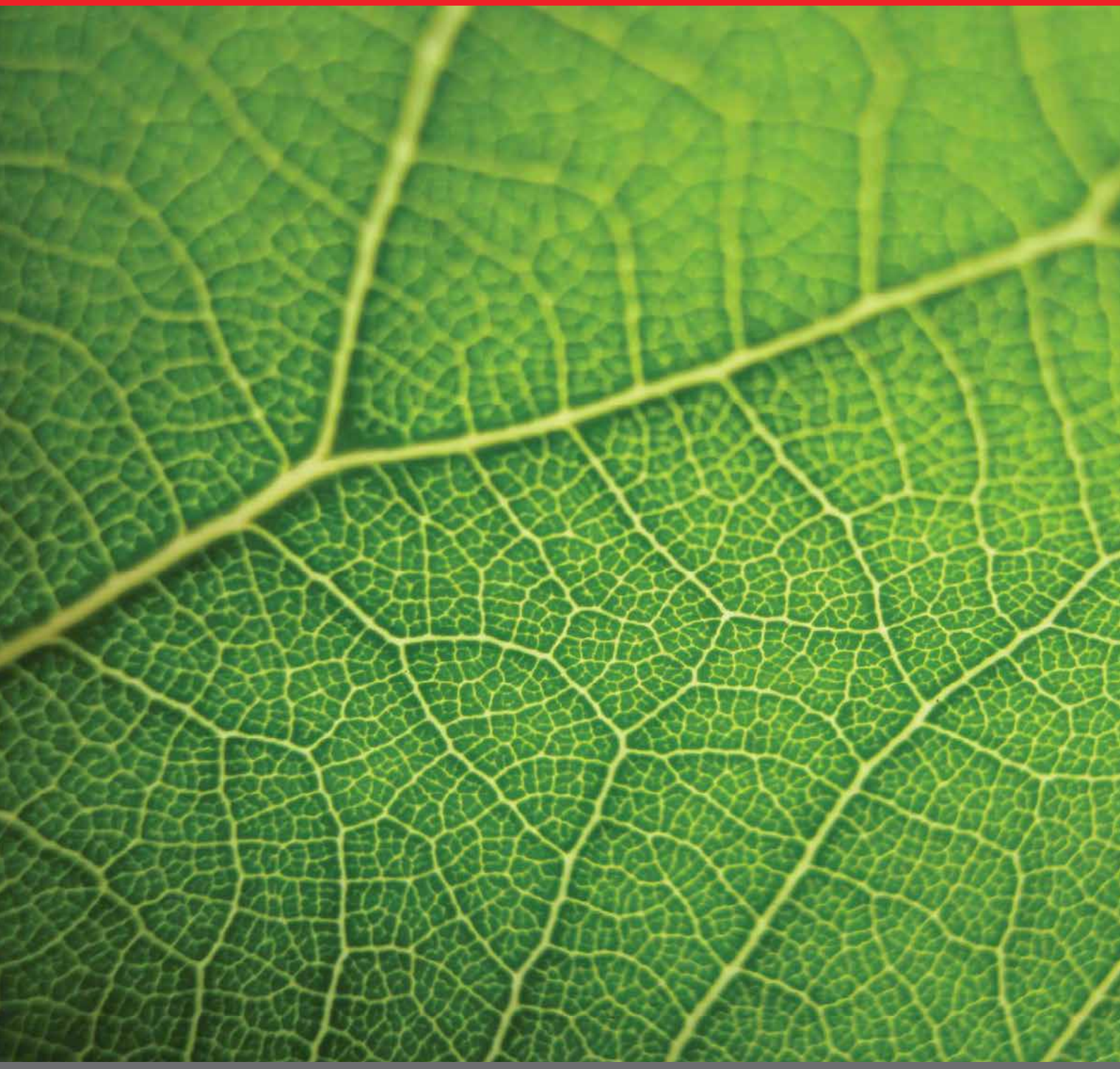
INFORMATION SYSTEMS (TC4)

TECHNICIAN DIPLOMA IN ACCOUNTING



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PREFACE

INTRODUCTION

The Institute noted a number of difficulties faced by students when preparing for the Institute's examinations. One of the difficulties has been the unavailability of study manuals specifically written for the Institute's examinations. In the past students have relied on text books which were not tailor-made for the Institute's examinations and the Malawian environment.

AIM OF THE MANUALS

The manual has been developed in order to provide resources that will help the Institute's students attain the needed skills. It is therefore recommended that each student should have their own copy.

HOW TO USE THE MANUAL

Students are being advised to read chapter by chapter since subsequent work often builds on topics covered earlier.

Students should also attempt questions at the end of the chapter to test their understanding. The manual will also be supported with a number of resources which students should keep checking on the ICAM website.

TABLE OF CONTENTS

TC4: INFORMATION SYSTEMS

AIMS OF THE COURSE

To develop students'

i. Understanding of the role of information and communication technology (ICT) in business.
ii. Understanding of the basic components of computerized processing systems.
iii. Ability to use computerized business systems.
iv. Understanding of how business systems are developed.
v. Understanding of the role of security in business information systems
vi. Understanding the use of social media networks

OBJECTIVES

By the end of the course, students should be able to:-

i. Explain the roles of information and communication in business
ii. State the basic components of computerized processing system
iii. Understand the uses of computers
iv. Describe how business applications are developed
v. Describe how ICT adds value to organizations.
vi. Have Knowledge of computer packages

FORMAT AND STANDARD OF THE EXAMINATION PAPER

There will be a three hour examination paper with seven questions. Candidates will be required to answer any five and each carrying equal marks.

SPECIFICATION GRID

This grid shows the relative weightings of topics within the course and should provide guidance regarding study time to be spent on each.

Syllabus area	Weighting
Introduction to Information Systems	5%
Information Systems Types	10%
Data Processing Options	5%
Computer Hardware	10%
Computer Software	10%
Data Communication	5%
Systems Theory	5%
Systems Development	20%
Information System Management	10%
Data Security and Controls	20%
Total	100%

Learning Outcomes

1. Introduction to Information Systems

   Candidates should be able to explain the role of information systems in an organization.

   In the exam, candidates may be required to:
   - Describe essential components and role of an information systems in a business
   - Describe various components of office automation
   - Explain uses of Computer Networks, Emails and Internet

2. Data Processing

   Candidates should be able to explain the following: data processing operations, data collection techniques, organizational levels and their information needs, role of computers in data processing and qualities of good information.

   In the exam, candidates may be required to:
   i. Define data processing
   ii. Describe Data processing operations
   iii. Describe the role of computers in data processing

iv. Describe factors that make information valuable
v. Describe qualities of good information

3. Information Systems Types

Candidates should be able to explain the role of different information systems types in an organization.

In the exam, candidates may be required to:
i. Describe main information systems types and their uses

4. Data Processing Options

Candidates should be able to define the following terms: - Stand alone systems, multi-user systems, batch and online systems.

In the exam, candidates may be required to:
i. Describe batch and online systems
ii. Describe inputs and outputs from batch and online systems and how the outputs from each type are used in an organization
iii. Describe real time systems

5. Computer Hardware

Candidates should be able to explain various parts of computer hardware.

In the exam, candidates may be required to:
i. Define computer hardware
ii. Describe basic components of a computer hardware
iii. Describe functions and parts of computer system unit
iv. Explain internal data representation
v. Describe different types of computers
vi. Explain embedded systems
vii. Explain computer generations
viii. Describe computer classification

6. Computer Software

Candidates should be able to explain the uses and classifications of various software products on the market

In the exam, candidates may be required to:
i. Define computer software
ii. Describe classification of software
iii. Explain uses of computer software packages
iv. Describe generations of computer languages

7. Data Communication

   Candidates should be able to explain how organizations can benefit by using the following technologies: - Internet, intranet and extranets.

   In the exam, candidates may be required to:
   i. Describe components and use of internets, extranets and intranets
   ii. Define E - Business
   iii. Explain uses of Computer Networks

8. Systems Theory

   Candidates should be able to define systems theory.

   In the exam, candidates may be required to:
   i. Explain systems concepts
   ii. Describe systems boundaries, and environment
   iii. Explain open and closed systems
   iv. Describe hard and soft properties

9. Systems Development

   Candidates should be able to differentiate systems development life cycle from software development life cycle.

   In the exam, candidates may be required to:
   i. Describe stages of systems development life cycle
   ii. Describe stages of software development life cycle

10. Information Systems Management

    Candidates should be able to differentiate between traditional data processing and modern data processing organizations.

    In the exam, candidates may be required to:
    i. Describe traditional data processing organization (typical structures) and modern data processing organization (typical structures)
    ii. Describe end user computing, types of end users , advantages and disadvantages of end user computing
    iii. Define computer bureau and explain various services and advantages and disadvantages of using computer bureaus

11. Data Security and Controls

    Candidates should be able to explain risks to information systems and various safeguards.

In the exam, candidates may be required to:

i. Describe data security
ii. Explain the need for security and controls
iii. Explain logical and physical controls
iv. Explain how computer viruses spread and their safeguards
v. Explain systematic development of a Disaster Recovery Plan

REFERENCES

ICAM *Information Systems* Manual

Loudon & Loudon: Management Information Systems : Managing the digital Firm

Turban: Information technology for management: Transforming organizations in the digital economy

Bocij P.: Business information Systems

.

C.S. French: Computer Science

Internet Resources

http://www.answers.com/Analog computers
http://en.wikipedia.org/wiki/Embedded_system
http://www.wordiq.com
http://www.computermuseum.li
http://www.columbia.edu/acis/history/generations.html

CHAPTER 1

INTRODUCTION TO INFORMATION SYSTEMS

This chapter provides an overview of information systems by introducing some essential concepts in the use of information systems in business organizations.

CONTENTS

LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Understand how a computer works
- Describe the hardware and software components of a computer
- Describe different types of hardware configuration
- Describe the role of computers
- Explain the benefits of computerized systems
- Understand what networks are.
- Know what systems development is.
- Understand security issues involved in the use of information systems

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1.1Computer

A computer is a device (machine used to perform one or more tasks) which will accept input data, process it according to programmed arithmetic and logical rules, store and output data and /or calculated results. Alternatively, we can define a computer as a group of mechanical and electronic devices working together to accept input, process them and produce output/results according to programmed rules.

Arithmetic operations include addition, subtraction, division and multiplication
Logical operations include logical comparisons like

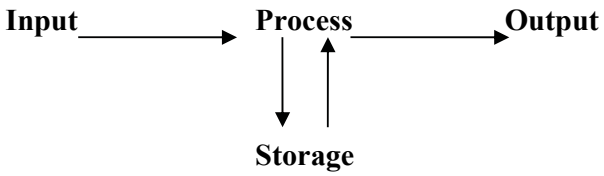
Let basicpay =30000

```
If  basicpay>20000
        Tax = basicpay * 10/1000
else
        tax=0
endif
```

The program will compute tax with a value of 3000.00

1.1.1 How a computer works

A computer works by accepting Data which is entered via an Input device like a keyboard and processed by the CPU and the Results/Output are viewed via an output device like a printer or the VDU. The data and the results may be stored on a disk drive and restored later.The process can be summarized as:



1.1.2 Components of a computer

A Computer system is made up of two components***: hardware and software***

Hardware refers to the physical or tangible parts of the computer. It is the physical machinery involved in the computer system. Any computer related device you can touch, constitutes the hardware.

Software is the organized collections of computer data and instructions, often broken into two major categories: system software that provides the basic non-task-specific functions of the computer, and application software which is used by users to accomplish specific tasks.

A program – is a set of instructions that directs a computer to carry out tasks.
Software and hardware are discussed in more detail in chapters to follow.

1.2 Information Systems(IS) and Information Technology (IT)

An information system is a set of procedures, methods and techniques for collecting, storing, transmitting and using information in the organization for planning, controlling and decision making. **Information Technology** describes all the equipment and software technologies used to capture, store, transmit or present information. This provides a large part of IS infrastructure.

1.2.1 Electronic Office (Office Automation)

It is one in which almost all data processing and communication is automated i.e an intelligent office. Below are some components that can be used in offices as part of office automation:

Components:

- Computers,
- printers,
- Scanners
- Word processors, Spreadsheets, Desktop publishing
- Networks
- E-mails
- Internet
- Telephones, Telex, Fax
- Teleconferencing, video conferencing
- Photocopiers
- Electronic Funds Transfers etc

1.3 The Role of IT in an Organization

The role computer systems is to provide support to people in their daily work by employing technological ways to collect and use information there by enhancing work processes.

a) To automate repetitive processes

- Automate basic functions like calculations, which can be carried out much faster with minimal costs.

b) As a provider of information

- Provides a regular flow of information via information systems to individuals who require it.

c) As a means of communication

- Data communications has revolutionalised the way companies operate and the way they are organized
- Communication is done via e-mails, cell phones, faxes
- Information can be shared via computer networks and the Internet

d) As an Integrator

- IT can act as a focal point of communications activities, which helps in linking together of different departments, and activities within an org

e) As goods and services supplied

- Some services providers use computers as an integral part of what they offer to their customers e.g. computerized booking offered by some airlines and car rentals.

1.4. Manual Information Systems and Computerized Information Systems

Companies and organizations are now investing in computerized information systems due to a number of benefits derived from computerized systems.

Advantages of Manual Systems

- High employment opportunities
- No need for electricity
- Security of information
- Initial cost is low

Disadvantages of Manual Systems

- Labour productivity is lower more especially with routine tasks
- Data processing is slower where large volume of data need to be dealt with
- Complex processing may not be done (Astronomical data) when using manual methods
- High risk of errors especially in repetitive work like payroll
- Difficult to make corrections or changes – usually requires somebody to start from scratch
- Poor quality of output which appears less professional
- Information is less accessible – often restricted to one user at a time
- Paper based systems are generally bulky to handle and store
- Generally expensive – wage cost is high, accommodation cost

Advantages of Computerized systems

- Processing of data is done in large volumes at a greater speed and with greater accuracy
- For computerized integrated accounting systems double entry is automatic
- Improved quality of management information which is easily accessible and reports can be presented in different formats and analysis
- Paperless offices
- Enables flexible working practices e.g. telecommuting.
- No fatigue-They can work 24 hours a day, in the dark, with minimum heating and little supervision
- They are much less error prone than humans, providing output of consistently better quality.
- They are much quicker than humans. Masses of information are readily available.
- They are more reliable than humans, allowing for better planning and control of output.
- They are immune from human conditions – such as sick leave, maternity leave, strikes, etc
- Less bulky - they occupy less..
- Results in better customer care- queries & enquiries can easily be handled.
- Over a period of time, computerized systems are cheaper than humans, due to savings in wages, power and accommodation and savings through improved output and quality.
- Ease of data storage
- Ease of data retrieval
- Enhanced security data

Disadvantages of Computerised Systems

- Computers can be expensive to install and maintain.
- Computers require trained technical personnel to use & maintain
- There are problems of concurrency if the same data is made in several computers which are not connected. Updating data on one machine leaves data in the other machines outdated and therefore lacks integrity.
- Storing large volumes of data on computers which are networked, present a real security problem.
- GIGO – Garbage in Garbage Out. If programs are wrong you get wrong results and if data is wrong you also get wrong results.
- Computers are tools for use by humans and cannot fully replace human common sense and experience. They don't think.
- Sometimes there is low employment opportunities since fewer people may be required
- There is need for electricity, power backup, air conditioning
- Frequency change of computer devices could lead to high operational costs
- Outage of service and /or loss of a computer may lead to business disruption

1.5 Computer Networks, Internet and E-mail.

In most cases, organisations use computers that are interconnected one to another so that it is possible to share programs, some peripheral devise such as printer, etc. The interconnected set of computers is called a **network**.

A computer network where all the interconnected computers are in a single geographical area is called a **Local Area Network (LAN)**. Typically, a LAN would be in a same building, same office, school or institutional campus. In some networks, the computers connected are in different geographical locations such as in different cities. Such are called **Wide Area Networks (WANs)**.

The Internet is a global network of computers. It has become an important tool for doing business for many organisations in the world. For example many organisations advertise on the Internet and thus making their adverts potentially available to virtually everyone on the globe as long they have Internet access. Advertising is just one of the many uses of the Internet.

People today use Internet-based **e-mail (electronic mail)** to send and receive messages electronically and thus enabling them to send or receive messages much faster than by post. Communication in an organisation and between organisations is subsequently more efficient than would have been the case if e-mail systems were not in use. There many other advantages of using e-mail.

Networks, the Internet, e-mail and other related technologies are discussed in detail later in this manual.

Chapter 1 Exercises

1)The modern electronic office is built around the installation of a Local Area Network which provides access to a Wide Area Network

Required :-

(a)Explain what is meant by two network terms
(b)Illustrate how these technical concepts support the various tasks performed in an electronic office.

2) Describe the role of information systems in an organization

CHAPTER 2

SYSTEM THEORY AND PRACTICE

This chapter introduces the concepts of a system and outlines basic examples of systems. The chapter covers Topic 6 of the syllabus

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CONTENTS

LEARNING OBJECTIVES

On completion of this chapter students should be able to

2 Define a system and subsystems

3 Explain the components of a system

4 Distinguish between open and closed systems

5 Distinguish between formal and informal system

6 Give practical examples of systems

2.1. Introduction

In order to have a better understanding of information systems, one needs to understand systems in general by studying systems theory. Systems theory is the study of the behavior and interactions within and between systems (Bocij, P: Business Information Systems). It provides a basic means for analyzing and improving business functions. It should be known that every system exists in an environment and is surrounded by a certain boundary.

2.2 Systems Concepts

What is a System?

A System is a group of interrelated components that work together to achieve a common goal or purpose. Each system has its own boundaries of some kind and includes various inputs, processes, outputs and outcomes geared to accomplish an overall goal of the system. Systems range from simple to complex ones.

Subsystems

Subsystems are smaller parts of a system. Each system is made up of several subsystems and each subsystem carries out part of the system function. In other words, every subsystem has a purpose within a larger system.

