on process and operational excellence helps one exceed customer expectations with ease. When one consistently meets promised standards, customers are more likely to develop a preference for your company.

Identifying **business processes** to **automate**

Business process automation is not restricted to a handful of functions. Some factors that can indicate the need for automation include:

1. High-volume of tasks;
2. Multiple people required to execute tasks;
3. Time-sensitive nature of task;
4. Task has significant impact on other processes and systems; and
5. Need for compliance and audit trails.

If an activity meets all the criteria listed above, it is very likely one needs to automate the business process.

Below are some commonly automated processes in organizations.

- E-mail and push notifications
- Helpdesk support
- Data aggregation and migration
- Backup and restoration
- Employee leave requests
- Procurement
- Call centre processes
- Sales orders
- Time and attendance tracking
- Payroll
- Invoicing
- Collections
- Product launches

6.23.3 Benefits of using business process automation tools

With automated business processes, one can expect multiple benefits.

1. **Boost in productivity brought about by enhanced access.** Cloud-based business process automation tools store data in a central database. This helps to access data from any location or device whenever needed
2. **B**usiness processes **will become much more transparent.** One can track and monitor processes while they are running, which can improve accountability and visibility.

3. **Insight through performance reports.** The ability to monitor processes on the go will also help you keep a lookout for errors, fixing them as they occur. Performance reports will provide insights so one can take preventive measures against recurring errors.
4. **Improved efficiency.** From a long-term perspective, one will notice faster turnaround times and a reduction in costs due to fewer manual interventions.
5. **Allocation of workforce to more challenging functions.** Since the application will handle all mundane recurring tasks. This way one can redirect your employees into tasks that require human effort and judgment.

A business process automation system will ultimately enable growing business efficiency. Since it is based on the notion of continuous process improvement, efficiency levels will keep increasing in response.

6.23.4 Best practices for Business Process Automation

Merely signing up for a business process automation tool may not guarantee success. There is need to take a pragmatic thorough approach to automate the business processes.

Here are some pointers on how to make automation a success.

- Start with a clear understanding of what tasks are involved, who is responsible, and when each task is to be executed.
- Ensure to have clearly defined goals when automating a business process. This will save a lot of time in course correction.
- Measure results with a phased approach. Many organizations are disappointed when the results do not materialise immediately.
- Invest adequate time in training employees and factor in an adjustment period.

- Adopt a long-term outlook to experience good return on investment)ROI).
- Use readymade solutions where available.

6.23.5 Key Differences Between Robotics and Automation

Although the phrases ‘robotics’ and ‘automation are sometimes used interchangeably, there are several key distinctions between the two terms and what they signify.

1. Robotics is better defined as a sub-category of automation, which includes software agents that do not require any hardware.

2. A Robot is controlled by a set of programming and mechatronics, allowing it to perform a variety of sophisticated series of movements. Automation varies by the component used.

3. Manufacturers, on the other hand, deal with robotics and automation daily since they create electrical products that make our lives easier.

4. When it comes to automating a system or machine to complete a task in a short amount of time and also with the maximum amount of precision, robotics and automation go hand in hand. Both of them are industrial machines that work mechanically.

5. Robots aren’t used in all sorts of automation, and that not all robots are built for process automation. However, most robots are used for that precise purpose – particularly in industrial settings. A toy line-following robot, for instance, can follow a line painted on the floor independently. It isn’t automation, though, because it isn’t carrying out a defined duty. Instead of moving drugs throughout a hospital, the line-following robot would be considered automation.

6. The goal of automation and robotics is not to eliminate all human workers from the workplace. They're just employed to speed up manufacturing and reduce the number of errors that might otherwise occur. There are many different sorts of automation, ranging from completely mechanical to completely virtual. They also range in difficulty from simple to mind-boggling. A collaborative robot dispensing system is an excellent example of combining the two.

7. Many automation will not include a robot as a component. Robots are simply one piece of industrial equipment that can be combined to form a semi-automated or fully automated system.

8. The primary goal of RPA is to reduce staff, whereas the other automation techniques aim to reduce processing time. Non-technical people can use the RPA technique to boost productivity by allowing them to focus on more vital duties that cannot be automated, whereas traditional automation is solely available to technical user.

6.24 DRONE TECHNOLOGY

6.24.1 Definition

A drone, also known as an unmanned aerial vehicle or UAV, is basically a flying robot that can be controlled remotely or it may have the technology to fly on its own using software-controlled flight plans which are embedded in their systems.

Drones have a wide range of uses that are crucial for several industries. For example, unmanned aerial vehicles are commonly used in the military for gathering intelligence, for anti-aircraft target practice. They are used in weather monitoring and prediction, traffic monitoring, in search and rescue efforts to reach places that are impenetrable by humans or larger machines, in surveillance, etc. Drone technology is also used for personal and business purposes, real estate and delivery services. When cameras are attached to drones, they are used for aerial photography and videography by photographers, filmmakers, real estate agents, etc.

6.24.2 Components of Drone Technology

Drone technology works in conjunction with Global Positioning system (GPS) and onboard sensors. Today, many drones have advanced features that make them extremely durable and intelligent, thus widening their scope of use. Below are the different components of drone technology:

Radar positioning and return home

Modern drones are integrated with dual Global Navigational Satellite Systems or GNSS, which includes GPS and GLONASS. These drones can fly in GNSS as well as non-satellite modes. Radar positioning helps in accurate drone navigation and also displays the current position of the drone in relation to the controller. The Return to Home feature guides the drone back to the controller.

Obstacle detection and Collision avoidance technology

High-tech drones come with obstacle detection and collision avoidance technology in order to ensure safety. These sensors thoroughly scan the surrounding environment, while SLAM technology and software algorithms transform the scanned images into a 3D map.

Gyroscope stabilization

Drones can fly smoothly because of the gyroscope stabilization technology embedded in them. In addition, the gyroscope also provides important navigational data to the central flight controller.

Inertial Measurement Unit (IMU)s

The IMU is a technology that can detect the current acceleration rate using one or more accelerometers. It does so by detecting changes in various rotational attributes using the gyroscope.

Motors and Propellers

These are technologies which enable the drone to move into the air and hover, or fly in any direction. They let the drone either hover or fly based on the data received from the flight controller and electronic speed controllers.

6.24.3 Uses of Drones

Military

This is perhaps the earliest use of drones. In the days of the cold war, they are used to spy. However, modern drones are far more advanced, being equipped with thermal imaging, laser range finders and even tools to perform airstrikes.