Examples of systems and subsystems

- An organization like a manufacturing company is a business system made up of many administrative and management functions, products, groups and individuals. For example, the production department of this company is a subsystem concerned with accomplishing a specific business goal i.e. manufacturing specific products.
- A human body is a biological system made up of many subsystems like the heart, the circulatory system, the digestive system and so on.
- A car is a mechanical system made up of subsystems such as a carburetor, an ignition system etc

The Nature and Components of a system

A system consists of an organized set of components. It exists within an environment and is surrounded with a boundary of some sort.

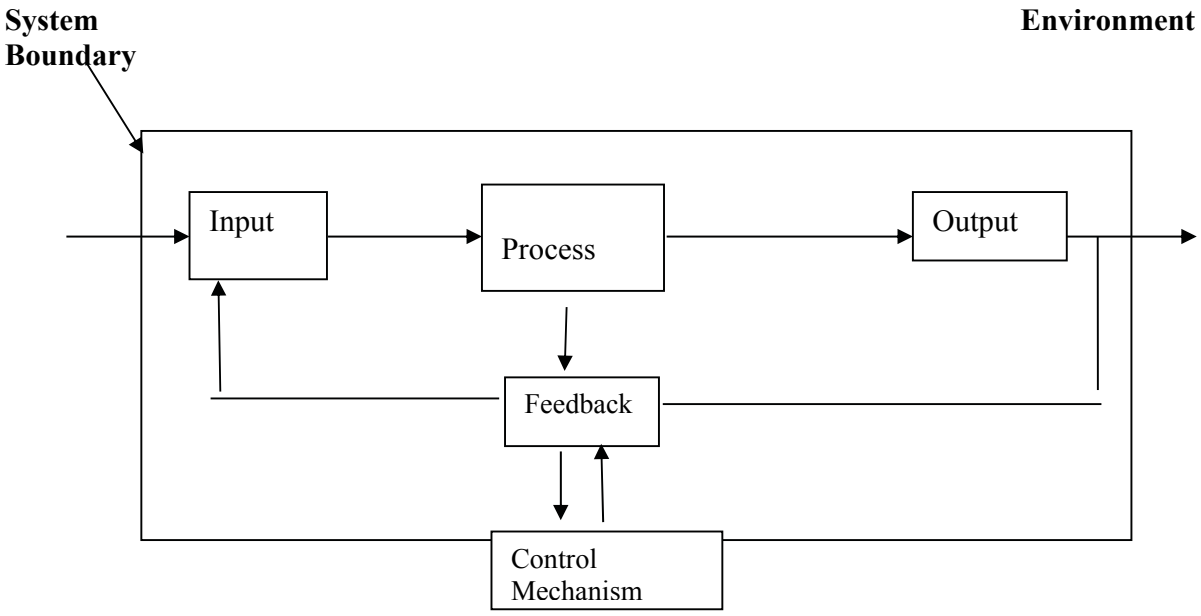
A system has various inputs, which go through certain processes to produce certain outputs, which together accomplish the overall desired goal of the system.

If one part of the system is changed, the nature of the overall system is changed as well. For example, if a carburetor is removed from a car, you no longer have a functioning car.

Main components of a system

- Input
- Process
- Output
- Feedback
- Control

Figure 2.1 below show a generic model of a system



Input
Input is the raw material for a process that will produce a particular output. e.g. data, knowledge, raw materials, machinery, money, time, manpower e.t.c

Output
These are products/finished products created by the system process e.g. information in an information system

Process
This is the transforming inputs into outputs e.g. Policies, procedures, and operations. Inputs are turned into output by subjecting them to a series of steps in the transformation process. Transformation is the process by which goals are obtained

Feedback
This is the information concerning the performance of the system which can be used to adjust the behavior of the system to maintain the system's aims.

The idea of feedback is to monitor the system output and performance and comparing it with the expected system goal

Control mechanisms
These are actions taken to ensure that the system is working to fulfill its objectives. If alterations are needed to the system, adjustments are made by some form of control mechanisms. Control is exerted as a result of feedback information regarding the performance of the system. Control tends to be exerted by adjusting the input and process components of the system until the correct

output is achieved. Feedback measures the system is performance and control uses feedback to take necessary actions. System monitoring involves checks to see if the system is meeting its goals.

System Environment
System environment consists of anything outside the system boundary. The environment can affect the system behaviour and conversely the system can affect the environment. For example, taking a business organization as system, customers, suppliers, competitors, business partners, government and regulatory agencies are part of its environment.

System Boundary
This is the interface between the system and its environment or other systems with which it interacts. It also defines the scope of the system i.e. it defines the components that make up the system. In other words, everything within the system boundary forms part of the system itself.

Interface - consists of exchanges between a system and its environment or other systems

Examples

i) In a cloth manufacturing system
- **Input** – cotton, dyes, water and other raw materials
- **Process** – grading, mixing, weaving the cotton
- **Output** – Finished cloth
- **Feedback** – checking and analyzing samples to detect any deviations from the required quality of cloth.
- **Environment** – Suppliers, customers, government, competitors, economy, distributors

ii) A banking information system for calculating annual interest:
- **Inputs** – Deposit amount or balance (Principal), interest rate, period
- **Process -** will include the algorithm or formulas used in the calculation of the interest.
- **Output** – total amount paid.
- **Feedback** – the total amount of interest paid to customers; customer views of the interests paid which can be used to adjust the interest rates
- **Controls –** adjusting the interest rate if the total interest would have other repercussion on the bank operations.
- **Environment** – customers; the policies the bank applies to their financial products; other information systems within the bank; the government policies that apply to the bank; national interest rates etc.
- **Boundary** – links with other systems like MIS (management information systems) where the TPS (transaction processing system i.e. the banking transaction processing information system in this case) provides data on customer's accounts and which will use these data to analyze the effects on the bank.

2.3 The systems approach

The systems approach is a way of understanding the relationships among system's parts rather than the parts themselves. It is based on the belief that the component parts of a system will act differently when the system relationships are removed and viewed in isolation and also removed

from its natural environment. The best way to fully understand why a problem or element in a system occurs and persists is to understand the part in relation to the whole system.

System theory and system thinking approach incorporates several ideas and this aids the designers and problem solvers to view information systems as having:

i) **Input**– directs their focus on raw materials(data in this case) within and outside the system boundary
ii) **Output** - directs their focus on what emerges from inside the system-what the system produces.
iii) **Process** –directs the designer's focus on transformation of inputs into outputs through which goals are achieved
iv) **System boundaries** - which help them to focus upon the important internal aspects of the system
v) **Hierarchy** –helps them to remember that systems are made up of smaller subsystems
vi) **Interdependence of components** - independent elements can never constitute a system and thus directing them to the fact that component parts of a system depend on each other.
vii) **Holism** - emergent system properties can be understood by looking at the system as a whole.
viii) **Goal seeking** –intra-system interaction must result in some goal or final output
ix) **Feedback** - to check the performance of the system so as to provide control mechanisms to maintain the system goals
x) **Regulation** - a method of feedback and control mechanism is necessary for the system to operate predictably

The effect of system theory and approach in an organization is that it has helped manager to look at organizations from a broader perspective. This broader view of a system can help you quickly identify the real cause of issues in organizations and know just where to address them. This can help you design smart, long lasting solutions to problems.

2.4 Open and Closed systems

Open systems

These are systems which interact with their environment. An open system receives information which it uses to interact dynamically with its environment. A high-functioning system continually exchanges feedback among its various parts to ensure that they remain closely aligned and focused on achieving the goals of the system. In an open system additional inputs are admitted from the environment and the openness therefore increases its likelihood to survive and prosper. Open systems aim to ensure compatibility between different systems.

Closed systems

A closed system is a system that does not interact with its environment. It does not take in information from its environment. In a closed system inputs are determined once and constant without any additional input. Closed systems therefore are likely to vanish with time. A chemical reaction taking place in a vacuum is an example.

2.5 Formal Systems and Informal systems

Formal Systems

Systems that include agreed upon procedures, standard inputs and outputs and fixed definitions Formal systems are generally rigid, well-defined, fixed definitions evolving slowly over time. An example would include financial accounting systems which processes financial transactions.

Informal systems

These are systems with no formal planning and design. They may be temporary, fluid in nature and likely to be quick to react to changes.

Chapter 2 Exercise

1. What is the relevant environment for any system
2. Explain the difference between open and closed system
3. What are key features of a closed system and what are the main strength of an open system
4. Describe the role of environment in a motor vehicle selling industry (any three)
5. What is a boundary?
6. What are examples of items of an interface?

CHAPTER 3

COMPUTER HARDWARE

This chapter provides an understanding of computer systems mainly the hardware components of the computer systems. It outlines all the basic components of computer hardware and their functions in a computer system.

CONTENTS

LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Define computer hardware
- Explain the main components of computer hardware
- The functions of the CPU and RAM, in a computer system
- Explain the role of Input, Output and Storage devices
- Give examples of input, output and storage devices

3.1 Introduction

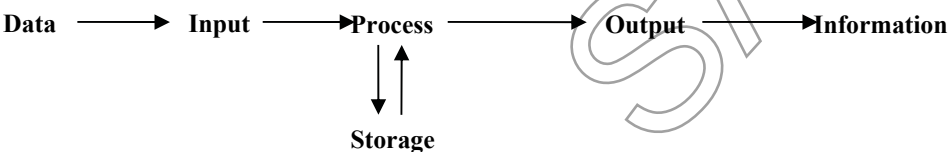
What is a computer?

A computer is a device which will accept input data, process it according to programmed logical and arithmetic rules, store and output data and /or calculated results. We can also define it as a group of mechanical and electronic devices working together to accept input data, process them and produce output/results according to programmed rules.

Just like any other system the basic activities are:

Input ⟶ **Process** ⟶ **Output**

This basic definition of computers indicates that data processing in a computer is as follows



The data is processed by using programmed arithmetic and logical rules which work by applying:

- Arithmetic operations of +, -, /, *
- Logical operations like If (x> y and y = z) then x > z (comparisons)

These rules are programmed in computer programs

What is a Program?

A program is a detailed set of logical instructions written in a computer language that directs the computer what to do.

A Computer system is a mixture of two components***: hardware and software***;

3.2 Computer Hardware

Computer hardware refers to the physical or tangible parts of the computer. Any computer related device you can touch, constitute the hardware.

Components of Computer Hardware

Computer hardware is basically composed of **four** major components.

a) The Processor (The Central Processing Unit)
b) Input Devices
c) Output Devices
d) Storage Devices

3.3 The Processor/ Central Processing Unit (CPU)

It is where the data processing activities and interpretation of information takes place. The CPU is referred to as the brain of the computer. It consists of circuits and registers which controls the interpretation and execution of instructions.

3.3.0 Component parts of the CPU

- Arithmetic and Logic Unit (ALU)
- Control Unit (CU)

3.3.1 Arithmetic and Logic Unit (ALU)

The function of the ALU is to perform all the arithmetic and logical operations in the computer. Calculations and all logical comparisons (decisions) required in the computer take place here. Once data is fed into the primary storage from input devices, they are held and transferred as required to ALU where the calculations will take place.

3.3.2 Control Unit

The Control unit coordinates all the activities of the CPU. It receives all the instructions from the memory, decodes them and triggers any appropriate action. It controls the flow of instructions to and from input devices, storage areas, and output devices. Although the CU does not process data, it acts as a central nervous system for the other data-manipulating components of the computer.

The control signals are coordinated by a clock and are sent at a regular interval in a sequence called **a cycle.**

The number of cycles in a second is measured in **hertz (Hz).**

1 KHz = 1 thousand cycles per second
1 MHz = 1 million cycles per second
1 GHz = I billion cycles per second

The speed of a computer is measured in **Hertz (MHz)** and is indicated by the clock speed of the computer.
The faster the speed of the processor, the more instructions the computer can process in any given time.

Manufacturers of processors include **Intel Company, AMD, Celeron and Digital company**

3.4 The Memory

Computer Memory are the internal storage areas in a computer that are used to temporarily or permanently store data or instructions to be executed.

3.4.1 Types of Memory

a) Random Access Memory (RAM).

Random Access Memory is also referred to as Primary Storage consists of computer chips, which are capable of holding data and programs whilst the computer is operating. The Primary Storage is used for **four purposes:**

- To hold programs and data while the computer is operating. The CPU acts on program instructions that are held in the memory
- To hold input data - the data waiting to be processed
- To hold data currently being processed - provides a working storage space when data is being processed
- To hold output data - provides a temporary storage space for finished results of the processing operations until they can be released to output devices

The reason for holding programs in memory is to speed up the processing. The processing capacity of a computer is dictated by the capacity of its memory among other factors.

RAM is the memory chip which is directly available to the processor. It is used to hold data while the computer is operating. The size of the RAM is extremely important, it determines the power of the computer.
The RAM chip is slotted on the Motherboard

Characteristics of RAM

- Data can be written or read
- It is volatile i.e. data and programs held get lost when the machine is switched off. As such there is need to save the work on permanent storage devices before the computer is switched off.
- It is temporary
- It is expandable i.e. the size of RAM can be increased
- It holds data on which the CPU is working on (i.e. the Memory directly available to the processor)
- It is the memory that is used by computer application programs
- The size of RAM determines the speed of the computer.

b) Read Only Memory (ROM)

ROM is a memory chip into which fixed data is written permanently at the time of manufacture.
Data can only be read but cannot be written to or deleted from it i.e. the data on this chip is unchangeable or irremovable. It contains a computer start-up program called the "Bootstrap" and the BIOS (Basic Input/output system) which a ROM chip containing programs needed to control the keyboard, monitor and disk drives. This type of memory chip is used to store system programs that test the system and load the Operating System when the machine is switched on.

Characteristics of ROM

- Data can only be read
- It is Non-volatile. It contains non-volatile and non-alterable programs which are hard-wired and are used to boot the computer. The contents will not be lost when power is switched off.
- It is permanent
- It is supplied only by the computer manufacturer. The programs and data are installed during the process of computer manufacture
- It is non-expandable i.e. cannot be upgraded
- Not used by application programs

3.5 Chips and Buses

A **chip** (card) is a small piece of silicon upon which is etched an integrated circuit which consists of transistors and their interconnecting patterns. Each chip has a specific function e.g. RAM chip, ROM, chip, Sound chip or card, Video card. The chip is mounted on a carrier board called a **Motherboard**

A **bus** is an electronic path through which signals travel in a computer. For example data travels between RAM and CPU through a bus.

3.6 Data Representation and Storage Capacity in Computer Systems

Storage capacity relates to the amount of data a storage device can hold at any one time. Each individual storage element in the computer's memory consists of a simple circuit, which can be switched on and off. Therefore data in a computer is represented electronically by storage cells which can be switched ON and OFF representing a 1 and 0 respectively.

3.6.1 Bits and, Bytes

Information in a computer is represented in form of 1s and 0s called **bits**. The data in this format is called binary data. Any data to be stored in a computer (whether numeric, character or instruction) must be expressed as binary numbers or binary digits.

A bit is a unit of storage that can hold a single binary value, 0 or 1.

Binary describes a numbering scheme in which there are only two possible values 1 and 0.

A group 8 bits forms a byte and 1byte represents one character. A character can be a letter, or a number or any of the many special characters found on the keyboard including space.

A **byte** is the basic unit of computer storage.

Units of Computer Storage Capacity

8 bits	=	1 Byte
1,024 bytes	=	1 Kb (Kilobyte)
1,024 Kb	=	1 Mb (Megabyte)
1,024 Mb	=	1 Gb (Gigabyte)
1,024 Gb	=	1 Tb (Terabyte)
1024 Terabytes	=	1 (Pb) Petabyte
1024 Petabytes	=	1 (Eb) Exabyte

3.7 Input Devices

Input devices are components or peripheral devices that feed data or instructions into a computer or other computational devices for display, storage, processing, or outputting or transmission. They convert the instructions and data into digital signals that can be processed by a computer. Examples of input devices are mouse, bar-code reader, magnetic-stripe reader, keyboard, modem, scanner, graphic tablet and stylus.

A **computer peripheral** is any external device that provides input and output for the computer. For example, a keyboard and mouse are input peripherals, while a speaker and printer are output peripherals. Computer peripherals, or peripheral devices, are sometimes called "I/O devices" because they provide input and output for the computer. Some peripherals, such as a monitor and external hard drives, provide both input and output for the computer.

Before data is processed into information it has to be captured into the computer system using these input devices. Input devices can be categorized into Manual and Automatic.

3.7.1 Manual Input Devices

a) Keyboard

This is the main input device to the computer and is used to enter data or commands directly into the machine for processing.

Standard keyboards have 20 function keys and 1 set of numeric keys while Enhanced keyboards have 12 function keys, 1 set of numeric keys and a numeric keypad. There are some variations in keyboards depending on the country in which a particular keyboard is used due to different languages and characters.

b) Mouse

A mouse is a device used to point, select, drag and open programs and files. A standard mouse has two or three buttons which can be pressed (clicked) to send specific signals to the processor.

Types of mouse

i) **Wheeled mouse**. This mouse has a removable rubber ball protruding from a small hole in its base.

ii) **Optical mouse.** This mouse has a small light-emitting diode (LED) that bounces light off the surface when the mouse is moved. The sensors convert the movement into coordinates that the computer understands. This mouse is replacing the wheeled mouse.

c) Touch screens

A touch screen is display screen on some electronic devices which enables users to make selections by touching areas of the screen. It has sensors built into the screen which detect the area that has been touched. These devices are widely used in vending situations, such as the selling of train tickets, mobile phones etc.