Delivery

Delivery drones are usually autonomous UAVs that are used to transport food, packages or goods to various locations. These flying vehicles are known as “last mile” delivery drones because they are used to make deliveries from neighbourhood stores or warehouses. Many global brands such as Amazon, Walmart, Google, FedEx, UPS and many other big brands are all currently using or testing out different versions of delivery drones.

Emergency Rescue

In most cases, emergency or disaster scenes are not safe for humans to rescue the situation due to the scope or severity of the disaster. Drones are deployed to effect the rescue. In the case of a capsized boat or drowning individuals, officials can throw an Autonomous Underwater Vehicle (AUV) into the water to assist in the rescue. If there’s an avalanche, drones are deployed to look for those caught in the snow. Pilot-less helicopters are currently in use in China and Australia to assist in fighting fires.

Agriculture

Drones have proven to be beneficial to the agriculture industry as well, presenting farmers with several ways to optimize their farms to maximize efficiency and reduce physical strain. Carrying out field surveys, seeding over fields, tracking livestock and estimating crop yield are all made easier through the use of UAVs while saving agriculture professionals valuable time.

Outer Space

NASA and the U.S. Air Force have been secretly testing out unmanned aircraft geared towards space travel. The X-37B UAV is the Air Force’s ultra-secretive drone that looks like a miniature space shuttle. It has been quietly circling the Earth for crmore than two years.

Private Companies, most especially, SpaceX have been carrying payloads to space stations for years. But recently, Blue Origin and Virgin Galactic have carried passengers to the edge of space to signify the commencement of space tourism. There are several companies in this race now.

Wildlife and Historical Sites Conservation

Drones have multifarious uses in conservation. They include wildlife conservation and conservation of historical sites.

Wildlife Conservation

Drones are cheaper and more efficient means of wildlife conservation. Tracking wildlife populations is almost impossible with humans on the ground. The bird=eye view provided by drones allows wildlife conservationists to track roaming groups of animals, ranging from lions and elephants in East Africa, to orangutans in Borneo and Bison on the Great Plains of America, to get a better idea of the health of their species and ecosystems. Conservation drones also make perfect tools in the fight against poaching efforts in Asia and Africa.

Drones are also being used for reforestation efforts all over the world. These drones scour the forest floors of forests decimated by fires and drop seed vessels filled with seeds, fertilizers and nutrients that will help a tree rise from the ashes.

Historical Sites Conservation

Drones are becoming instrumental in historical sites conservation efforts. Drones are being used to produce 3D maps of historical sites like Chernobyl, the ancient Greek sites of Ephesus in Europe. This opportunity gives historical preservationists the ability to find clues about culture and architecture while using 3D imagery to recreate lost sites.

Medicine

Drones are used to deliver critical medical supplies such as vaccines and organs for transplants to difficult-to-reach areas. They ensure quick and safe delivery, which can save lives.

Photography

Drones have been a boon for photographers who use UAVs to take expansive aerial photos. Ever wonder what it's like to get a bird's eye view of your favorite city, beach or building? There are drones made specifically for photography that provide a new way to photograph some of your favorite destinations from above.

6.24.4 Requirement to fly a drone

In many jurisdictions, commercial businesses that utilise drone technology require a pilot's licence. Some jurisdictions have developed a Remote Pilot Certificate by taking an aeronautical knowledge test for commercial use of drones.

General Rules for Flying a Drone in Nigeria

Below are highlights of drone regulations as stipulated by the Nigeria Civil Aviation Authority (NCAA)

- It is unlawful to operate a drone without first seeking the required authorisations. Flight plans must be submitted to the NCAA for authorization prior to conducting each individual drone flight within Nigeria.

- Drones weighing more than 250 grams (.55 pounds) must be registered with the NCAA.
- Drone operators must obtain a Remotely Piloted Aircraft Systems Certificate prior to flying in Nigeria.
- All drone operators must be at least 16 years of age or older.
- Drones may not be operated in a reckless or other manner that may cause harm to person, property, or other aircrafts.
- Do not fly across the border from or into another state.
- Do not operate over the high seas without proper authorization from Air Traffic Control.

6.24.5 Challenges of Drone Technology

Despite its usefulness, fears have been expressed about the deployment of drone technology. These include:

Privacy

Because drones rely on cameras to operate, which often allow operators to take photos and record videos, many have shown discontent at being captured without their consent. Several laws exist to restrict drones from intruding too far on others' privacy but many users choose to ignore these laws.

Air Accidents

Drones now constitute risks to civil aviation as they are currently able to attain heights of up to 50,000 feet, the range for commercial flight operations. They move stealthily, hence they may not be easily observed by pilots. This may lead to air accidents and disasters as air traffic radars find it difficult to track them.

Crashes

Drones have a high risk of crashing. This is further accentuated by

- their limited battery power during operation,
- propellers that spin quickly to provide lift,
- and the potential to fall from great heights,

posing great risk to people, property, and the environment as the number of drones deployed increase astronomically.

6.25 CHAPTER SUMMARY

The systems development life cycle is a comprehensive tool for solving organizational problems, especially those that relate to the flow of computer- based information. It is essential for an organization to select a particular approach to use in the development of its systems in order to avoid adopting any ad-hoc methods or trial-and-error approaches that may not work well and are very likely to result in failed systems.

Prototyping is a typical fourth-generation language (4GL) tool that is used to develop good working systems. It entails the early definition of a system, the creation of a prototype of it, and the continued test and review in conjunction with users. The resulting iteration enables refinements to be made until the final working system is attained. Through this approach, users are assured of a good working system and the chance of just any solution being thrown at users is far remote.

Using JAD and RAD, make it possible to fully engage users in the development of systems. User ownership of the systems developed is therefore assured.

(b) Outsourcing is a way of an organization engaging its management capabilities in critical (or key) areas of competence and giving out other activities which are not key to its operations to other experts to undertake on its behalf. This means that management can now focus more on the organization's core activities and perform better, while it pays for expert services from outside vendors. It should be noted that an organization is not expected to outsource a core activity because doing so will easily result in

leaks in the organization's operational information and may open it to attack from its competitors.

(c) There has been a discussion on computer crimes that includes virus and worms

(d) There has been a discussion on cyber crime giving many examples

(e) Standard health issues are discussed

(f) We give the definition and application of computer forensic to legal issues.

(g) We explained Cloud computing model – advantages and disadvantages

(h) We discussed the concept of disruptive technologies covering the following:

- Artificial intelligence and machine learning;
- Internet of Things
- Distributed ledger – blockchain technology
- Computer robotics and business automation; and
- Drone technology.