3.7.2 Automatic Input Devices (Document Reading devices)

i) Magnetic ink character recognition (MICR) devices

MICR device is a special machine that recognizes special formatted characters printed in magnetic ink. The characters are read and converted into computer sensible form. Magnetic ink characters are usually found on bank notes, cheques and deposit slips therefore MICR applications are common in the banking industry. The main advantage of MICR is its speed and accuracy, though MICR documents are expensive to produce.

ii) Optical Mark Reading (OMR) devices

OMR involves marking on a pre-printed form with a pen, pencil or typed line across in an appropriate box.

OMR device senses and reads the marks on the form in each box using an electric current, and translates them into machine code. Applications in which OMR is used include **National Lottery entry forms** and Answer sheets for **multiple choice questions.**

iii) Scanners and Optical Character Recognition (OCR) software

A scanner is device that reads text or illustrations printed on paper and translate the information into a form the computer can use. A scanner works by digitizing an image which cannot be edited. To edit text digitized by an optical scanner, you need the Optical

Character Recognition (OCR) software which translates the picture into editable text format.

iv) Bar code Readers and Electronic Point of Sale (EPOS) terminals

Bar codes are groups of marks, which, by their spacing and thickness, represent specific code or values. Bar code readers are devices that read bar codes and convert them into computer sensible form and this information is fed into the EPOS terminal. They are usually found in large retails stores. The barcode readers and the EPOS applications enable the provision of immediate sales and stock level information in a real time basis.

v) Electronic Funds Transfer at the Point of Sale (EFTPOS) terminals

An EFTPOS terminal is a system used with a customer's credit card or debt card to pay for goods or services in shops and service stations. The customer's credit card account or bank account will be debited automatically with the amount paid for the goods or services. EFTPOS systems combine point of sale systems with electronic funds transfer. Many retail shops and service stations have now introduced EFTPOS systems.

vi) Magnetic stripe cards or Badges

The magnetic stripe card is a plastic card that contains machine-sensible data on a thin strip of magnetic recording tape stuck at the back of the card. The data is read by the magnetic card readers which converts this information into computer-sensible form. The widest application of magnetic stripe cards is bank credit cards or ATM cards. The card contains information like the holder's name, card number, expiry date etc

vii) Smart cards

A smart card is a plastic card in which is embedded a microprocessor chip which contains information about the card holder and the account details. A smart card has a memory and a CPU which gives it the processing capability. This means that the information held on smart cards can be updated (eg using a PC and a special device). Examples of applications include debit cards, credit cards, computer security systems and cable/Satellite TV systems.

ix) Voice recognition or Voice data entry (VDE) devices

This is a device that converts speech into computer-sensible form via a microphone.
For example, it is possible to have speech turned into text in a word processor.

x) Kimball Tags

These are punched cards used for data collection associated with clothing and retailing applications. However, the cards in use today have magnetic stripes for data such as garment type, size, department etc

They are used in conjunction with barcode readers.

xi) Biometrics

Biometric devices are used to capture physiological characteristics of a person. They are mainly used in automated method of verifying the identity of a person based on physiological or behavioral characteristics.

They rely on body parts to identify and validate the person.

The applications include:

- Finger prints or Thumbprint
- Face prints
- Retinal scans
- Voice

3.8 Output Devices

The output devices convert data from the computer into forms which humans can understand and use. The devices allow you to see the processed data or information.

3.8.1 Types of output devices

a) Monitor or Visual Video Display Unit (VDU)

The Monitor allows you to see the instructions you send to the computer, and the processed data or information from the CPU after interpreting the instructions.

b) Printers

The Printer allows you to print out the processed data or information on to a paper. It is a device that allows you to obtain a hard copy of the processed data.

Types of printers

i) Impact Printers

Dot Matrix Printers, Daisy Wheel and Thimble Printers.

- Make image by striking the paper with a metal or plastic mechanism.
- Noisy when printing due to striking activity. E.g. Dot Matrix
- They are slow, print a single character at a time
- Have poor resolution hence poor quality printouts
- Printer resolution is given by the number of dots per inch (dpi)
- Use continuous sheets of paper having holes along its sides used to feed paper on printer and suitable for high volume printing
- Relatively cheap

ii) Non-Impact Printers

Laser Jet Printers

- Spray ink on paper using heat and pressure to create texts or images.
- Prints using technology similar to that of the copier

- The ink used is called tonner.
- They are quiet and make little noise when printing
- They are fast - printing speed is measured as pages per minute (PPM)
- Produce high quality output
- Relatively expensive

Ink-Jet Printers

- Non-Impact printers that print one character at a time.
- Faster than Dot matrix printers. Speed is 200-300 characters per second.
- Quality- fairly high quality output.

c) Other output devices

- *Speakers*- for sound output
- *Plotters* – for printing graphs and maps
- *Projectors* – used for presenting information to a large audience
- *Microfilm/Microfiche* systems
- *Modems* – can be used as both input and output devices

3.9 Storage Devices

The storage devices are used for permanent or long-term storage of data. The data and programs are stored on backing storage devices before they can be loaded into the memory for processing by the CPU.

These storage devices are also referred to as:-

- Backing Storage
- Secondary Storage Area
- Auxiliary storage

3.9.1 Types of storage devices

a) Magnetic Disks

Magnetic disks offer direct access to data in which the data is stored and accessed randomly. The disks are coated with magnetic materials. Each surface of the disk is made up of concentric cycles called **tracks** and these are divided into **sectors.** A group of sectors with space enough to store an independent block of data that can be accessed independently are called **clusters.**

Types of Magnetic Disks

i) Hard Disk

A hard disk is a storage device fixed in the computer system itself. The hard disk capacity varies widely. At the time writing, modern computers can have up to 500Gb on average. Larger computer systems may have removable disk packs.

ii) Floppy disks

These are small and removable disks, they provide a cost-effective means of electronic storage for small amounts of information. The size of a floppy disk is 3.5" disk can hold up to 1.44 Mb of data. However, floppy drives are no longer in use.

iii) A zip disk

It is a type of removable disk, with much larger capacity (100 Mb) that stores data in a compressed form. A Zip disk is suitable for back-up, storage or for moving files between computers.

b) USB Flash disk or Memory Stick

Flash disks offer direct access to data in which the data is stored and accessed randomly. It is a storage module made of flash memory chips i.e. contents can be flashed off to provide room for new entry. Flash memory is a non-volatile computer memory that can be electrically erased and reprogrammed.

Flash disk capacity ranges from 128MB to infinite. Writing and reading speed is much faster than that of magnetic disks. It can allow data to be written and wiped over 1 million times and can keep data for a long period of time.

Flash disks are mainly used for storage and transferring data between computers and other digital devices. The flash is inserted into one of the USB ports.

c) Optical Disks

Optical disks offer direct access to data in which the data is stored and accessed randomly. An optical disc is an electronic data storage medium that can be written to and read from using a low-powered laser beam. *Laser* stands for "light amplification by stimulated emission of radiation."On this disc, data such as music, text, or graphic images is digitally encoded.

Types of optic disks

i) **CD-ROM (Compact Disc – Read Only Memory)**

The discs on which data is recorded once and thereafter can only be read. A CD-ROM can store 650 megabytes of data. It is mainly used to store commercial software products or music.

ii) **CD-R (Compact Disc- Recordable)**

CD recorders are now available for general business use with blank CDs (CD-R). CD-R is a Write Once, Read Many times (WORM) and the writing can be done in sessions. They are used mainly for music, software programs and data transfers.

iii) **CD-RW** (*C*ompact **D**isc **Rew**ritable) or CD-Erasable

These are rewritable disks (CD-RW) i.e. it can be written and erased as many times as possible. The capacity is between 650Mb to 700Mb. However they are not reliable

for long term storage. They are used mainly for music, software programs and data transfers.

iv) **DVD (Digital Versatile Disc) or (Digital Video disc)**
The CD format has started to be superseded by DVD. DVDs are used for multimedia files with video graphics and sound – requiring greater disk capacity. The minimum storage capacity is 5 GB. They are mainly used for movies, software and data archives. They can also be found as DVD-ROM, DVD-R, DVD-RW (holds data that can be rewritten multiple times or HD-DVD (High density DVD).

v) **VCD (Versatile Compact Disc) or Video Compact Disc**
It is a CD that contains moving pictures and sound. Its capacity is between 650MB to 700 MB. They can be played on almost all standalone DVD players and computers with DVD-ROM or CD-ROM drive. DVDs are better than VCDs in terms of quality and sound.

vi) **Mini DVD-R**
It is a recordable media ideal for a broad range of mobile storage applications including multimedia content like video, still images, business presentations, internet downloads, data transfer etc.

d) Tapes (Data Cartridges)
Tapes do not offer direct access to data but sequential. Like an audio or videocassette, data has to be recorded along the length of a computer tape and it is more difficult and time consuming to access data on a tape than data on disk (i.e. direct access is not possible with tape). Reading and writing are separate operations. Tape cartridges have a much larger capacity than DVDs and they are still widely used as a backing storage medium. Fast tapes which can be used to create a back-up file very quickly are known as Tape streamers.

3.9.2 Disk Drives and Tape Units

Each type of disk has a drive in the main system unit. A drive is the mechanism that reads from or writes to storage media. You need to have a floppy disk drive in order to read data from or write data to a floppy disk. And the disk drive for the floppy disk is drive A or drive B, while that of a hard disk is drive C: and that of a CD-ROM (Compact Disc Read-Only memory) is drive D. Tapes are slotted in tape units

3.10 Computer History and Developments

Computers were developed along two separate engineering paths, producing two distinct types of computer, **Digital and Analog computers**

3.10.1 Analog Computers

An analog computer was designed to operate on continuously varying data where numbers were presented by electrical voltage. They accept inputs which vary with respect to time. Analog computers work by translating data from constantly changing physical conditions into

corresponding mechanical or electrical quantities. They set up the model of the problem to be solved, representing the variables in the problem by physical aspects of the device itself which are made proportional to the variables concerned. The output from analog computers is often in the form of smooth graphs from which information can be read displayed by meters or oscillators.

3.10.1. Characteristics of analog computers:

- Operates using continuous variables**.** Meaning that it uses numbers that change not in steps, but change in a smooth continuous manner.
- Performs operations in a truly parallel manner; meaning that it can perform many calculations all at the same time.
- They do not have the ability to store data in large quantities,
- They do not have the comprehensive logical programming facilities hence they cannot perform comparisons.
- Analog computers are extraordinarily fast.
- Limited precision - the precision of analog computers is not good; they are limited to three, or at most, four digits of precision.
- The cost of hardware required to provide high degree of accuracy is often prohibitive and therefore they do not offer high degree of accuracy and display.

Analog computers were well known in the 1940s but they are now virtually extinct i.e. they largely have been made obsolete for general-purpose mathematical computations. These computers are now kept in museums for historical purposes.

However the analog mechanism is still used in many devices. For example, some automobile speedometers are mechanical analog computers that measure the rotations per minute of the drive shaft. Measuring instruments with pointers on a circular disk like thermometers and voltmeters are also good examples.

Examples of analog computers:

- The slide rule. This was the first analog computer to be developed
- Torpedo data computer. The TDC Mark III was an electromechanical analog computer used to solve targeting problems for torpedoes during World War II.
- Differential analyzer (1960). Used to solve differential equations and is currently housed at the Cambridge museum
- GEDAA. The GEDA A-14 was an analog computer developed in 1957 by Goodyear Aircraft Corporation for large and small problem solving.
- ANACOM. Westinghouse Electric Company (founded in 1886) produced the ANACOM analog computer in 1948.
- MONIAC computer (Hydraulic model of UK economy)
- Tide predictors
- Mechanical integrators
- Water integrator

- Target predictors

3.10.2. Digital Computers

Digital computers are computers that were designed to operate using discrete data (non continuous data). The computers require the variables of the problem to be expressed in terms of discrete numbers (digits) like 0, 1, 2, 3, 4…… in steps and proceeds in these discrete steps from one state to the next. The variables are manipulated based on the arithmetic and logic rules and results expressed in numeric terms. Digital computer can only perform sequential (one at a time) operations. The circuits of a digital computer perform directly the mathematical operations of addition, subtraction, multiplication, and division. The numbers operated on by a digital computer are expressed in the binary system ; binary digits, or bits, are 0 and 1, so that 0, 1, 10, 11, 100, 101, etc., correspond to 0, 1, 2, 3, 4, 5, etc. that is to say in digital computers, even letters, words and texts are stored and represented digitally. Binary digits are easily expressed in the computer circuitry by the presence (1) or absence (0) of a current or voltage. Digital computers are the ones being used today for different purposes.

Characteristics of digital computers:

- They operate using discrete data**.**
- They have the ability to store data in large quantities.
- They have comprehensive logical programming facilities hence can compare results with other data.
- Lower speed than analog computers
- They have higher resolution hence better display
- Digital computers have almost unlimited precision, but quite slow compared to analog computers.

Examples of digital computers are desktop computers, laptop computers etc.

3.10.3. Hybrid computers

These are computers that have the combined features of digital and analog computers. It is designed to handle both analog and digital data. The digital component normally serves as the controller and provides logical operations, while the analog component normally serves as a solver of differential equations.

Example of a hybrid computer is an ATM.

3.11 What distinguishes a Computer from a Calculator?

A computer is distinguished from a calculating machine, such as an electronic calculator

- **Logical operations** - being able to store a computer program (so that it can repeat its operations and make logical decisions)
- **Complexity -**the number and complexity of the operations it can perform
- **Memory –** the computer is able to store and keep indefinite information without losing it
- **Speed –** The computer processes data & gives out results very fast

3.12 Common Types of Computers

Computers are categorized by both size and processing capabilities

i) Supercomputers

Supercomputers are the most powerful & sophisticated machines designed to perform complex calculations at very high speed. They are able to process very large amounts of data. Supercomputers are used for applications such as meteorological applications (weather patterns) or astronomical applications. They are expensive and therefore not meant for commercial use. Manufacturers of supercomputers include ***Cray and Fujitsu***

ii) Mainframe computers / Enterprise servers

Mainframes are the largest (huge) and next most powerful computer. They are designed to meet the computing needs of a large organization with large data processing requirements. They have very extensive storage facilities & large memories.
A mainframe is normally used by having a number computer terminals linked to it by cables. Manufacturers include ***IBM and HP***

iii) **Minicomputers**

These are computers whose size & processing capabilities lie somewhere between those of a mainframe and a Personal Computer (PC). They have more processing power than a PC but less than a mainframe. Though somewhat smaller, they are intended to meet the needs of a small company by serving up to a hundred terminals. Manufacturers include **ICL, IBM and DELL**

iv) **Personal computers (PCs)/ *Microcomputer (Desktop computer)***

A PC is a general-purpose, single user computer powered by a **Microprocessor chip.** PCs are the most common type of computers found in organisations. They are small in size and have small storage capacity. They are used for small to medium sized businesses. Most often they are linked together in **Networks** to enable sharing of information between users.

v) Portables

These include Laptops/briefcase computers and Palmtops/handheld computer. They usually have similar processing capabilities to PC and are usually powered by a battery. However their main drawbacks are keyboard ergonomics (keys are small and too close together) and limited battery power

3.13 Computer Generations

A computer has evolved through a series of generations since its invention. The first electronic computer (the adding machine) was produced in 1940

3.13.1 First Generation Computers (1940- 1955)

During the years **1943 to 1946**, Dr. John W. Mauchly and J. Presper Eckert, Jr. completed the ENIAC (Electronic Numerical Integrator and Computer), the first large-scale electronic digital computer. It weighed 30 tons, contained 18,000 vacuum tubes, and occupied a 30' x 50' space.

Characteristics

- Built using thousands of **vacuum tubes (electronic valves)** which controlled internal operations and were huge
- Used **Magnetic drum** as primary internal-storage medium with very little storage capacity
- **Limited main-storage** capacity
- Used a **lot of electricity**
- Produced great deal of heat and subject to frequent burnout
- Required extensive and special air-conditioning
- Bulky; occupied a lot of floor space
- Slow with Slow input/output, punched-card-oriented: Operators performed input and output operations through the use of punched cards.
- **Low level symbolic- programming language**: The computer used machine language which was cumbersome and accomplished through long strings of numbers made up of Zeroes and Ones.
- **Applications**: payroll processing and record keeping though still oriented toward scientific applications that business data processing.

The type of computers in the first generation were mainframes
Examples: IBM 650, UNIVAC I

3.13.2 Second Generation Computers (1955 – 1964)

In **1958**, computers built with transistors marked the beginning of the second generation of computer hardware.

Characteristics

- Used **transistors** for internal operations: tiny solid state transistors replaced vacuum tubes in computers. Transistor were much smaller than vacuum tube
- Used **Magnetic core** as primary internal-storage medium: Electric currents pass through wires which magnetize the core to represent on and off states.
- Increased main-storage capacity: The internal or main storage was supplemented by use of magnetic tapes for external storage. These tapes substituted for punched cards.
- **Faster input/output**: Devices could be connected directly to the computer and considered "on-line".
- **Magnetic disks** were also developed that stored information on circular tracks that looked like phonograph records.
- **Used high-level programming languages** (COBOL,FORTRAN, Pascal)
- **Increased speed and reliability**: Modular-hardware was developed through the design of electronic circuits.

- **Less bulky;** computers were made smaller and faster.
- Less expensive
- The heat problem was then minimized
- Consumed less energy
- Faster and more reliable data processing
- **Batch-oriented applications** like billing, payroll processing, updating and inventory files: Batch processing allowed for collection of data over a period time and then one processed in one computer run.

The type of computers in the second generation were mainframes
Examples: LEO Mark III, ATLAS, IBM 7000, IBM 1401

3.13.3 Third Generation Computers (1964-1971)

In **1969**, Dr. Ted Hoff of Intel Corporation developed a microprocessor, or micro programmable computer chip, the Intel 4004.

This was the start of commercial computers

Characteristics

- Used **integrated circuits (ICs):** *ICs* replaced the transistors of the second-generation machines.
- **Magnetic core** and **solid-state** main storage: hence greater storage capacity.
- More **flexibility with input/output** and **disk-oriented:**
- Extensive use of **high-level programming languages**: The software industry evolved during this time. Many users found that it was more cost effective to buy pre-programmed packages than to write the programs themselves. The programs from the second generation had to be rewritten since many of the programs were based on second generation architecture.
- Smaller size, more powerful and better performance and reliability: Advances in solid-state technology allowed for the design and building of smaller and faster computers.
- **Remote processing** and **time-sharing** ability through communication: Computers were then able to perform several operations at the same time. Remote terminals were developed to communicate with a central computer over a specific geographic location. Time sharing environments were established.
- Availability of **operating-system software** to control Input/Output and do tasks handled by human operators:
- **Applications** such **as airline reservation systems, market forecasting**, credit card billing: The applications also included inventory, control, and scheduling labor and materials. Multitasking was also accomplished.

The type of computers in the third generation were mainframes and minicomputers
Examples: IBM 360 series, NCR 395, ICL 1900 series, Burroughs B6500

3.13.4 Fourth Generation Computers (1971 – Present computers)

Computers in use today

Characteristics

- Uses **a general-purpose microprocessor chip** with control unit and ALU on a single chip classified **as Large Scale Integration (LSI)**
- The development of 8 bit microprocessor computers
- **Increased storage capacity** and speed.
- **Big memory and storage capacity**
- **Modular design** with complex integrated circuits classified as Large Scale Integration **(LSI)**
- Compatibility between equipment
- **Special application programs**
- **Versatility** of input/ output devices

Type of computer – mainframes, minicomputers, microprocessors microcomputers – modern day computers

Characteristics

- Use new technologies of superconductors which will greatly improve the speed of information traffic and DNA molecules which will give the computer some reasoning capabilities and improve the logical operations.
- Will be able to converse with people in a human-like manner and will be able to mimic or imitate human senses, manual skills and intelligence
- Can accept spoken word instructions and be able to reason and draw inferences and able to learn from mistakes
- Have a combinations of some or all of the following technologies:
  - extremely large scale integration
  - parallel processing
  - high speed logic and memory chips
  - high performance
  - micro-miniaturization
  - voice/data integration
  - knowledge-based platforms
  - artificial intelligence, expert systems , virtual reality generation

3.14 Embedded Systems

An embedded system is a special-purpose computer system designed to perform one or a few dedicated functions. It can be any electronic system that uses a computer chip, but that is not a general-purpose workstation, desktop or laptop computer. It can be anything that has computer logic beyond a circuit board and some chips. It is usually embedded as part of a complete device including hardware and mechanical parts. It is completely encapsulated by the device it controls.

In contrast, a general-purpose computer, such as a personal computer, can do many different tasks depending on programming or different software that are put on it to allow it to have different purposes.

3.14.1 Characteristics of embedded systems

i. Embedded systems are designed to perform single or some specific tasks, rather than be a general-purpose computer for multiple tasks. Usually not general purpose
ii. Embedded systems often use a (relatively) slow processor and small memory size to minimize costs. The slowness is not just clock speed.
iii. Programs on an embedded system often must run with real-time constraints with limited hardware resources: often there is no disk drive, keyboard or screen and little memory. A flash drive may replace rotating media, and a small keypad and LCD screen may be used instead of a PC's keyboard and screen. A liquid crystal display (LCD) is an electronically-modulated optical device shaped into a thin, flat panel made up of any number of color or monochrome pixels. It is often utilized in battery-powered electronic devices because it uses very small amounts of electric power
iv. Firmware is the name for software that is embedded in their hardware devices.
   - The software is permanently set or stored into a read-only memory (ROM) or Flash memory IC chips, in contrast to a general purpose computer that loads its programs into RAM each time.
   - The software starts running some special purpose application programs as soon as it is turned on and will not stop until it is turned off.

4 Embedded Systems often have no operating system

5 Embedded systems are not always standalone or separate devices. They are usually embedded as part of a complete device i.e. they consist of small, computerized parts within a larger device that serves a more general purpose

3.14.2 Uses of Embedded Systems

- Embedded systems span all aspects of modern life and there are many examples of their use.
- They are used in automobiles, planes, trains, space vehicles, consumer and office appliances, Traffic lights and other handheld appliances.
- Physically, embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling machine and nuclear power plants

3.14.3 Application areas and Examples of embedded systems

a) In banking systems - Automatic teller machines (ATMs)
b) In telecommunications - telephone switches for the network of phones and mobile phones on the end-user
c) In Computer networking uses - Network routers and network bridges to route data and firewalls
d) Digital watches, robots (Traffic Lights)
e) In consumer electronics include personal digital assistants (PDAs), mp3 players, mobile phones, videogame consoles, digital cameras, DVD players, video recorders,
f) Computer printers, disk drives (floppy disk drives and hard disk drives), handheld calculators
g) Home automation products, like thermostats, air conditioners, sprinklers and Alarm systems
h) In household appliances, such as microwave ovens, washing machines and dishwashers,
i) In Transportation systems. New airplanes contain advanced avionics such as inertial guidance systems and GPS receivers that also have considerable safety requirements. The Global Positioning System (GPS) is a global navigation satellite

j) In automobiles & various electric motors — brushless DC motors, induction motors and DC (direct current)
k) Automotive safety systems such as anti-lock braking system (ABS), Electronic Stability Control (ESC/ESP), and automatic four-wheel drive.
l) Medical equipment like Stethoscopes for amplifying sounds, microscopes
m) Embedded computers within petrol pumps

Power, cost and reliability are important considerations in designing embedded system

Chapter 3 Exercise

1. How would you identify a powerful computer ?
2. The specification of a typical business PC might include the following terms

   Intel 2.70 processor
   4.00 GB RAM
   500 GB hard disk storage
   15 inches SVGA colour monitor
   USB port

   Explain the meaning and purpose of these items and comment on the specifications given

3. The mouse is an innovation which makes systems easier to use. Describe how this works.
4. Discuss the various computer generations along with key characteristics of the computers of each generation. Also give examples of computers belonging to each generation

5. What are the two most common optical disks formats ? describe the basic types for each format
6. Discuss the various types of monitors and printer

7. Discuss the important features and uses of micro, mini, mainframes and super computers
8. Identify and briefly explain characteristics of minicomputer which distinguish it from the main-frame computer

CHAPTER 4

SOFTWARE

This chapter introduces the concepts of computer software and the types of computer software. The chapter covers Topic 3 of the syllabus

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CONTENTS

LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Define computer software
- State the difference between system and application software
- Define an operating system
- State the capabilities of operating system
- Explain what a spreadsheet is and its characteristics
- Describe the generations of programming languages.

4.1. DEFINITION OF COMPUTER SOFTWARE

Software is a generic term for organized collections of computer data and instructions, often broken into two major categories: system software that provides the basic non-task-specific functions of the computer, and application software which is used by users to accomplish specific tasks.

A software program is a series of statements or instructions to the computer. Computers function by obeying these series of instructions (the program). The program instructions are held in the main memory and passed one by one into the control unit, where they are decoded so that the control unit can set up the circuits appropriately.

4.2 Types of software

For computer hardware to play a useful role it requires computer software. Computer software is divided into two main types, system and application software. These types of software are interrelated, each of which must interact closely with the other. The system software surrounds and controls access to the hardware. Application software must work through the systems software in order for it to be able to operate. Computer users work primarily with application software.

Below is a diagram that shows the relationship between the user, software and hardware.

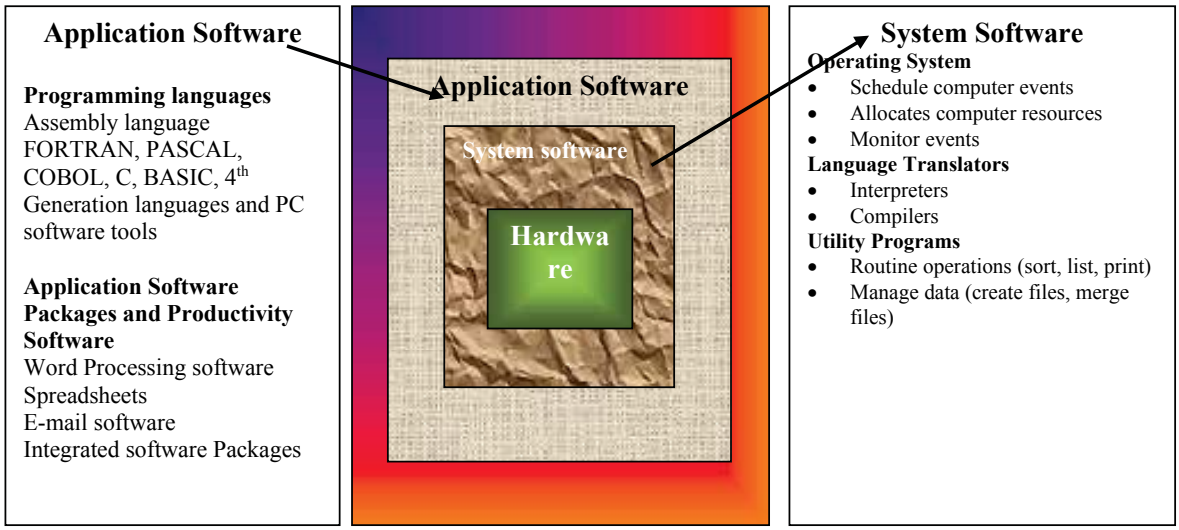


Fig 4.1: relationship between the user, software and hardware

4.2.1. System Software

These are software programs which control and manage the operation and performance of the computer itself. These programs manage computers resources like the central processor, communication links and peripheral devices.

Types of system software

- Operating system
- Utility programs

4.2.1.1 Operating system

This is system software that bridges the gap between application software and hardware via the human computer interface.

Operating system takes control of the internal organization.

The functions of operating system:

- Schedule the use of computer resources and computer jobs and monitors computer system activities
- It provides locations in primary memory for data and programs and controls the input and output devices e.g. printers, terminals and telecommunication links
- Operating system also coordinates the scheduling of work in various area of the computer so that different parts of different jobs can be worked on the same time.
- It also keeps track of each computer job and may also keep track of who is using the system, what programs have been run and keeps track of unauthorized attempts into the computer system (security)

4.2.1.1.1 Capabilities of operating systems

Multiprogramming
Multiple programs can share computer resources at any time through concurrent use of the CPU.

Virtual storage
It handles programs more efficiently by breaking down the program into tiny sections that are read into Memory only when needed. The rest of each program is stored on disk unit until it is required
This allows very large number of programs to be executed concurrently by a single machine.

Time sharing
This allows many users to share computer processing resources simultaneously by allocating each a tiny slice of computer time to perform computer tasks and processing from user to user.
This arrangement permits many users to be connected to a CPU simultaneously, with each receiving only a tiny amount of CPU time.

Multiprocessing
This links two or more processors (CPUs) to work parallel in a single computer system.
The operating system can assign multiple CPUs to execute different instructions from the same program or from different programs simultaneously, dividing the work between CPUs.

Examples of operating systems:

- Windows
- Linux
- Unix

4.2.1.2. Language translators

Language translators interpret high level language programs written in programming languages into machine language that the computer can execute.

A program in a high level language before translation into a machine language is called ***source code.***
A ***compiler*** translates source code into machine code called ***object code.*** A compiler accepts a source code written in a high level language and converts it to a particular machine code. A compiler converts the whole source program into machine code before the program is executed. An ***interpreter*** translates also converts a program written in a high level language to machine code but does this by converting one source code statement at a time and executes it.

4.2.1.3 Utility software

Utility software is system software designed to help in analyzing, configuring, optimizing or maintaing a computer.

Utility software usually focuses on how the computer infrastructure (including the computer hardware, operating system, application software and data storage) operates.

Examples of utility software:

- Copying
- Sorting
- Deleting
- Tracking

4.2.2. Application Software

Applications software is the name given to software that aids users to perform specific tasks on the computer.

As there are so many things users would want to do with the aid of the computer, it is possible to classify applications software as being *off-the-shelf packages* or *bespoke software*, depending on *whom* the software has primarily been developed for.

Applications software can be obtained in a variety of ways and pricing structures. Most software is bought but some software can be obtained free. Software which is bought is usually copyrighted and protected by law from illegal copying (*software piracy*).

When software is acquired it needs to be installed in your computer before you can start using it. Most software comes on CD-ROMs.

Examples of application software include:

- Word processors e.g. Microsoft word
- Spreadsheets e.g. Microsoft excel
- Presentation software e.g. Microsoft PowerPoint, open office impress
- Database management software e.g. Microsoft access
- Web browser e.g. Mozilla Firefox, Microsoft Internet Explorer, Chrome
- Computer games

Off-the-shelf packages

Off-the-shelf packages are ready made software products. Their use shortens the system development process, as they are readily available for use. More specifically they offer many advantages.

Advantages including:

- They are readily available
- They are well documented (i.e., among other things, the installation and user manuals are clear, concise and complete).
- They are of high quality (since they are produced by experts)
- They are more reliable (many people and organizations will have used them before you)
- They are relatively cheap (the cost of production is shared among many users)
- They are regularly updated and upgraded (updating refers to correcting errors in the software package and upgrading refers to releasing new versions of the software package. Normally new versions are sold at a discount to bona fide customers of earlier versions)
- They can be customized. (To customize software means to adapt it to suit the needs of a particular organization or individual).

Limitations / Disadvantages of using an off-the-shelf package

Off-the-shelf packages have some problems associated with their use, including the following:

- As earlier on pointed out, the user requirements would need to be modified. This implies that the system '*will **not meet** all the user requirements'*
- User dependence on supplier for maintenance.
- May not provide a competitive advantage since your competitors could be using the same package.

Specific purpose software package Vs General-purpose software packages

Off-the-shelf packages can be classified as being a specific purpose software package or a general-purpose software package.

Specific purpose software packages

With a specific purpose package, such as a payroll system or an accounting package, the user has very little control over the process since the package is written to perform a prescribed set of

tasks. The user will typically just enter data via the keyboard or the mouse, probably selecting from a set of menus, and the software would subsequently perform a lot of related processes.
With a payroll software package, for example, the user enters the employee details and the number of hours worked, etc. The package then calculates the tax and other deductions and the net wage, and prints the employee's pay slip.

General-purpose software packages

General purpose programs are those which perform particular types of common information processing activity. A spreadsheet package such as Ms Excel is designed to help users perform calculation-oriented tasks. One user of Microsoft Excel will use it for a *budget control system* while another will use it for *stock control purposes* and yet another user can use it for a *payroll system.*

The following table summarizes some common categories of general-purpose software packages, their examples and uses:

Class of package	**Example(s)**	**Application / Uses**
Spreadsheet Packages	Ms Excel, Lotus 1-2-3	For calculation-oriented tasks. Applications include stock control, sales forecasting and cash flow analysis
Word Processors	Ms Word, WordPerfect	For drafting & redrafting documents. Writing letters, memos, poems, novels, etc
Graphics Packages	CorelDraw	For creating pictorial information
Database Management Systems	dBase, Ms Access	For organising and storing data at one central place such that it is easy to manage.
Presentation Graphics Packages	Ms PowerPoint	For presentations
Desktop Publishing Packages	Adobe PageMaker, Ms Publisher	For typesetting and composition systems. Designing publications such as Newsletters, Invitation
Project Management Software	Ms Project	As a project planning, monitoring and control aid.
Web Browsers	Ms Internet Explorer, Mozilla Firefox	For surfing the Internet

The following is a brief description of the facilities in some of the commonly used packages above:

4.2.2.1 Word Processors

When used for producing documents, word processors offer the following facilities and advantages:

- Capability to store a document on backing storage.
- Capability to type a document once and print as many times as desired. With an ordinary typewriter to produce multiple 'original copies' you have to retype many times.
- WYSIWYG facility. (**W**hat **Y**ou **S**ee **I**s **W**hat **Y**ou **G**et – a facility that enables users to view a document on screen in exactly the same format as its printed copy
- Formatting (changing the appearance of text). This allows users to change the appearance of text as desired. Text can be made to be **bold**, in *italics*, **underlined**, big or small, among many other formatting options. With a typewriter such formatting options are not there.
- Editing facility - you can easily, erase, copy , move or insert text on screen, with a great deal of tidiness
- Spell Checking Facility - allowing users to check their documents for spelling and some grammatical mistakes. You can't do this with a typewriter

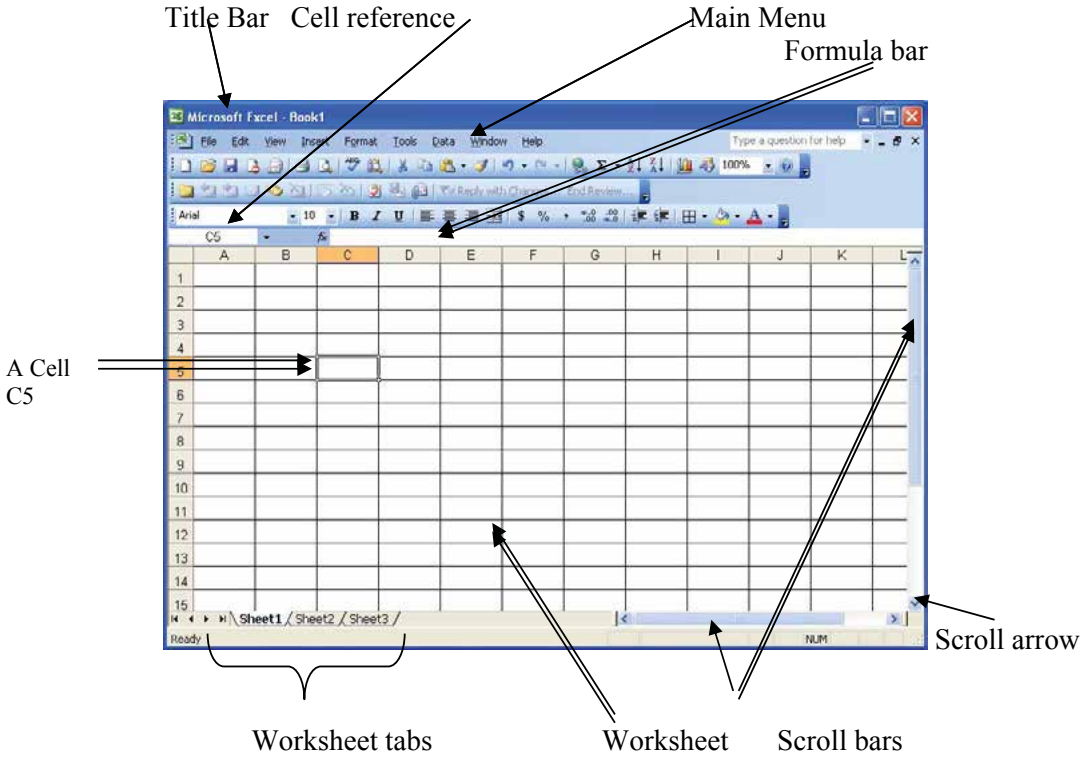
4.2.2.2 Spreadsheets

A spreadsheet is a general-purpose package which consists of rows and columns as the interface. The intersections between rows and columns are called ***cells***. Spreadsheets enable the arithmetical and statistical analysis of data.