6.26 MULTI CHOICE AND SHORT ANSWER QUESTIONS

1. A crime in which an imposer obtains pieces of personal identification in order to impersonate someone else is called
   A. Espionage
   B. Identity theft
   C. Fraud
   D. Spamming
   E. Data diddling

2. One way of providing security to prevent unauthorised persons gaining physical access to a company's IT environment when computer personnel are on duty is by using
   A. Password

B. Firewall
C. Identity cards
D. Locks and keys
E. Fire Extinguishers

3. The Repetitive Stress Injury (RSI) problems normally associated with computer users does **NOT** include
   A. Hepatitis
   B. Tendonitis
   C. Tennis elbow
   D. Inability to hold objects
   E. Sharp pains in the fingers
4. A program capable of attaching itself to disks and other files and replacing itself repeatedly without users knowledge is called
   A. Virus
   B. Worms
   C. Trojan House
   D. Logic Bomb
   E. Variant

5. In the assessment stage of System Development Life Cycle (SDLC), system Analysis focus on three types of needs which are input, output and ....
6. After the new system is developed, the four strategies for implementation are: Direct Conversion, Parallel Conversion, pilot change over and ....
7. Which of the following is a method for collecting data during system investigation?

   ....
8. The personnel responsible for determining the

information needs of the users and producing a system design uin accordance with these is called............

9. The terms of reference for a feasibility study group during system development is set out by...............
10. The most widely used method of fact-finding in system investigation is ....
11. The people for whom systems are designed and who actually use the computer systems to perform their job are called ....
12. A user or person who illegally penetrated a computer network to access and manipulate data is called ....
13. A computer crime that involves transferring funds in small quantities from large accounts to the criminal's account is called....................
14. Protective measure taken to prevent physical, logical and procedural damages to the computer systems is called ....
15. Which of the following is **NOT** part of implementation activities in a system Development Life Cycle?
    A. Acquisition of hardware and software
    B. End-user training
    C. Cost-benefit analysis
    D. System documentation
    E. File conversion

16. A malicious program that spreads from computer to computer with the capability to
17. travel without human action is ....

18. Which one of the following is **NOT** a key element in presenting a digital evidence that is legally acceptable?
    A. Identification
    B. Investigation
    C. Preservation
    D. Analysis
    E. Presentation

19. A computer crime that uses a system program that can bypass regular system controls to perform unauthorised acts is called ....

20. In computer forensic, the **THREE** types of data that we are concerned with are active, archival and ....

21. A software that provides a variety of tools for investigating a suspect's personal computer is called
    A. Computer software
    B. Cyber software
    C. Forensic software
    D. Software tools
    E. Service software

22. Which one of the following is **NOT** a computer crime?
    A. Impersonation
    B. Computer virus
    C. Spoofing
    D. Spooling
    E. Scavenging

23. Security threats related to computer crime or abuse include the following **EXCEPT**
    A. Impersonation
    B. Trojan horse method
    C. Logic Bomb
    D. Computer virus
    E. Provision of service
24. Computer forensic **DO NOT** involve **ONE** of the following:
    A. Data extraction
    B. Data recovery
    C. Data gathering of computer system and peripherals
    D. Investigation of computer personnel
    E. Investigation of computer believed to be involved in cybercrime.

25. Forensic investigation as a process does **NOT** involve the................of digital evidence
    A. Identification
    B. Presentation
    C. Preservation
    D. Analysis
    E. Design

25. If a robot can alter its own trajectory in response to external conditions, it is considered to be:

A. intelligent
B. mobile
C. open loop
D. non-servo
E. creative

Ans: A

26. ---------- Provide the means to create capability that reflects true awareness of the physical world and people.

A. sensors

B. heterogeneity

C. security

D. connectivity

E. feelers

ANS.A.sensors

27.-------- in IoT as one of the key characteristics, devices have different hardware platforms and networks.

A. sensitivity

B. heterogeneity

C. security

D. connectivity

E. homogeneity

B. heterogeneity

28. What is the full meaning of IoT?

(a) Introduction of Things

(b) Internet of Things

(c) Internet of Tracking

(d) Interaction of Things

(e) Improvement of things

Answer: B

29.What is the role of Cloud in smart grid architecture of IoT?

Store data

Manage data

Collect data

d) Security

e) Dispose data

AnS: B

30. What is the role of Bigdata in smart grid architecture of IoT?

(a) Store data

(b) Manage data

(c) Collect data

(d) Security

(e) Dispose data

Answer: A

31. Data in ___________ bytes size is called Big Data.
A. Teta

B. Giga

C. Peta

D. Meta

E. Kilo

ANS: C. Peta

32. Numbers , text, image, audio and video data is ____
A. Volume

B. Value

C. Veracity

D. Variety

E. Velocity

D. Variety

33. The examination of large amounts of data to see what patterns or other useful information can be found is known as

A. Data examination

B. Information analysis

C. Big data analytics

D. Data analysis

E. Pattern mapping

ANS: C. Big data analytics

34. Application of machine learning methods to large databases is called
A. data mining.

B. artificial intelligence

C. big data computing

D. internet of things

E. big data simulation

ANS: A. data mining.
35. If machine learning model output involves target variable then that model is called as
A. descriptive model

B. predictive model

C. reinforcement learning

D. generic model

E. Linear model

B. predictive model

36. In what type of learning labelled training data is used
A. unsupervised learning

B. supervised learning

C. reinforcement learning

D. active learning

E. Q-learning

ANS: B. supervised learning

37. What characterize unlabelled examples in machine learning?

A. there is no prior knowledge

B. there is no confusing knowledge

C. there is prior knowledge

D. there is plenty of confusing knowledge

E. There is no knowledge at all

ANS: D. there is plenty of confusing knowledge

38. Data used to build a data mining model is called………...
A. training data

B. validation data

C. test data

D. hidden data

E. mined data

ANS: A. training data
39. The problem of finding hidden structure in unlabelled data is called…
A. supervised learning

B. unsupervised learning

C. reinforcement learning

D. Semi-supervised learning

E. Mixed learning

ANS: B. unsupervised learning
40. Of the Following scenarios, which would you address using supervised learning Algorithm?
A. given email labelled as spam or not spam, learn a spam filter

B. given a set of news articles found on the web, group them into set of articles about the same story.

C. given a database of customer data, automatically discover market segments and group customers into different market segments.

D. find the patterns in market basket analysis

E. Given a set of unrelated materials.

ANS:A. given email labelled as spam or not spam, learn a spam filter

41. You are given reviews of few netflix series marked as positive, negative and neutral. Classifying reviews of a new netflix series is an example of
A. supervised learning

B. unsupervised learning

C. semi-supervised learning

D. reinforcement learning

E. Mixed learning

ANS: A.supervised learning

42. The output of training process in machine learning is
A. machine learning model

B. machine learning algorithm

C. null

D. accuracy

E. Training algorithm

ANS: A.machine learning model

Distributed Ledger/Blockchain Technology

43. Blockchain is a peer-to-peer _____________ distributed ledger technology that makes the records of any digital asset transparent and unchangeable.