Areas of application of spreadsheets include the following:

- Budgeting
- Sales Analysis
- Cash flow forecasts
- Payroll
- Stock Control
- "What if" analysis for decision making
- Statistical Analysis

Below is an example structure of a spreadsheet



All information is recorded in cells. Each cell is identified by its ***cell address*** for example D2 (also called ***cell reference***) A cell can contain *textual* information or *numerical* information. Numerical information can be a *figure* or a *formula* (freely declared by the user or an *in-built* formula, called ***afunction***). The formulae allow models to be built and what- if analysis to be performed

One of the powerful facilities of a typical spreadsheet package is copying of formulae. Once a formula in one cell is entered, it can be copied very easily by using, for example in Ms Excel, the *fill handle* – you drag it along a column or across a row as is appropriate.

When copying the formula, will normally change (relative to the cells being copied to) because some of the cell references are **relative.** Cell references can be made to remain unchanged if, when in a formula, they are copied to another part of the spreadsheet. This can be done by making them ***absolute cell references.*** The following are illustrations of relative and absolute cell references as used in Ms Excel:

Cell Reference Example	Type	Effect when copied
A3	Relative	Both row and column change
$A3	Partly Absolute / Partly Relative	Column remains constant, row changes
A$3	Partly Absolute / Partly Relative	Column changes, row remains constant
A3	Absolute	Both row and column remain constant

Characteristics of a typical spreadsheet package include:

- Capability to store a spreadsheet file on backing storage.
- Printing spreadsheet data
- User friendliness
- Easy installation
- High speed
- Rearranging the spreadsheet (*inserting/ deleting rows/columns)*
- Formatting spreadsheet data
- Automatic recalculation of formulae once the data in the cell contained in the formulae are changed
- Representing spreadsheet data graphically
- Database facilities (Sorting and Filtering[1])
- Macro facility (*enables users to automate a sequence of tasks*

4.3 Choosing an appropriate package

When faced with the task of computerizing some system, assuming you have decided to use an off-the-shelf package, it can be quite tricky deciding which one, among many alternative 'suitable' packages.

The following are some factors which are worth considering when choosing a package:

The user requirements

This is the most important factor. It would be senseless to buy software that does not meet the user requirements. However it is very difficult to find a package that can meet all the user requirements - the package may need to be customized or, alternatively and more commonly, the user requirements are modified to match the 'best fitting' package.

Documentation

A good package is one that is well documented – it must have a very clear and concise user manual and a comprehensive and clear '*on-screen'* help.

[1] Filtering enables users to view only those records that meet certain criteria

User friendliness
A good package is one that is easy to use. It should allow users without much computer expertise to operate. Such a package is likely to be:

- one with an 'on-screen help',
- one with user interface design consistency in different modules,
- one that can allow experienced users to operate more quickly by using shortcuts,
- one that provides an easy way of abandoning an operation without causing the system to crash
- one which makes data entry easy (provision of default entries and by having a logical sequence of data fields on the entry screen, for example, makes data entry easy)

Other Users
It is very important to find out how many other users are there to use the package as their number can be an indication of how good the package is.

Support and Maintenance
Will the support be there? If so, for how long and in what manner?

Upgrades and Updates
Shall new versions be sold to you at a discount? What are the conditions for software updates?

Portability

Ability of the software to run on different computers.

4.4 Bespoke Software

Bespoke software is software that is specially developed for an organization or a user to meet their specific needs.

Advantages of Bespoke Software.
Bespoke software's advantages over off-the-shelf software include:

- Ability **to meet all the user requirements**
- Can offer a competitive advantage to the organization.
- The **product can be sold** to other similar organizations and act as a source of revenue for the organization.
- If the software product is developed 'in-house' by the organization's IT department, it **will give its staff some experience** in developing computer-based systems.

Disadvantages of Bespoke Software and Implications

- Developing bespoke software may be time consuming and subsequently delays the commissioning of the package
- Developing bespoke software is relatively expensive. For this reason in most cases only big organizations can justify their use.

- The software could be of poor quality. To develop software of good quality, you may need to have it developed by experts; this cannot be guaranteed if the software is being developed in-house.

4.5. Licensing Agreements

Introduction

Some software, as explained earlier, can be obtained free. However, most software has to be bought. Laws exist to protect the '*intellectual property*' relating to software because the author (owner) of the software needs to benefit monetarily from his work.

Commercial-oriented License Agreements.

Probably the most common way of acquiring software is to buy from software houses and corporations such as Microsoft and Lotus. Associated with such copyrighted products, are strictly enforced licenses. The following are some of the options:

Single Licence

A single copy of the program is purchased on CD-ROMs or floppies together with manuals. The copy should be installed on one machine only. Any other installation on a different machine requires buying another copy (another complete package) from the supplier.

Site Licence

You buy a package and are given permission to install it on a very specific number of machines (e.g. 15 machines) in a single site. There is one or two copies of the user manual. To install on more machines than the licensed number, you pay an extra fee.

License by Use

You buy a package and are allowed to have a specific number of simultaneous users, e.g. 15. You can install the software on any number of machines, e.g. 120 as long as there is a maximum of 15 simultaneous users of the package at any one time.

Licence by Station

You buy the software and are allowed to install on a fixed number of machines. A 15-user license means you can only install on 15 machines.

Network Multi-License

Typical in a networked environment, software is stored centrally in the file server so that potentially it can be used simultaneously by multiple users. However, having a network does not necessarily mean that the program installed in the file server is always usable simultaneously – most programs would not be. In most cases you need to buy a network version of the program.

If a 20-user network version is bought, then only up to 20 operators in a network can use the package simultaneously. You need to pay for any increase in the number of simultaneous users.

Typical Nature of a Software License

Licenses can allow users to make a back up copy of the installation disk(s). Some can allow the purchaser to install the program on a machine and sell the program provided no copies are kept.

Licenses normally would prohibit the following:

- Renting the program
- Leasing the program
- Making additions/alterations to the program
- Copying the copyrighted software without permission from the copyright owner.
- Copying the software's manuals without permission from the copyright owner.
- Distributing the copyrighted software permission from the copyright owner.
- Distributing the software's manuals and notes without permission from the copyright owner

When you have the software license, you may be entitled to a number of after-sales services such as user support and some '*warranty'*. However, licenses will usually limit the manufacturer's liability for any problems caused by the use of the software.

4.6 Non-commercial oriented Software Products

4.6.1 Public Domain (PD)

Most public domain software products are obtained by downloading from the Internet. Such programs are not copyrighted by their authors and can be distributed and used free of charge. The code can be altered. Usually these are small programs and utilities.

4.6.2 Freeware

This is very similar to PD except that alteration of the code is not allowed. You can just copy and use the code – the Author retains the copyright over the program and its code.

4.6.3 Shareware

These are usually packages such as word processor or a spreadsheet which a user can obtain from the Internet free of charge and use for a specified period of time to try out the suitability and effectiveness of the program. Should the user like the program he pays the quoted price to purchase it. The payment will usually earn the user a user manual of some kind and associated after-sales services associated with a software license.

If the user is not satisfied with the program, he must stop using it after the prescribed number of days.

4.7. Software Piracy

If you copy software to avoid paying the license you are guilty of software piracy. If you copy software manuals and programs notes without permission from the copyright owner, you are also

guilty of software piracy. If you distribute software or its manuals without permission from the copyright owner, you are guilty of software piracy.

Software piracy is not only a moral and legal issue, but also an IT security issue. Pirated software is a common source of viruses. It is important to make sure unlawful copying of software or bringing unlicensed software into the workplace is prevented. Employees must be educated in this issue and those found in the wrong must be punished accordingly.

4.8 Evolution of programming languages

Application software is primarily concerned with accomplishing the tasks of end users. Programming languages and software tools can be used to develop application software. Programming language also called computer language is used by programmers to pass instructions and communicate with the computer, computer language is used when programmers are writing programs on the computer.

Programming languages are categorized into low level and high level languages.

Low level or machine level languages

A low level language is a computer language that is in machine code or assembly code, a low level language is usually in pure binary form, these languages are mainly hardware oriented. Low level languages are closely related to a computer's internal codes. It consists chiefly of a set of letters (mnemonics) which are translated by a program called assembler into machine code

- **First generation programming languages 1GL**

1GL is machine language or the level of instructions and data that the processor is given to work on (which in conventional computers is a string of 0s and 1s).Here a program is usually written in a symbolic language which is then translated into binary by the computers operating system. Programming using machine language was a very slow and labour intensive process.

- **Second generation programming languages 2GL**

This is assembler sometimes called assembly language. An assembler is a special program written in machine language used to translate – convert symbolic language instructions (source program) into machine language instructions (object program). The resulting program can only be executed when the assembly process is completed. The assembler also detects syntax errors in the source program so that these can be corrected before the program is tested.

High level languages

These languages were developed in order to ease the work of programmers by making the programming language more procedure oriented. Statements of a high level source program are closer to natural English or other natural languages.

High level languages are also problem oriented, they are developed to solve different types of application problems.

A high level source program is translated i.e. converted into object program by means of a *compiler* or *interpreter*.

- **Third generation programming languages 3GLs**

These are problem oriented languages, these are languages designed to handle a particular class of problem. Translation is done using compilers or interpreters, third generation languages are structured programming languages e.g.

- COBOL (Common Business Oriented Language)
- BASIC (Beginners All Purpose Symbolic Instruction Code)
- FORTRAN(Formula Translation)
- Pascal, named after a French mathematician
- PL/1 (Programming Language 1)

- **Fourth generation programming languages 4GLs**

This generation is higher than 3GLs
It has programming languages that can be employed directly by end users or less skilled programmers to develop computer applications more rapidly than conventional programming languages.

These are non- procedural, they need one only to specify what has to be accomplished rather than provide details about how to carry out the task.

4GLs are slow in processing the job at hand, they need powerful processors. 4GLs are usually programmed interactively- meaning that programming errors are detected at an early stage. An example of 4GLs is SQL for databases.

Fourth generation programming languages encourage **end user computing**- this is where end users come up with their own systems using programming languages (**See chapter 15 section 2)**

- **Fifth generation programming language 5GLs**

These programming languages use a visual or graphical development interface to create source programs. These languages are usually used for artificial intelligence.

Visual programming allows you to drag icons to assemble program components.

4.9 PRACTICAL USAGA OF COMPUTER PACKAGES

Windows is popular and widely used operating system. An operating system is a computer program that coordinates all the activities of computer hardware such as memory, storage devices and printers, and provides the capability for users to communicate with a computer.

Windows operating systems simplifies the process of working with documents and programs by organising the manner in which the user interact with the computer. Windows is used to run application software.

Using a Mouse
Windows users work with a mouse that has at least two buttons. For a right-handed user, the left button usually is the primary mouse button and the right mouse button is the secondary mouse button. Left-handed people, however, can reverse the function of these buttons.

Table 1 explains how to perform a variety of mouse operations. Some programs also use keys in combination with the mouse to perform certain actions. The function of the mouse buttons and wheel varies depending on the program

Operation	**Mouse Action**
Point	Move the mouse until the pointer on the desktop is positioned on the item of choice.
Click	Press and release the primary mouse button, which is usually the left mouse button.
Right-click	Press and release the secondary mouse button, which usually is the right mouse button.
Double-click	Quickly press and release the left mouse button twice times without moving the mouse e.g start a program.
Triple-click	Quickly press and release the left mouse button three times without moving the mouse e.g select a paragraph.
Drag	Point to an item , hold down the left mouse button , move the item to desired location on the screen, and release the left mouse button e.g. move an object from one location to another.

Starting Windows
It is not unusual for multiple people to use the same computer in work, educational, recreational, or home setting. Windows enables each user to establish a user account, which identifies to windows 7 the resources such as program, and storage locations, a user can access when working with a computer.

Each user account has user name and may have a password and an icon, as well. A User name is a unique combination of letters or numbers that identifies a specific user to windows. A password is a private combination of letters, numbers, and special characters associated with a user name that allows access to user's account resources. A user icon is a picture associated with a user name.

When you turn on your computer, an introductory screen consisting of the windows logo and copyright messages is displayed. When windows logo appears, depending on your computer settings you may or may not be required to log on to the computer. Logging on to a computer opens your user account and makes the computer available for use.

Introduction to Microsoft Office

Microsoft Office package offers features that provide users with a better functionality and easier ways to work various files they create. Microsoft Office includes a wide variety of programs such as PowerPoint, Excel, Access, Outlook and Publisher etc

- Microsoft Word or Word , is a full-featured word processing program that allows you to create professional-looking documents and revise them easily
- Microsoft PowerPoint or PowerPoint is a complete presentation program that allows you to produce professional-looking presentation
- Microsoft Excel or Excel is a powerful spreadsheet program that allows you to organize data, complete calculations , make decisions, graph data, develop professional looking reports etc
- Microsoft Access or Access is a database management system that allows you to create a database, add, change, and delete data in the database, ask questions about data in the database and create forms and reports using data in the database
- Microsoft Outlook or Outlook is a communications and scheduling program that allows you to manage e-mail accounts, calendars, contacts and access to other internet content

Word

Word is a full-featured word processing program that allows you to create many types of personal and business documents, including letters, memos, resumes, reports, newsletters etc. Word has many features designed to simplify the production of documents. With word you can easily change the shape, size and colour of text.

To Start a Program using the Start Menu

Across the bottom of windows desktop is taskbar. The taskbar contains start button which you use to access programs, files, folders and setting on the computer. A Folder is a named location on a storage medium that contains related documents. The taskbar also displays a button for each program currently running.

Clicking the Start button displays the start menu. The Start menu allows you to access programs, folders and files on the computer and contains commands that allows you to start programs, store and search for documents, customize the computer and obtain help about topics. A menu is a list of related items and each command on a menu performs a specific action, such as saving a file, or obtaining help.

The following are steps to start word program

Figure 1

1)Click the start button on windows to display the start menu (Figure 1)

2) Click All programs at the bottom on the left pane on the start menu to display all program list (Figure 2) A pane is an area of a window that displays related content.
3) Scroll to and then click on the folder (Microsoft Office) Figure 3
4)Scroll to and then click on Microsoft Word (Figure 3)


Games
GuestMaster V16.0
HP
HP Help and Support
Inno Setup 5
Intel
IrfanView
Kaspersky Endpoint Security 10 for Wins
Maintenance
Microsoft Office
Microsoft Press Training Kit Exam Prep
Microsoft SQL Server 2008
Music, Photos and Videos
Nero 7 Premium
PESEdit.com 2014 Patch
Productivity and Tools
QuickBooks
R.G. Catalyst
Security and Protection
Spec Ops Line
Back
Search programs and files
Kaunda
Documents
Pictures
Music
Recent Items
Computer
Control Panel
Devices and Printers
Default Programs
Help and Support
Shut down
10:07 AM
2015/05/11

Figure 2


Games
GuestMaster V16.0
HP
HP Help and Support
Inno Setup 5
Intel
IrfanView
Maintenance
Microsoft Office
Microsoft Office Access 2007
Microsoft Office Excel 2007
Microsoft Office Groove 2007
Microsoft Office InfoPath 2007
Microsoft Office OneNote 2007
Microsoft Office Outlook 2007
Microsoft Office PowerPoint 2007
Microsoft Office Publisher 2007
Microsoft Office Word 2007
Microsoft Office Tools
Back
Search programs and files
Kaunda
Documents
Pictures
Music
Recent Items
Computer
Control Panel
Devices and Printers
Default Programs
Help and Support
Shut down
TeamViewer...
10:14 AM
2015/05/11