A. Decentralized
B. Centralised
C. Demanding
D. Secure
E. Popular

Ans:A Decentralized

44. ___ hosts the software needed for transaction initiation, validation, mining, block creation, and smart contract execution.

A. External Account
B. EVM
C. Ethereum full node
D. Smart Contract
E. Cryptograph

Ans:C Ethereum full node

45. What is Blockchain?

A. A currency
B. An accounting ledger
C. A type of currency
D. A distributed ledger on a peer-to-peer network
E. A general ledger

Ans: D A distributed ledger on a peer-to-peer network

46. Bitcoin is based on _________ blockchain.

A. Private
B. Public
C. Privatepermissioned
D. Public Permissioned
E. Permissioned

Answer: B) Public

47. BATM stands for _____.

A. Bounded access transaction machine
B. Broad access transaction machine
C. Broadcast ATM
D. Bitcoin ATM
E. Blockchain ATM

Ans: D Bitcoin ATM

48. Smart Contract characteristics do NOT include:

A. Alterable
B. Fast
C. cost-effective
D. A high degree of accuracy
E. Trnsparency

Ans: A Alterable

Drone Technology .

49. The size and weight of the MICRO Drones varies between
(A)200cm to 300cm and 2kgs to 3 kgs
(B)50cm to 200cm and 250gm to 2 kgs
(C)300cm to 400cm and 3kgs to 4kgs
(D)10 cm to 40cm and 50gm to 150gm

(E) 500cm to 700cm and 1kg to 2kg
Ans:B 50cm to 200cm and 250gm to 2 kg

50.What is an UAV?
(A)Unmanned Aerial Vehicle
(B)Unmanned Automatic Vehicle
(C)Unused Automatic vehicle
(D)Upper Aerial Vehicle

(E) Unarmed Aerial Vehicle

Ans: A. Unmanned Aerial Vehicle

51. Material borne by a drone while in operation is called

A. Drone material

B. Drone luggage

C. Payload

D. Camera

E. Visor

Ans: C Payload

DATA PRIVACY
52. ________ is the process of retaining or keeping of data at a secure place for long-term storage.

A.Data archiving
B.Archival Storage
C.Disposal of Data
D. Backup
E. Disk Storage

Ans : A

53. What does DPIA expand as?

A. Data Privacy Impact Assessment

B. Data Privacy Information Assesssment
C. Data Protection Impact Assessment
D. Data Privacy Identification Assessment
E. Data Protection Identification Assessment
ANS: C Data Protection Impact Assessment

54. Who is responsible under the GDPR to make a notification in the event of a data breach to the supervisory authority?

A. Data Subject
B. Data User
C. Data Processor
D. Data Controller
E. Data report manager

55. What does GDPR expand as?

A. General Data Privacy Regulation
B. Global Data Protection Regulation
C. Global Data Protection Regulation
D. General Data Protection Regulation
E. Global Data Privacy Registration
Ans: D. General Data Protection Regulation

56. In case of a data breach, GDPR requires the notification to be sent to authorities within?

A. 72 hours
B. 42 hours
C. 24 hours
D. 12 hours
E. 8 hours
Ans: A 72 hours

57. Which data are NOT considered ‘personal data' under the GDPR?

A. Name
B. Date of Birth
C. Maiden name
D. Phone number

E. Ethnicity

Ans: E Ethnicity

58. Which of the following is available on the company's website?

A. Data Privacy Policy
B. Employee Privacy Notice
C. Management Privacy Policy
D. Employment candidate Privacy Notice
E. Website Privacy Policy

Ans.: E Website Privacy Policy

59.The two major categories of software are: application software and

A. Utility software

B. System software

C. UNIX software

D. High-level languages

E. CAD software

Answer: (B) System software

6.26.1 Solutions to MCQ and SAQ

1) B
2) C
3) A
4) A
5) Procedure
6) Phase Changeover
7) A
8) System Analysis

9) Steering Committee
10) Interview
11) End users
12) Hackers
13) Salami Technique
14) Computer security
15) C
16) WORMS
17) B
18) SUPERZAPPING
19) LATENT
20) C
21) D
22) E
23) D
24) E
25) A
26) A
27) B
28) B
29) B
30) A
31) C
32) D
33) C
34) A
35) B
36) B
37) D
38) A
39) B

40) A
41) A
42) A
43) A
44) C
45) D
46) B
47) D
48) A
49) B
50) A
51) C
52) A
53) C
54) *
55) D
56) A
57) E
58) E
59) B

6.27 SELF-ASSESSMENT QUESTIONS

(1) What is the difference between the parallel approach and the retrospective parallel approach as applied to a system changeover?

(2) In the development of a new system, why is prototyping important?

(3) Explain briefly the term 'outsourcing'.

(4) What is the relevance of 'Joint Applications Development'' (JAD) to the organization?

(5) Define the concept of' Rapid Application Development' (RAD).

(6) Define the term computer virus

(7) The use of computers and communication Technology can have some adverse effects on human health. List any three of such effects on human health

6.27.1 ANSWERS TO SELF-ASSESSMENT QUESTIONS

1) Whereas the parallel approach uses current transaction data to compare the old and new systems, the retrospective parallel approach uses old transaction data that would have been run already in the old system. This makes the latter approach faster than the former in its application.

2) Prototyping is important because it affords the eventual users of the system the opportunity to ensure that the final product meets their exact needs. The iteration process allows users to suggest any changes they deem necessary on their way to arriving at the final product.

3) Outsourcing involves an organisation's management giving out certain non-key functions to other companies to perform on its behalf in order that the organisation can focus better on its core business functions. Outsourcing covers such services as computer centre operations, network ope r a t i ons and applications management as well as systems integration. It is often closely related to

   downsizing and/or divesting in order to concentrate on key business competencies.

4) Joint application development describes the process by

which an organization allows its system developers the opportunity of working in close collaboration with users of these systems. The participation of users in system development ensures that users get precisely what they require and eventually this goes to benefit the organisation itself.

5) Rapid application development is a quick way of building software, and it combines a managed approach to systems development with the use of (modern) software tools such as prototyping and modelling. RAD involves end users heavily in the development process. It has to be so because users' needs must be fully covered and this is best done with their full commitment and participation.

6) A computer virus is a type of infections coding or malicious coding designed to change or compromise computer system. The coding is parasitic in nature. Once it funds a host (which might be a PC), it is released and replicates itself very quickly.