Figure 3

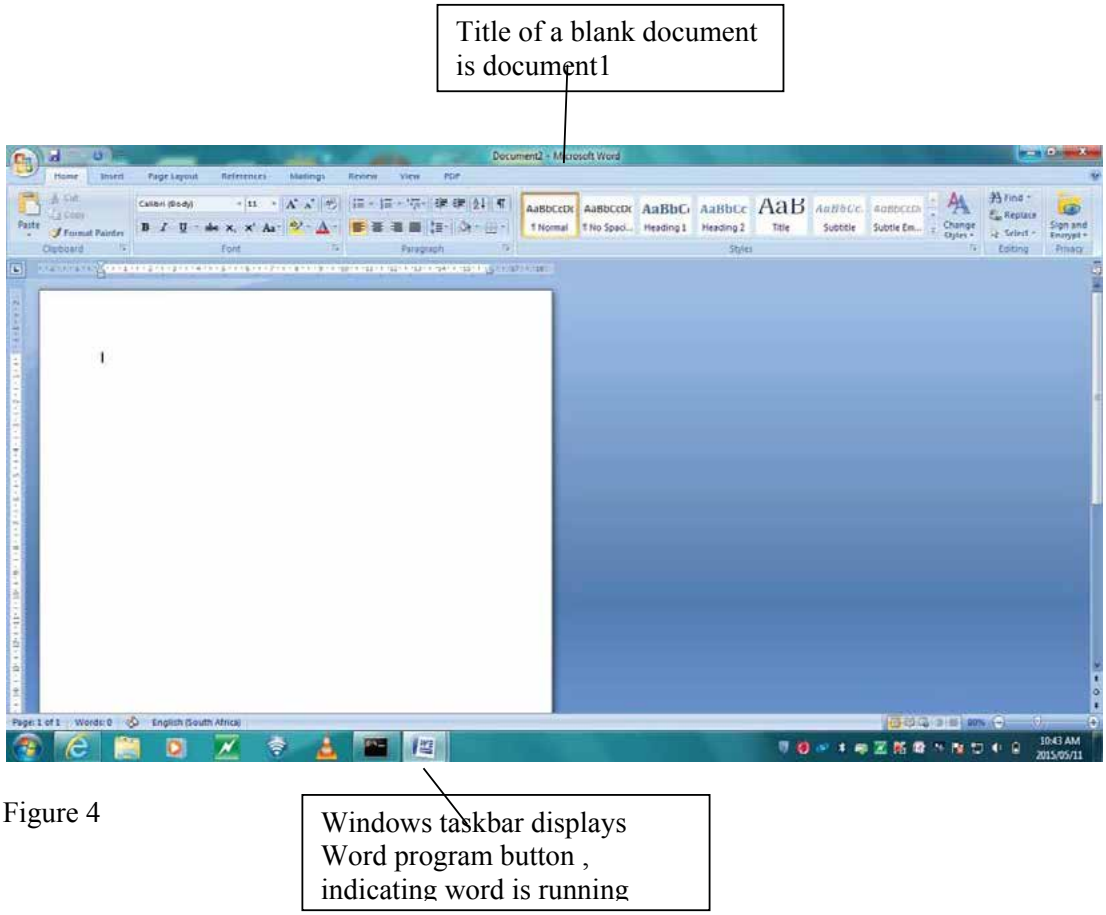
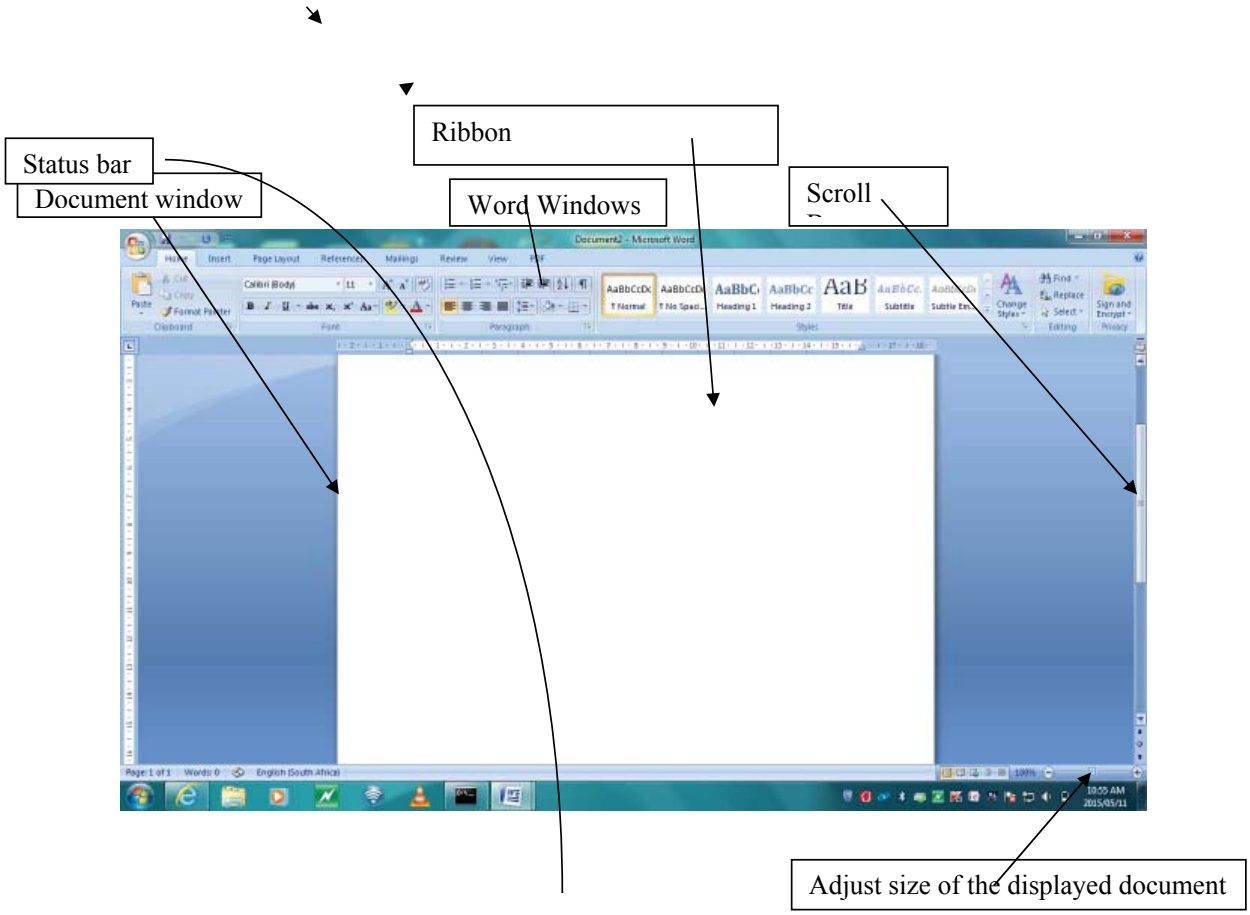


Figure 4

THE WORD DOCUMENT WINDOW, RIBBON AND ELEMENTS COMMON TO OFFICE PROGRAMS

The word window consists of a variety of components to make your work more efficient and documents more professional. These include document window, ribbon, mini tool bar ,short cut menus and quick access toolbar. Most of these components are common to other Microsoft office programs; others are unique to word.

Scroll Bars you use a scroll bar to display different portions of a document in the document window. At the right edge of document window is vertical scroll bar. If the document is too wide to fit in the document window, a horizontal scroll bar also appears at the bottom of the document window. On the scroll bar, the position of the scroll bar box reflects the location of the portion of the document that is displayed in the document window.



Status Bar is located at the bottom of the document window above the windows taskbar, presents information about the document, the progress of the current task and the status of certain commands and keys , it also provides controls for viewing the document. As you type text or perform certain tasks, various indicators and buttons may appear on the status bar.

The left side of the status bar shows the current page followed by the total number of pages in the document, the number of words in the document and an icon to check spelling and grammar. The right side of the status bar includes buttons and controls you can use to change the view of a document and adjust the displayed document.

Ribbon The ribbon , located near the top of the window below the title bar, is the control centre in word and other office programs. The ribbon consists of tabs, groups, and commands. Each tab contains a collection of groups, and each group contains related functions. All office programs have a home tab which contains most frequently used commands

MINI TOOLBAR

The mini toolbar which appears automatically based on the tasks you perform, contains commands related to changing the appearance of text in a document. All commands on the mini toolbar also exists on the ribbon. The purpose of mini tool bar is to minimize mouse movement.

To Display a Different Tab on the Ribbon

When you start word, the ribbon displays main tabs: File, Home, Insert, Page Layout, References, Mailing ,Review and View. The tab currently displayed is called active tab

1) Click insert on the ribbon to display the inset tab

To Enter Text in a Document

The first step in creating a document is to enter text by typing on the keyboard. By default word positions text at the left margin as you type. The following steps type this line of text, a headline, in a document

1)type Rewarding Career as text in figure 26

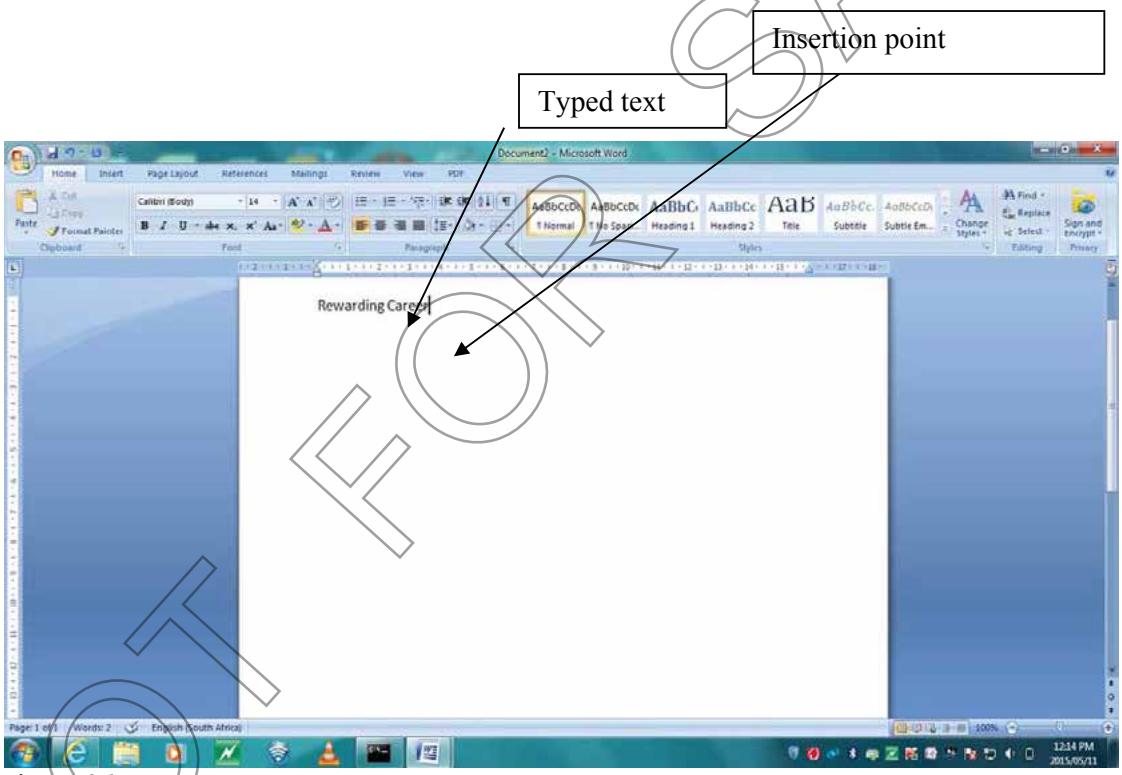


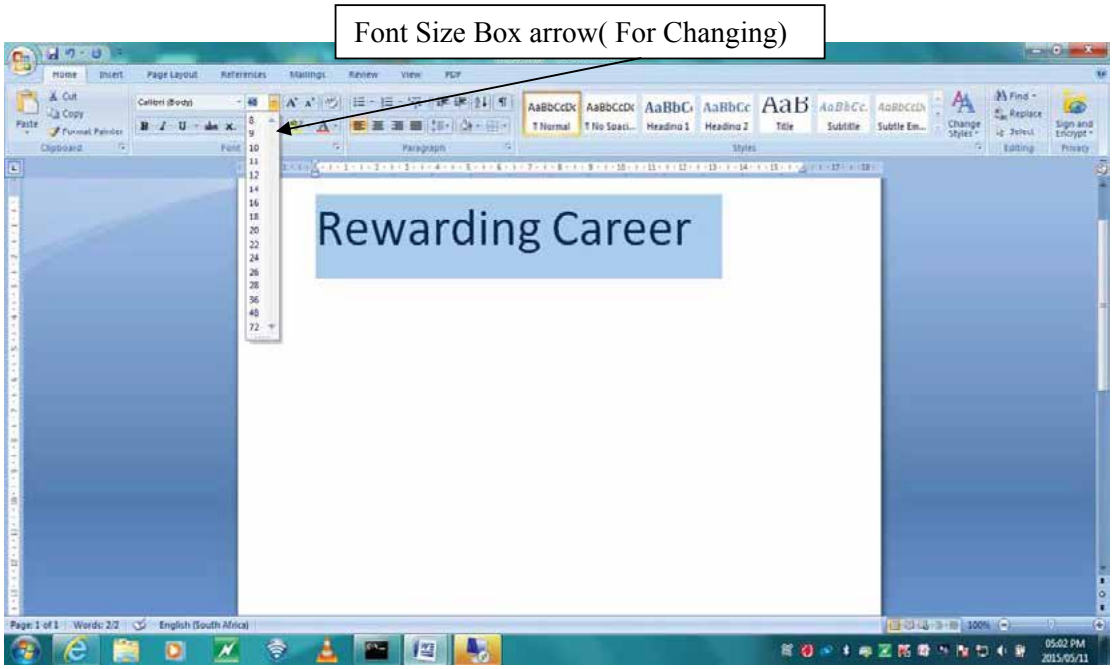
Figure 26

After the insertion point press [enter] key and type the following passage

Wordwrap
Wordwrap allows you to type words in a paragraph continually without pressing the ENTER key at the end of each line. As you type , if a word extends beyond the right margin extends beyond the right margin. Word also automatically positions that word on the next line with the insertion point.

Word automatically creates a new paragraph each time you press the ENTER key.

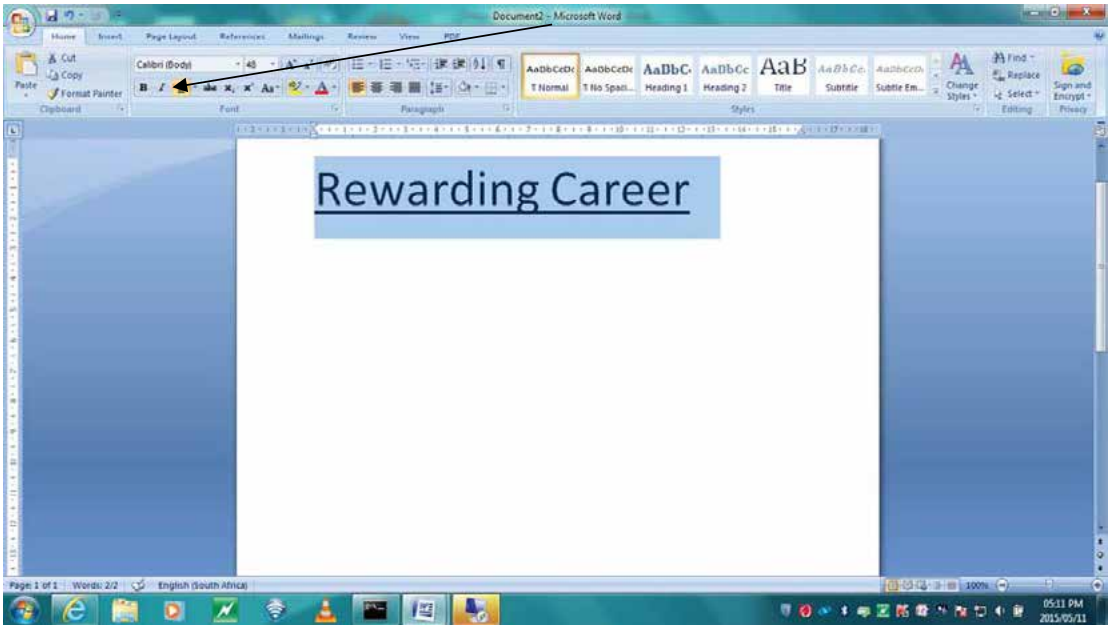
To Change the font size of selected text
If you would like the headline to be large as possible the following steps increase the font size



To Underline Text
Underlines are used to emphasize or draw attention to a specific text

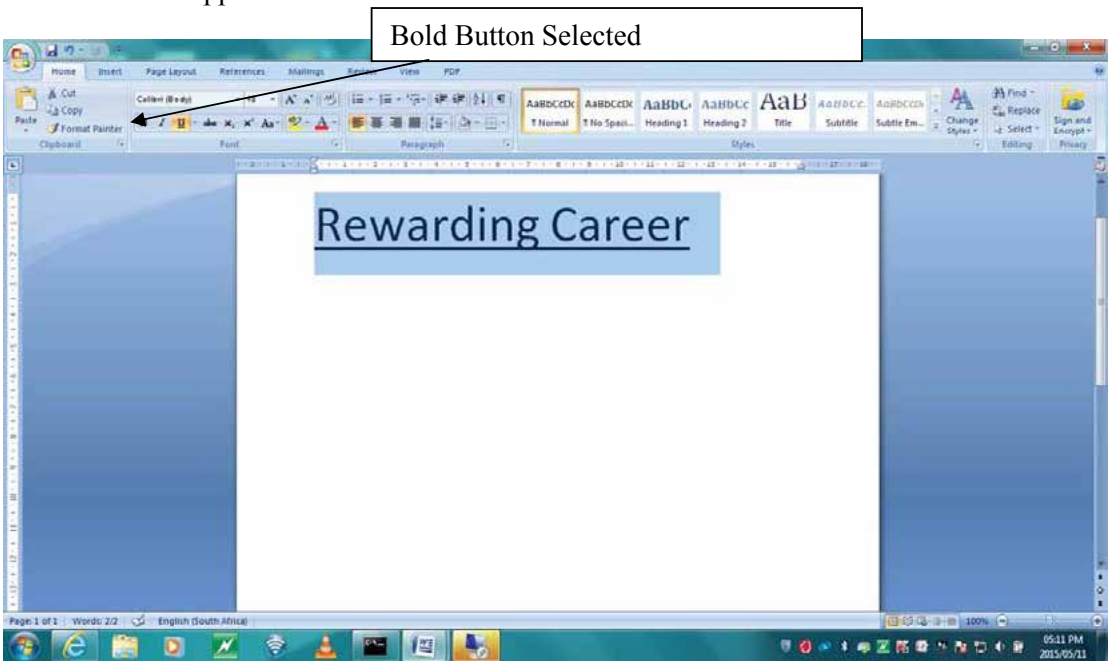
You will select the text and press underline button

Underline Button



To Bold Text

Bold characters appear somewhat thicker and darker than those that are not bold.