A virus will typically infect the memory and/or backing storage. Some viruses may cause no visible harm to a computer system but others cause extreme havoc immediately they get into the computer.

7. The adverse effect of computers on human health are:

(i) Repetitive strain injuries

(ii) Eyestrain and headaches

(iii) Back and neck pains

6.28 STANDARD EXAMINATION TYPE QUESTIONS

AND ANSWERS QUESTION 1

Low-level and high-level languages are major programming languages used (probably) in the immediate past; itemize five main features of these languages.

Solution

i. Features of a low-level language are

* It is machine oriented;
* It runs (i.e. (executes) very fast;
* It is tedious to write and it is time consuming
* It is written in mnemonics (i.e. symbols)
* It is written by experts;
* It conserves internal memory space;
* It has complex coding details.

ii. Main features of a high-level language are

- It is problem oriented;
- It is a procedural language i.e. it needs the instructions to execute a process.
- It runs very slowly compared to a low-level language
- It is very easy to write
- It is written in the programmer's spoken language
- It can be written by non-expert enduser
- It uses more internal memory space compared to the low-level language
- It has less coding details

QUESTION 2:

What is a computer virus? Give five ways of preventing a computer virus in your environment

Solution

A computer virus is a segment of computer code which once introduced maliciously by an attacker into a host program is able to gain control of the system and replicates itself onto other programs in the and external media inserted into the infected PC. After a of dormancy, the virus activates Itself to destroy the host program and data.

Ways of Prevention

Computer virus can be in a CBIS (computer based information system environment by

- using original storage media
- not copying software from the internet;
- not using Games diskettes;
- regularly using antivirus software during system‟s booting
- not allowing to bring into the computer environment any external storage media

QUESTION 3:

a. Explain the following data elements: file, field, bit, byte, record, database and arrange them in an ascending order.

b. Given the table

Customer Number	Customer Name	State Code	Credit Limit	Credit Balance
10568	AJETCo	Lagos	40,000	10,000
23795	Tosa Co.	Oyo	20,000	5,000
38697	Willy Co.	Ogun	10,000	50,000
56696	Best Co.	Benue	50,000	20,000

Identify the following

i. File
ii. Field
iii. Byte
iv. Record

Solution

a. * bit is the smallest unit of data.
A bit stands for binary digit and is represented by a 1 (one) or a 0 (zero).

* byte: is a string of bits. A character is represented by a byte. In the ASCII coding system 7 bits = 1 byte while in the EBCDIC coding system 1 byte = 8 bits.

- field: A field is sequence of characters that stores information.

There are four types of fields:

- Character field which contains text
- Numeric fields which store numbers
- Date fields for storing dates
- Logical fields for testing if a condition is true or false

- Record: A record consists of a group of related fields.
- File: A file is a collection of related records
- Database: A database is an integrated collection of data flies

Ascending order is

Bit ⟶ byte ⟶ field ⟶ record ⟶ file ⟶ database

(c) i. The whole table is a file being a collection of records (i.e. a collection of all the rows)

ii. Each column is a field e.g. customer number, customer name, code, credit limit and credit balance

iii A byte is just a character e.g. any alphabet like C, any numeric number like 1 or any other symbols like W or any punctuation (e.g. comma)

iv. A record is any row in the table

QUESTION 4

a. Give two differences between a hardcopy and a softcopy.

b. Mention four characteristics that determine the choice of a printer

c. Name and describe briefly the two classifications of printers

d. Give three examples of each classification.

Solutions

a. The differences between a hardcopy and a softcopy are

Hardcopy	**Softcopy**
* It can be touched	* It cannot be touched
* It persists	* It is transient
* It may not be used as classified document	* It can be used as a classified document i.e. as confidential Information
* It can be distributed	* It cannot be distributed
* Page size can be as large as possible size	* Page size is restricted to the screen
* It takes some time to produce	* It is generated instantly

The characteristics that determine the choice of a printer are:

i. Speed of producing output
ii. Quality of output
iii. Cost of purchase of printer
iv. Graphics abilities
v. Associated noise levels
vi. Multiple colour output,

b. The two classifications of printers are impact and non-impact printers

i. Impact printers make contact with paper and sound (noise) is produced during printing

ii. Non-impact printers do not make contact with paper and are relatively noiseless during printing.

c. Examples of Impact printers are:

* Dot-matrix
* Daisy wheel
* Chain or barrel printers
* Band printers

Examples of non-impact printers are

* LASER printers
* InkJet printers
* Thermal printers
* Xerographic printers.

QUESTION 5

(a) i. What is an application package?

ii. State five sources of an application package

iii. List five criteria used in the selection of an application package

(b) You have been appointed as an accounting staff in a newly computerized company.

Recommend five different application packages for your office computer.

Solution

(a) An application package is a suite of programs designed to solve a particular problem. It includes documentation of details of how to setup the program and run it on the computer and relevant media on which the program is stored which is usually magnetic floppy diskette or optical disk.

Application packages rationalize programming efforts,

ii. Sources of application packages are:

- Mail order as advertised in computer magazine
- Over the counter from retail shops or stores i.e. off-the-shelf
- Dealers (i.e. vendors) in micro computers.
- Manufacturers of computers, who also develop software.
- Computer bureau and information centres with expanded activities
- Specialised organizations known as "software-houses"
- From the Internet.
- In-house by programmers (i.e. tailor made programs)

iii. .Criteria used in the selection of application packages include:

- Purchase price of the package
- Primary memory capacity required.
- Availability of installed security facilities. . .
- After sales maintenance
- Ability to users' need
- User's friendliness
- Flexibility of the package
- The technology version of the

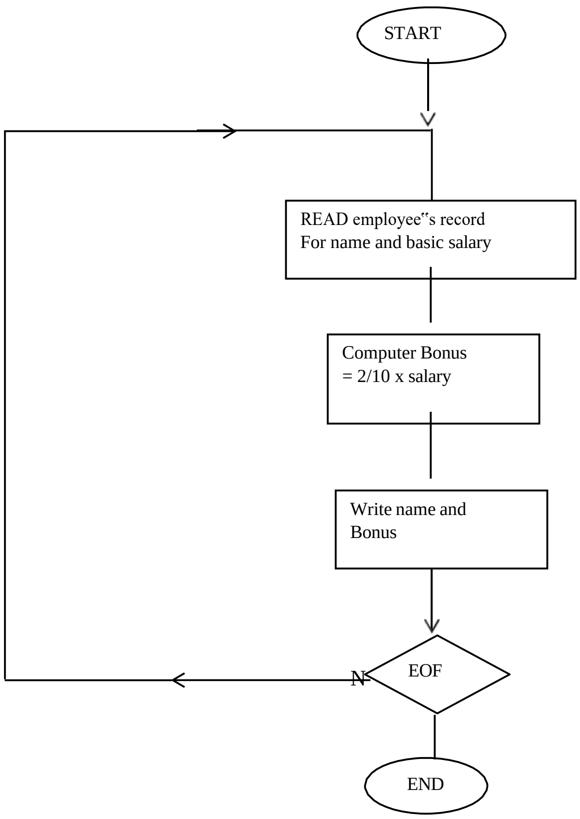
(b)The types of packages include:

- Electronic spreadsheet e.g Excel, Multiplan, PC-Focal, Professional Plan, Quaitro, Supercale, Lotus 1-2-3.
- Word processing package e.g. WordStar, WordPerfect, Display write, MS word, Multimate, Professional write
- File manager and Database Management system (DBMS) e.g. Dbase, Rbase, Reflexive, Access, Oracle
- Graphics e.g. free lance graphics, Adobe Pagemaker, Power point
- Statistical package e.g. SPSS (Statistical Package for social sciences)
- Accounting package e.g. SUN, Accounting saga, Dac Easy, Peach Tree.
- Stock/Inventory control package
- Payroll package
- General ledger package.

QUESTION 6

LAD company has 50 employees and plans to give 20% of basic salary as anniversary bonus. Draw a flowchart to depict the process.

Solution



Note EOF means End of file.

Question 7

Describe briefly four main methods of interconnecting networks or independent computers.

Solutions

The four main methods if interconnecting networks or independent computers are through

- MODEM connection
- ISDN connection
- Bridge or Router and
- Gateway

The explanations are as follows

i A MODEM connection. MODEM is an acronym for Modulation Demodulation. A modem connection is It converts signals into analogue and vice-versa.

ii. An ISDN connection. ISDN is an acronym for Integrated Service Digital Network. ISDN Connection uses the public telephone services and the data sent is in a form. All connections to the ISDN require network terminal equipment (NTE).

iii. Bridge or and Routers normally connect the type of networks,

iv. Gateway: A Gateway connects one type of network to another type.

Question 8:

Cables used in networks and interconnecting independent computers include; twisted -pair, coaxial and fibre optic. Give five parameters used in determining the selection of any one type

Solution:
The parameters used in the selection of cables include:

- The data bit rate;
- The reliability of the cable;
- The maximum length between nodes
- The possibility of electrical hazards;
- Power loss (noise) in the cable;
- Tolerance to harsh conditions;
- Expenses and general availability of the cable;
- Ease of connection and maintenance;
- Ease of running cables

Question 9:

(a) Explain briefly what is meant by an office automation system.

(b) Enumerate and discuss three application areas of office automation system

List two adverse effects of office automation system on office workers.

Solution:

(a) An Office Automation System is a conglomerate of various technologies intended to improve the efficiency of office work by replacing the routine clerical, secretariat and paper-based tasks with computer-based devices.

(b) Some of the application areas of Office Automation System are:

(i) Word Processing

This involves hardware and software tools that allow the computer to behave like a typewriting device giving excellent face presentation of prepared document.

(ii) Desk top Publishing

This involves the use of computer systems equipped with special features to produce documents that look professionally printed. Such systems combine texts, art and a variety of fonts.

(iii) Electronic Mail

This refers to technologies used to send messages and documents from one electronic work station to another. Its use in business include facsimile, voice mail and electronic mail box.

(iv) Teleconferencing

This refers to the holding of meetings among people who are at physically different sites. Types of teleconferencing are video and audio teleconferencing. This system work can be done from home or other physical sites different from the office.

(v) Desktop Organizers

These are software packages that provide users with electronic equivalent of organizing and coordinating tools likely to be found on an office desk. Such tools include: Calendar, Card file, notepad, clock and calculator.

(vi) Archival Storage

This refers to off-line storage system used for historical and long time storage of material. Such common technologies used to store archival material include magnetic tape, and computer output on microfilm/microfiche (COM).

(c) Some adverse effect of Office Automation on Office workers include:

(i) Possible harmful effects and danger of display devices (e.g. monitor) to users‟ eyes.

(ii) Strain on the body (e.g. pain on backbone) due to long sitting to operate the computer system.

(iii) Reduction in number of office workers.

(iv) Reduction in retirement age.

Question 10:

(a) The following are some of the common units that can be used in a computing environment: Byte, Hertz, Band and MIPS. Explain each of these units and what they are used to quantify.

(b) Briefly describe the operation of a public key encryption.

(c) (i) What is a Website?

(ii) Give any two reasons why a business organisation may choose to develop and maintain a website.

Solution:

(a) A byte represents a sequence of bits (i.e. binary digits) which forms a character. In the ASCII coding system. 1 byte = 7 bits. In the EBCDIC Coding System, 1 byte = 8 bits; this is the usual definition of a byte. It is a unit of measurement of computer main memory or any storage medium.

A hertz is the number of pulses or cycles per second. It is a measure of processor speed.

Baud is the number of bits of data that can be transmitted along a communication line in one second. Baud is a unit of measurement used to specify data transmission sped.

MIPS is an acronym for millions instructions per second. It is used to measure the number of instructions processed per second for a given processor type.

(b) Public Key encryption uses two different keys - one private and the other public.

The public key is used by the sender to encode the message while the private (or secret) key is used by the recipient to unscramble the message. The sender locates the public key of the recipient and encrypts a message with it. Upon receiving the message, the recipient uses his private key to decrypt it.

(c) (i) A website is a place on the internet where an individual, company or organization has information about itself.

(ii) Reasons why a business organization may choose to develop and maintain a website are to:

*sell or market products and services;

*advertise products and services;

* promote corporate image;

* provide information about itself;

*reach out to several people simultaneously.

Question 11

The keyboard is the most widely used input device for the microcomputer. Give other input devices and state one advantage of each over the keyboard.

Solution:

The keyboard is the most widely used input device for the microcomputer. Give; other input devices together with one advantage of each over the keyboard are discussed as follows.

(1) The mouse is used in a windows environment on the VDU. It is a better means of controlling a cursor, than a keyboard and the spreadsheet.

(2) Voice data entry involves the use of a voice recognition unit, which recognizes a limited number of keyboards. It is advantageous to blind people who cannot operate the keyboard. Other applications include home banking systems and air traffic control systems.

(3) Touch screens are touch-sensitive screens which are built onto a normal VDU and which transit messages depending which part of the screen is touched. Applications include manufacturing and stock control operations.

(4) Magnetic stripe cards can be used for input by the use of magnetic card reader. Application areas include the banking system where ATM is in use.