To Print a Document
Click on file ribbon,
Click on Print Tab , select printer and select ok to print

To Save Document

Click on file ribbon
Click on file tab, select save

To Start Excel
Excel is a powerful spreadsheet program that allows users to organize data, complete calculations, make decisions, graph data, develop professional looking reports.
Workbooks and Worksheets : A workbook is like notebook, inside the workbook are sheets, each of which is called a worksheet.

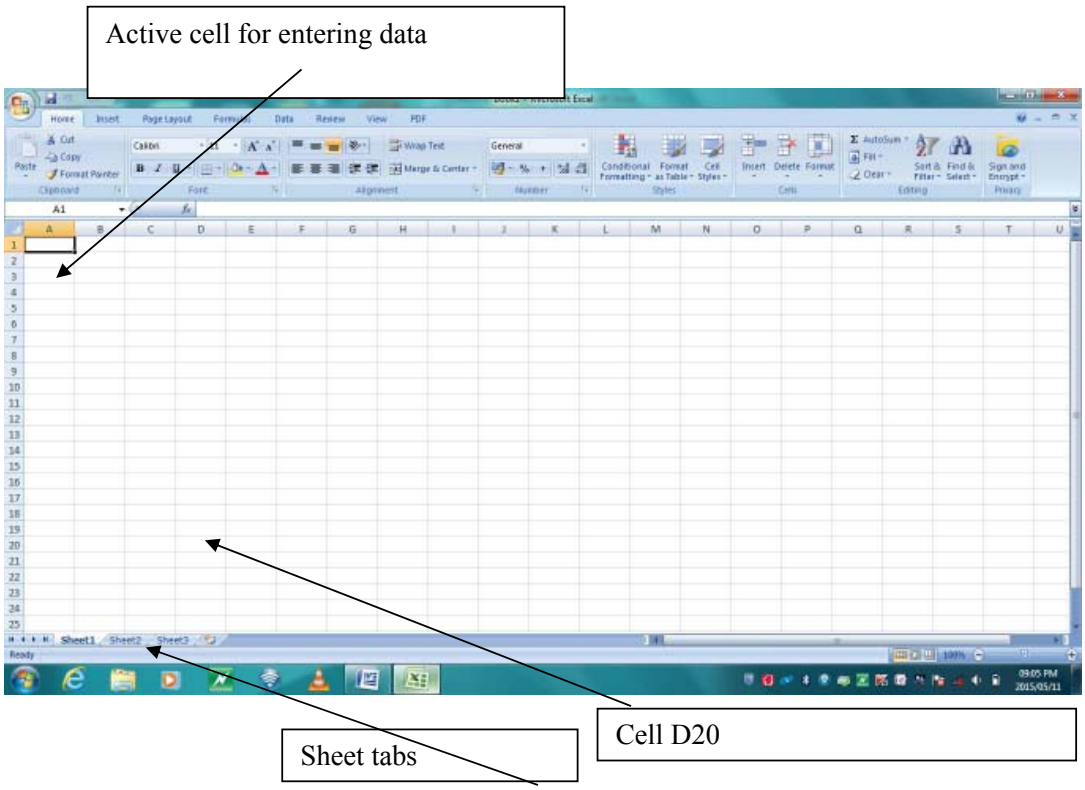
1) Click the start button on windows taskbar to display the start menu
2) Click Program
3) Click on Microsoft Program
4) Click on Excel

Unique Features of Excel
The Excel window consists of a variety of components to make your work more efficient and worksheets more professional. These include the document window, ribbon, mini toolbar and shortcut menus.
Excel opens a new workbook with three worksheets. If necessary you can add additional worksheets as long as your computer has enough memory to accommodate them.
Each worksheet has a sheet name that appears on a sheet tab at the bottom of the workbook. For example, sheet1 is the name of the active worksheet.

The worksheet is organized into rectangular grid containing vertical columns and horizontal rows. A column letter above the grid also called column heading, identifies each column. A row number on the left side of the grid is also called row heading, identifies each row.
The intersection of each column and row is a cell. A cell is the basic unit of a worksheet into which you enter data.

A cell is referred to by its unique address or cell reference which is the coordinates of the intersection of a column and a row. To identify a cell, specify the column letter first followed by row number.
An active cell is the one into which you can enter data.

Ribbon when you start excel, the ribbon displays eight main tabs: file, home, insert, page layout, formulas, data, review and view. The formula and data are specific to excel. The formula tab allows you to work with excel formulas and the data tab allows you to work with data processing features such importing and sorting of data.



Please enter a worksheet for trading company called Cell trading in cell d1

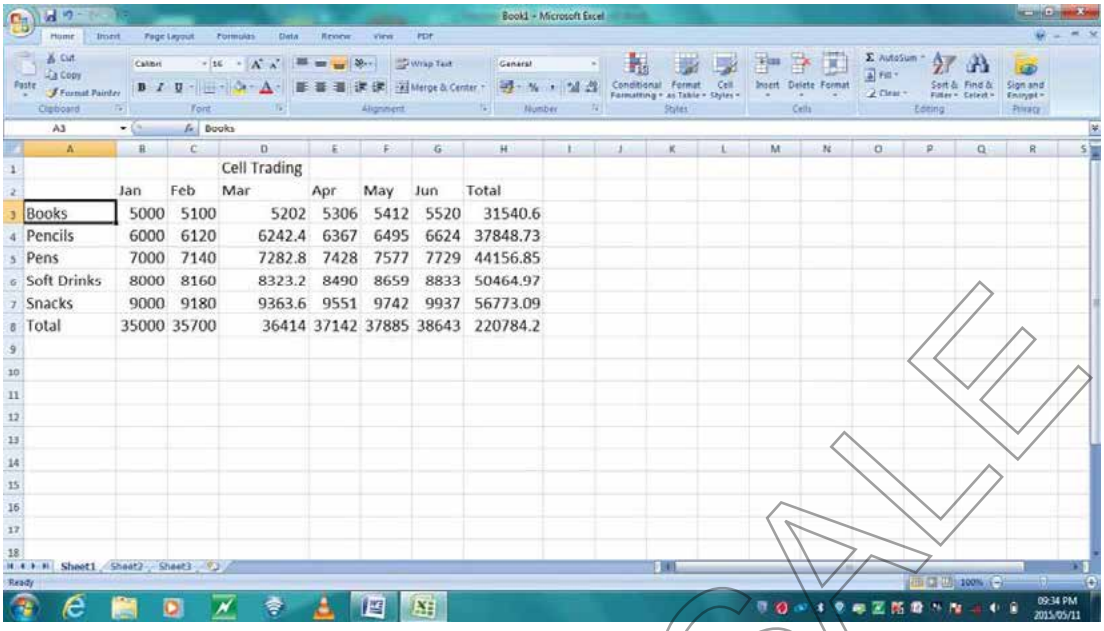
The company is trading in five products namely books, pencils, pens, soft drinks and snacks first month the income is 5,000, 6,000 ,7,000, 8,000 and 9,000 respectively and it is increasing at 2 percentage per month.

The data is entered as on the sheet below the formula for the month of jan is in cell b8 +b3+b4+b5+b6+b7

Please similarly insert the formula for the months of feb to jun.

The total for books is cell h3 can be calculated using a formula as follows in cell h3 put in the following formula =sum(b3:g3)

Please enter similar formula for the rest of the products.



To Print a Document
Click on file ribbon,
Click on Print Tab , select printer and select ok to print

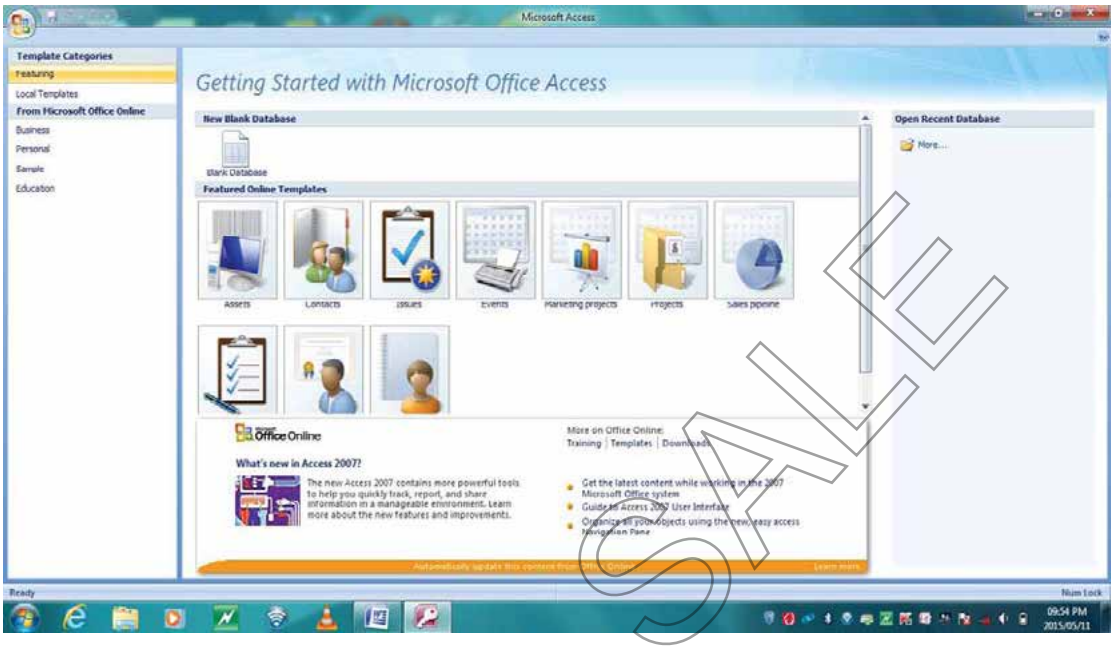
To Save Document

Click on file ribbon
Click on file tab, select save

Access
The term database describes a collection of data organized in a manner that allows access, retrieval and use of data. Access is a database management system that allows you to create a database, add, change and delete data in the database, create queries that allows you to ask questions concerning the data in the database and create forms and reports in the database.

To start a program

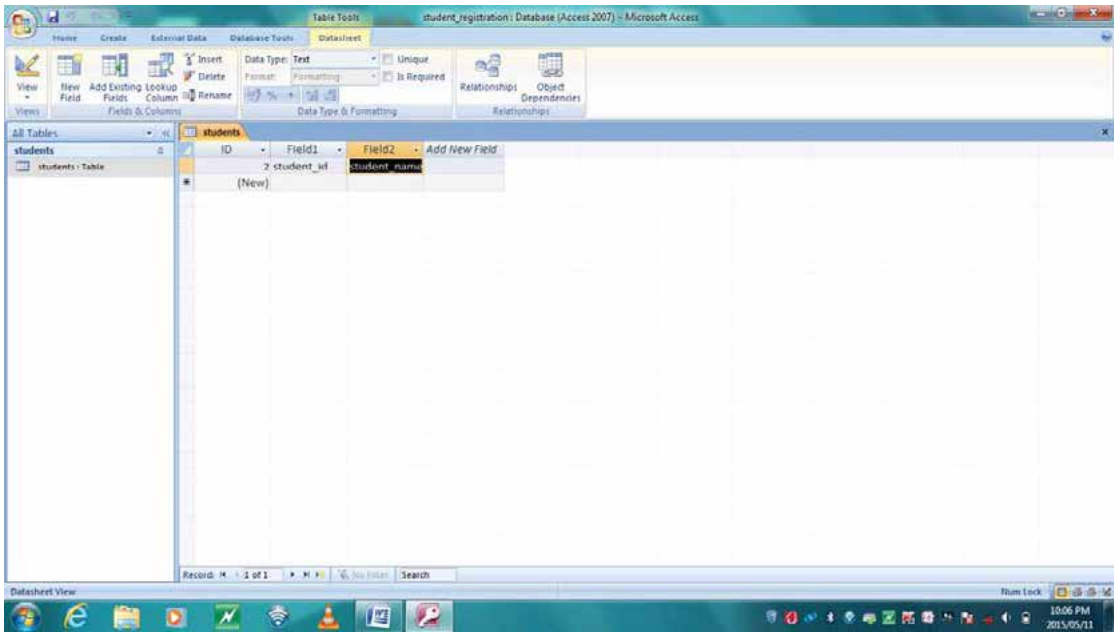
1) Click the start button on windows
2) Click on programs
3) Click on Microsoft office
4) Click on Microsoft access



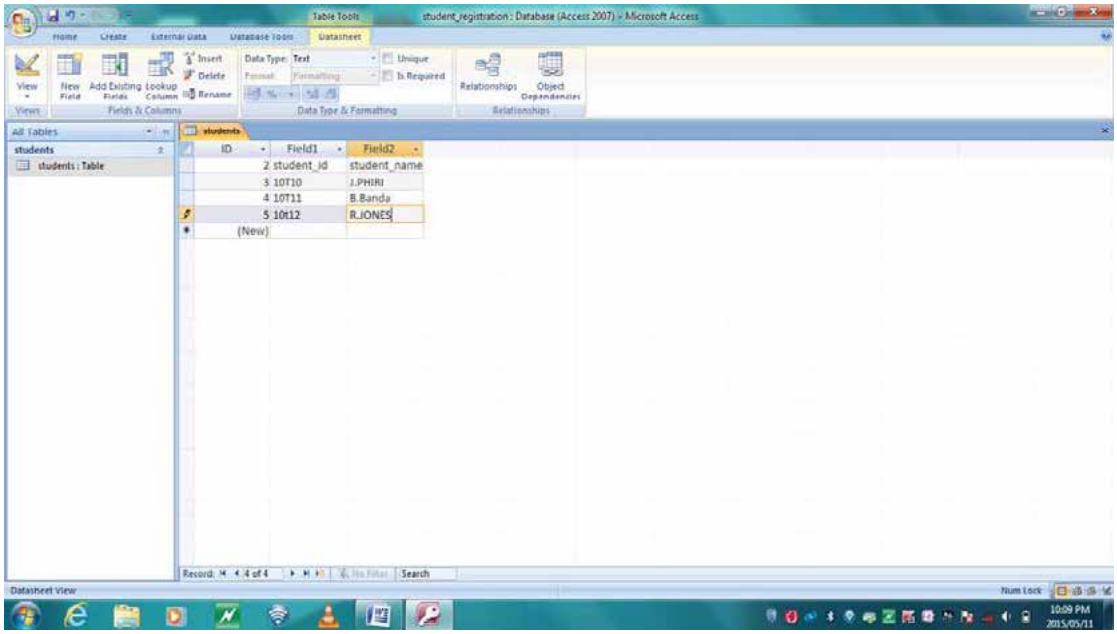
Unique Elements in access
You work on objects such as tables, forms, and reports in access work area.

To create database
Using the above click on blank database

On file name student registration
Click on the create button to create the database
On table field_1 enter student no and on field_2 enter student name
Select save
On table name enter students then say ok check on the figure below

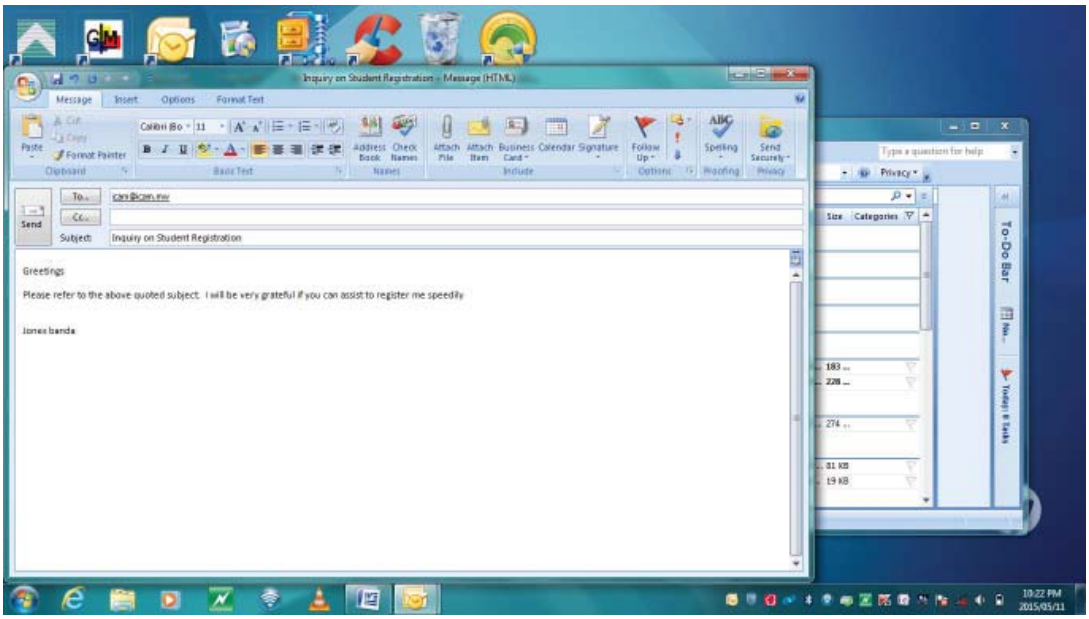


Yon add records to table by using arrow to position in correct field and enter data as shown on figure below



Outlook
Outlook is a powerful communications and scheduling program helps you to communicate with others, keep track of contacts and organize your calendar.