(5) Document readers technologies include MICR, OMR and OCR. Application areas include the banking system for cheques clearing where MICR is used. Other areas include Examination Bodies making use of Multiple choice questions where OMR is used. OCR input system is used on turnaround documents such as credit card invoices.

QUESTION 12

a.	What is big data?	2 marks
b.	Describe the SIX 'V's OF Big data.	9 marks
c.	What are the benefits of big data?	9 marks
		Total 20 marks

SUGGESTED ANSWER TO QUESTION 12

a. Big Data is defined as extremely large data sets that may be analysed computationally to reveal patterns, trends, and associations, especially relating to human behaviour and interactions.

Big Data is also defined as **data that contains greater variety, arriving in increasing volumes and with more velocity**.

b. The Six 'V's of Big data

The 'V's describe the characteristics of big dat. They are

- the large volume of data from many environments;
- the wide variety o f data types frequently stored in big data systems; and
- the velocity at which much of the data is generated, collected and processed.
- Value: The value or worth of the information to the company. This is determined by the relevance of the data to the company.
- Veracity: This refers to the accuracy of the data. This determines its reliability.
- Variability: This is the rate of change in the structure of the data.

c. Benefits of Bigdata

Companies use big data in their systems to

- improve operations,
- provide better customer service as they follow the trend of customer behaviour more closely and accurately.
- Create personalised marketing campaigns as the companies have more comprehensive knowledge of customer behaviour.
- Enable the company to take actions that ultimately increase revenue and profits.
- give competitive advantage in the marketplace to businesses that use it effectively as they are able to take faster and more informed business decisions.

QUESTION 13

a. Describe disruptive technologies
b. Why are they important?
c. State FIVE examples of disruptive technologies
d. What is artificial intelligence (AI)?
e. What are the factors encouraging the adoption AI? s
f. What is adaptive intelligence?

SUGGESTED SOLUTION TO QUESTION S

a. Disruptive technology is an innovation that significantly alters the way that consumers, industries, or businesses operate. A disruptive technology sweeps away the systems or habits it replaces because it has attributes that are recognisably superior.

b. Disruptive technologies are important because

I. They affect the way we live work and earn income
II. They change the structure of industries and economies
III. They render some old technologies redundant.

c. Examples of disruptive technologies

I. Artificial intelligence and machine learning
II. Internet of things
III. Distributed ledgers – blockchain technology
IV. Computer robotics and business automation
V. Drone technology
VI. e-commerce
VII. online news sites
VIII. ride-sharing apps
IX. GPS systems.
X. the automobile
XI. electricity service
XII. television

d. **Artificial intelligence** refers to systems or machines that mimic human intelligence to perform tasks and can iteratively improve themselves based on the information they collect.

Artificial intelligence (AI) is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence.

Artificial intelligence (AI) **is intelligence demonstrated by machines, as opposed to the natural intelligence displayed by animals including humans.**

e. Three factors are driving the development of AI across industries:

I. **Affordable, high-performance computing capability is readily available.** The abundance of commodity compute power in the cloud enables easy access to affordable, high-performance computing power. Before this development, the only computing environments available for AI were non-cloud-based and hence, cost prohibitive.

II. **Large volumes of data are available for training.** AI needs to be trained on lots of data to make the right predictions. The emergence of different tools for labelling data, plus the ease and affordability with which organizations can store and process both structured and unstructured data, is enabling more organizations to build and train AI algorithms.

III. **Applied AI delivers a competitive advantage.** Enterprises are increasingly recognizing the competitive advantage of applying AI insights to business objectives and are making it a businesswide priority. For example, targeted recommendations provided by AI can help businesses make better decisions faster. Many of the features and capabilities of AI can lead to lower costs, reduced risks, faster time to market, and much more.

f. **Adaptive intelligence**

This is a new term which is evolving from Artificial Intelligence. Adaptive intelligence applications help enterprises make better business decisions by combining the power of real-time internal and external data with decision science and highly scalable computing infrastructure.

These applications essentially make the business smarter. It empowers the business to provide customers with better products, recommendations, and services—all of which bring better business outcomes.

QUESTION 14

a. What is Internet of Things (IoT)?

b. Discuss any SIX areas of application of (IoT).

SUGGESTED SOLUTION TO QUESTION 14

a. **Internet of things** (**IoT**) describes physical objects (or groups of such objects) with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks

b. Areas of Application of IoT

The extensive set of applications for IoT devices is often divided into consumer, commercial, industrial, and infrastructure spaces as follows:

3. Consumer applications

These are IoT devices created for consumer use. They include

connected vehicles – vehicles with autonomous attributes.

home automation, - smart homes e.g. iPhone controlling devices in the home.

wearable technology – wearable devices which monitor various parameters.

connected health – appliances which connect patients to the hospital directly without human intervention, in cases of emergency. These are appliances with remote monitoring capabilities.

4. Organizational applications

a. Medical and healthcare

The **Internet of Medical Things** (**IoMT**) is an application of the IoT for medical and health related purposes, data collection and analysis for research, and monitoring. It is described as the technology for creating a digitized healthcare system, connecting available medical resources and healthcare services. It is also used in remote health monitoring and emergency notification systems, wearable heart monitors and point-of-care medical diagnostics, where portability and low system-complexity is essential.

The application of the IoT in healthcare plays a fundamental role in managing chronic diseases and in disease prevention and control.

b. Transportation

Digital variable speed-limit sign

The IoT can assist in the integration of communications, control, and information processing across various systems. Including:

- smart traffic control,
- smart parking,
- electronic toll collection systems,
- logistics and fleet management,
- vehicle control,
- safety, and road assistance, and
- vehicular communication systems - vehicle-to-everything communication (V2X) which consists of three main components: vehicle to vehicle communication (V2V), vehicle to infrastructure communication (V2I) and vehicle to pedestrian communications (V2P). V2X is the first step to autonomous driving and connected road infrastructure.

b. Building and home automation

IoT devices can be used to monitor and control the mechanical, electrical and electronic systems used in various types of buildings (e.g., public and private, industrial, institutions, or residential) in home automation and building automation systems.

c. Industrial applications

Also known as IIoT, industrial IoT devices acquire and analyse data from connected equipment, operational technology (OT), locations, and people. Combined with operational technology (OT) monitoring devices, IIoT helps regulate and monitor industrial systems.

d. Manufacturing

The IoT can connect various manufacturing devices equipped with sensing, identification, processing, communication, actuation, and networking capabilities. Network control and management of manufacturing equipment, asset and situation management, or manufacturing process control allow IoT to be used for industrial applications and smart manufacturing IoT intelligent systems enable rapid manufacturing and optimization of new products, and rapid response to product demands.

Digital control systems to automate process controls, operator tools and service information systems to optimize plant safety and security are within the purview of the IIoT. IoT can also be applied to asset management via predictive maintenance, statistical evaluation, and measurements to maximize reliability. Industrial management systems can be integrated with smart grids, enabling energy optimization. Measurements, automated controls, plant optimization, health and safety management, and other functions are provided by networked sensors.

In addition to general manufacturing, IoT is also used for processes in the industrialization of construction.

d. Agriculture

There are numerous IoT applications in farming, such as collecting data on temperature, rainfall, humidity, wind speed, pest infestation, and soil content. This data can be used to automate farming techniques, take informed decisions to improve quality and quantity, minimise risk and waste, and reduce the effort required to manage crops.

e. Maritime

IoT devices are used in monitoring the environments and systems of boats and yachts. Many pleasure boats are left unattended for days in summer, and months in winter, so such devices provide valuable early alerts of boat flooding, fire, and deep discharge of batteries.

Infrastructure applications

Monitoring and controlling operations of sustainable urban and rural infrastructures like bridges and railway tracks is a key application of the IoT. The IoT infrastructure can be used for monitoring any events or changes in structural conditions that can compromise safety and increase risk.

The IoT can benefit the construction industry by cost-saving, time reduction, better quality workday, paperless workflow and increase in productivity. It can help in taking faster decisions and save money with Real-Time Data Analytics. It can also be used for scheduling repair and maintenance activities in an efficient manner, by coordinating tasks between different service providers and users of these facilities. IoT devices can also be used to control critical infrastructure like bridges to provide access to ships. Usage of IoT devices for monitoring and operating infrastructure is likely to improve incident management and emergency response coordination, and quality of service, up-times and reduce costs of operation in all infrastructure related areas. Even areas such as waste management can benefit from automation and optimization that could be brought in by the IoT.

a. Metropolitan scale deployments

There are several planned or ongoing large-scale deployments of the IoT, to enable better management of cities and systems. For example, Songdo, South Korea, is the first of its kind fully equipped and wired smart city, Much of the city is wired and automated, with little or no human intervention.

b. Energy management

Significant numbers of energy-consuming devices (e.g. lamps, household appliances, motors, pumps, etc.) already integrate Internet connectivity, which can allow them to communicate with utilities not only to balance power generation but also helps optimize the energy consumption as a whole.[51] These devices allow for remote control by users, or central management via a cloud-based interface, and enable functions like scheduling (e.g., remotely powering on or off heating systems, controlling ovens, changing lighting conditions etc.).

c. Environmental monitoring

Environmental monitoring applications of the IoT typically use sensors to assist in environmental protection[93] by monitoring air or water quality,[94] atmospheric or soil conditions,[95] and can even include areas like monitoring the movements of wildlife and their habitats.

Military applications

The Internet of Military Things (IoMT) is the application of IoT technologies in the military domain for the purposes of reconnaissance, surveillance, and other combat-related objectives. It involves the use of sensors, munitions, vehicles, robots, human-wearable biometrics, and other smart technology that is relevant on the battlefield.

c. Internet of Battlefield Things

The **Internet of Battlefield Things** (**IoBT**) is a project that focuses on the basic science related to the IoT that enhances the capabilities of soldiers.

d. Ocean of Things

The **Ocean of Things** project is a DARPA-led program designed to establish an Internet of things across large ocean areas for the purposes of collecting, monitoring, and analysing environmental and vessel activity data. The project entails the deployment of about 50,000 floats that house a passive sensor suite that autonomously detect and track military and commercial vessels as part of a cloud-based network.

Product digitalization

There are several applications of smart or active packaging in which a QR code or NFC tag is affixed on a product or its packaging. The tag itself is passive, however, it contains a unique identifier (typically a URL) which enables a user to access digital content about the product via a smartphone. The term "Internet of Packaging" has been coined to describe applications in which unique identifiers are used, to automate supply chains, and are scanned on large scale by consumers to access digital content. Authentication of the unique identifiers, and thereby of the product itself, is possible via a copy-sensitive digital watermark or copy detection pattern for scanning when scanning a QR code, while NFC tags can encrypt communication.

QUESTION 15

a. What are distributed ledgers?
b. Describe FOUR benefits of distributed ledgers.
c. Describe FOUR fields of a blockchain.
d. Describe FOUR features of a blockchain.
e. Describe a cryptocurrency.
f. State FIVE examples of crypto currency.

SUGGESTED SOLUTION TO QUESTION 15

a. Distributed ledgers are databases shared across a network and spread over various geographical locations. A ledger is a collection of financial accounts. In this instance, distributed means spread out and controlled globally. Thus, distributed ledgers are held and reorganized by multiple parties in different locations and institutions.

b. Benefits of Distributed Ledgers

1. Highly transparent, secure, tamper-proof, and immutable

In distributed ledgers, the entries happen in the database without third-party involvement. After records are written into distributed ledgers, they cannot be altered by any other party. Hence, until the ledgers are distributed, the records cannot be tampered with.

2. The need for a third party is eliminated

Distributed ledgers are usually operated without a third party to save a lot of money and time. In the supply chain business, results can be written directly by sensors to the blockchain without the need for a third party. It saves a considerable amount of money, effort, and time.

3. Inherently decentralized

The distributed ledgers' inherently decentralized nature adds another layer of security. As the database is spread globally, it is difficult to attack.

4. Highly transparent

Distributed ledgers have a high level of transparency. They allow all the stored information to be freely and easily viewable. It provides a significant amount of transparency desired by many industries.

e. Four fields of a Blockchain

Every block has four fields:

- Previous hash—this field stores the hash of the previous block in the Blockchain.
- Transaction details—this field contains information regarding several transactions.
- Nonce—this field contains a random value (the nonce value) whose sole purpose is to act as a variate for the hash value.
- Hash address—this field contains the unique identification of the block; it is a hex value of 64 characters, both letters, and numbers, obtained by using the SHA-256 algorithm

f. Features of Blockchain

These are the four features of Blockchain

- It is a public distributed ledger, which works using a hashing encryption.
- Every block has a hash value, which is the digital signature of the block.
- All the transactions are approved and verified on the Blockchain network using a proof-of-work consensus algorithm.

g. The Blockchain network utilises the resources of the miners, who are there to validate the transactions for rewards. A crypto currency is a form of digital currency that can be used to verify the transfer of assets, control the addition of new units, and secure financial transactions using cryptography.

h. Examples of Cryptocurrency

There are several cryptocurrencies available in the market right now. Some of the more popular ones are:

- Bitcoin
- Litecoin
- Ethereum
- Z Cash
- Dash
- Ripple
- Monero
- NEM
- Stellar