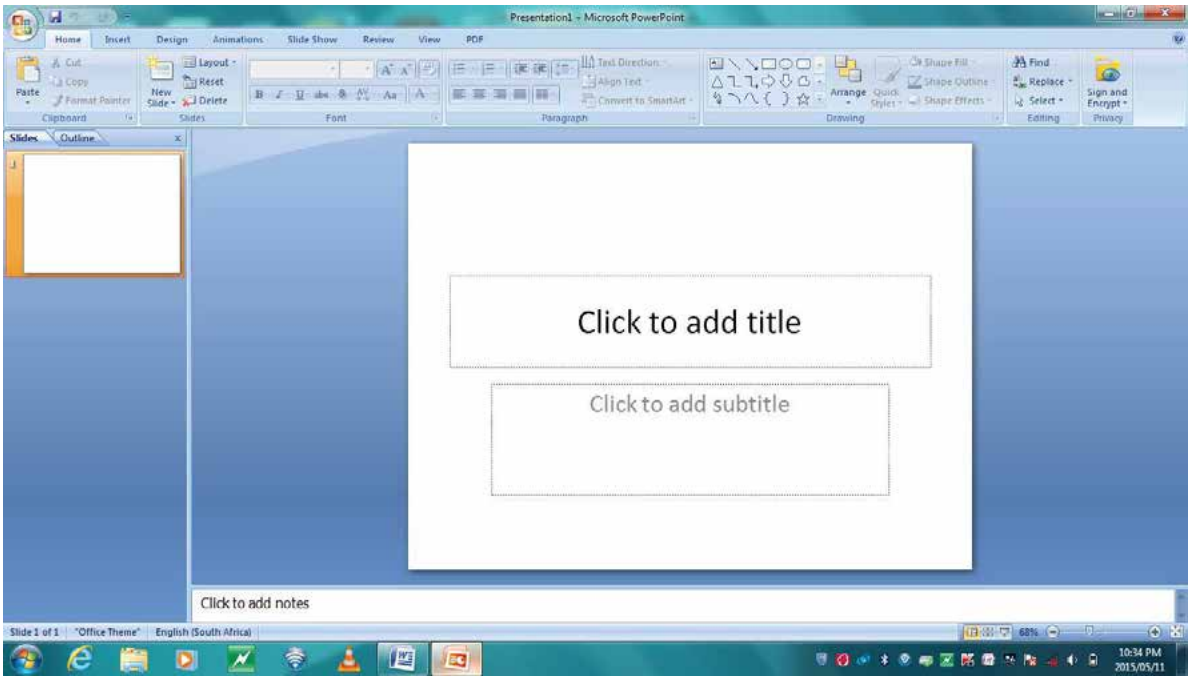
Electronic mail is the transmission of messages and files over a computer network
So on TO Field you enter the correct email address and you type the message



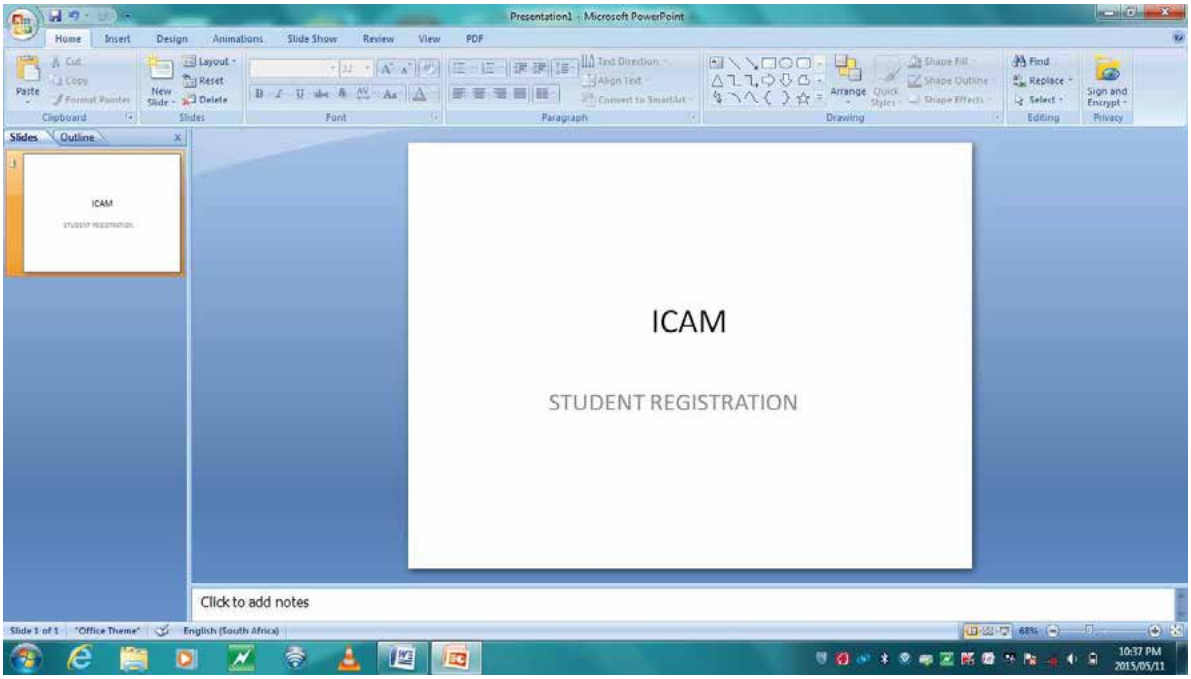
The PowerPoint window and Ribbon
The power point window consists of a variety of components to make your work more efficient and documents more professional: the window, ribbon, mini toolbar, shortcut menu and quick access toolbar.
The basic unit of power point is slide. A slide may contain text, objects, tables, charts and drawing. Layouts are used to position this content on the slide.

To start a program

1) Click the start button on windows
2) Click on programs
3) Click on Microsoft office
4) Click on Microsoft power point

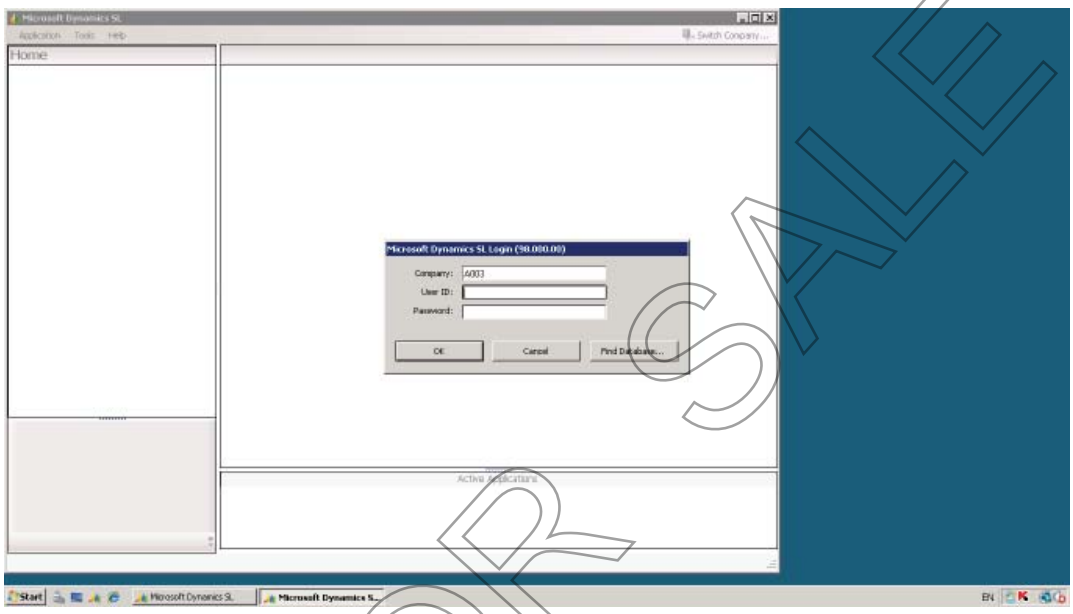


On click add title
Type ICAM
On click to add subtitle
Type student registration



Accounting Systems
Majority of businesses manage their financial records using computerized accounting packages. There are many types of accounting systems on the market

Login
To use an accounting systems, you need to login in by supplying a user id and password seek screen 98.000.00 below



An accounting system comprises modules like Accounts Payable, Accounts Receivable, Inventory, Fixed assets, Payrolls and General Ledger

Accounts Payable

The Accounts Payable module performs the functions needed to process vendor invoices and maintain accounts payable information. In addition, it generates a wide variety of useful accounts payable reports that help make cash management easier and more efficient.

The Accounts Payable module uses the voucher approach to accounts payable. Each vendor invoice entered is assigned a voucher number. The Accounts Payable module uses these invoices as source documents for the voucher transactions that update accounts payable accounts..

All vouchers increase the balances of accounts payable accounts. As vouchers are paid, the Accounts Payable module reduces accounts payable account balances. Corrections to vouchers are handled through debit and credit adjustment transactions.

Accounts Receivable

The Accounts Receivable module performs the functions needed to process customer invoices and maintain accounts receivable information. In addition, it generates a wide variety of useful accounts receivable reports that help make customer account management easier and more efficient..

Cashbook

The Cash Manager module provides a powerful tool to manage cash and reconcile banking accounts. Three major functions are provided by this module:

· A consolidated point of bank reconciliation. Cash Manager integrates with Accounts Payable, Accounts Receivable and Order Processing to allow all reconciliation to be centralized into one location.

Inventory

Inventory is an important asset of most companies and a very significant financial component for some organizations. Inventory is the generic term for the goods, including raw materials, finished goods, and supplies that cost money, have value and are stored and used in the business. Inventory is usually stored in one or more locations referred to as stores, warehouses, or just inventory locations. Within one of these inventory sites, the items may be stored on shelves, in bins, tanks, etc. Tracking the location of inventory is a key function of the Inventory system.

General Ledger

This is the main system where trial balance and other financial reports are produced.

Chapter 4 Exercises

1. Operating systems are software which enable the user to drive the computer. They are often quite technical, latest versions use new techniques to make them user friendly.

    a) Briefly explain five tasks performed by an operating software
    b) Define the term user friendly

2. You have recently taken control of the accounts office of a small business and plan to purchase a personal computer for general accounts, spreadsheets and access to online services. Write short note explaining the meaning and significance of the following aspects of the computer you want to buy

    (a) **Windows operating environment**
    (b) **Integrated computer packages**
    (c) **Features you would expect to find in an computerized accounting systems**

3. Why are application software important? In which areas are application software used. Give relevant software names and their use.
4. Write in detail about the categories in which a software can be divided
5. Describe a range of features you expect to find in typical spreadsheet and word processing packages.
6. Mention six major benefits which electronic filling systems have brought
7. What criteria should be considered when choosing a programming language for a project
8. Give advantages and disadvantages of high and low level languages
9. Distinguish between machine language and assembly language
10. Distinguish between compilation and interpretation.
11. What can you do with word processing software that you can not do with a pencil and paper?
12. Formatting a word document means changing the appearance of a document, what are the major choices which have to be made to format a document
13. Explain benefits of using spreadsheet.

CHAPTER 5

DATA PROCESSING

This chapter aims at providing an understanding of data, information sources of data and data processing. It focuses on the data processing cycle and the role that computers play in data processing.

CONTENTS

LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Distinguish between data and information and give examples
- Explain the data processing activities and the role of computers in data processing
- Explain why information requirements vary as we go up in the organizational chart
- Explain the qualities of good information and what makes information valuable
- Explain what information technology is and the role it plays in business organizations.

5.1 Introduction

Information is vital to every business organisation and is at the heart of any information system. Everything that we do in life depends on information and organisations need systems that can provide them with the much needed information.

5.2 Data and Information

Although data and information are used interchangeably they are not the same

5.2.1 Data

Data refers to the raw material for data processing which does not give meaning on its own i.e. unprocessed facts, figures or events which are not put in a form that people can understand and use.

For instance, *completed questionnaires* are *data* since they don't tell much but once they have been processed and analysed, the resulting report is *information*. Another example is a *Price list* which does not provide any information in terms of what and how much has been sold.

5.2.2 Information

Information is the data that has been processed in so as to provide meaning to the person who receives it (i.e. facts that have been interpreted & understood by users). Data is said to be information when it has been converted into a more useful form. Examples of information may include a bank statement, a sales forecast, a cash flow, a telephone directory etc.

5.3 The Data Processing Cycle

Data processing can be summarized as:

Input → **Process** → **Output**

Data processing can be done manually or by use of computers. Figure 3.1 below shows the activities comprising the data processing cycle which are:

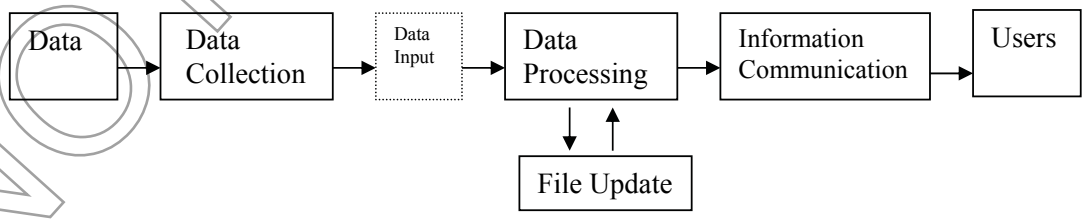


Figure 3.1

Data collection
All data needed for data processing is collected and made available and there must be a system or procedure to ensure data is collected and made available. Data can be collected through surveys, research or Informal gathering or individual collection

Sources of Data & Information
Data & information can be sourced from both inside and outside the organization therefore information systems need to be designed to help in obtaining the relevant data.

Internal sources
Internal sources may include
- Accounting records like Sales Ledger, Purchases Ledger, Cash book
- Payroll system
- Production department, Sales & marketing department
- Members of staff – information may be obtained informally in the course of the day-to-day business or through meetings, interviews, questionnaires and discussions.

External Sources
- Government
- Newspapers, Libraries, Information bureaus, Legal experts, TV reports, Internet

Data can be gathered using formal methods of collection which can be entrusted to particular individuals.

Data Processing Operations
For the data to be transformed into information it undergoes the following operations by use of software

i. ***Classifying***- grouping according to sex/gender, region i.e. placing data into categories e.g. an expense can be categorized as a fixed or a variable cost.
ii. ***Sorting***- arranging in a particular order, either alphabetical or numerical order e.g. by surname or payroll number
iii. ***Calculating***- producing total figures, averages etc
iv. ***Summarizing*** – making conclusions & summarizing into meaning information. Can be summarized in form of graphs, tables or test. The summarized data is the information in form of output.

5.4 File accessing
This involves bringing the file up to date to reflect the current position. Files are accessed to incorporate the processed data. The old data on the file is replaced by the new data.

5.5 Information Communication
This involves the routine dissemination of information to users. Information will be useless until it is communicated to the people who need it.

5.6 The Role of Computers in Data Processing

Most processing in organisations today is done using computers. The major roles that computers play in data processing include:

- Processing large volumes of information which could not easily be done manually,
- Storing large volumes of information which could not easily be done manually,
- Increasing the speed i.e data is processed at a greater speed
- Improving the accuracy of information i.e. information processed with a computer has greater accuracy
- Presenting the processed information in a number of neat and presentable ways
- Facilitating the dissemination of information to the users.
- Element of human being as the user
- Security of data

Manually, without the use of computers, data **is** processed following manual methods using human beings. The data undergoes the same operations of Classifying, Sorting, Calculating and Summarizing. Human beings use their brains which are equivalent to the memory in the computer and follow a set of procedures which are likened to program instructions in the computer. The tools that human beings use may include: books, paper, pens, pencils, calculators, files and filing cabinets for storage of information. Manual data processing however is slow and cumbersome.

5.7 Organizations' Information Requirements

Need for Information

Why do organizations require information?

Organizations require information for various purposes.

a) Planning

Information helps managers to plan for the resources needed and how they will be used. Planning requires thorough knowledge of available resources, time scales and the likely outcomes.

b) Controlling, Monitoring and evaluation

Once the plan of action is implemented, actual performance needs to be monitored and controlled in order to assess whether it is proceeding according to plan or not.

c) Performance measurements

Overall performance of departments and the organization as a whole must be measured. Information on costs, revenues, volumes, timescales and profitability is required. This helps to make comparisons against plan.

d) Decision making

Managers at all levels within the organization make decisions which involve choosing between different alternatives. Therefore making and implementing decisions requires information

5.8 Organizational Levels

Organizational levels are those levels in the organizational chart over which the supervisor has direct control depending on the number of subordinates.

a) **Level 3: Corporate Level Or Strategic Level**

Involves the top management which supports the whole organization and it is concerned with strategic issues and its relation the external elements in the environment. The level is concerned with long-term planning

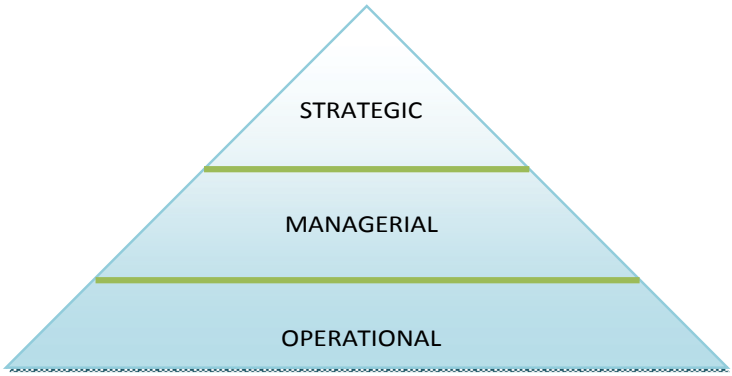
b) **Level 2: Tactical Level/ Managerial Level**

This level support specific departments or functional level of an organization e.g. Human Resource Department. The function mainly involves management of resources within constraints imposed.

c) **Level 1: Operational and Supervisory Level**

This level is there to fulfill the operational services in distinct units of organizations i.e. control of the day to day activities of an organization

Figure 5.1 below diagram gives a hierarchical structure of an organisation



5.9 Information and Functional Areas (Division/Departments)

Business organizations are also divided into the following main functional areas which have specific needs of information

5.9.1 Sales and Marketing

Responsibilities

- Responsible for selling companies products or services.
- Identification customers and contact of customers for business product.
- Determination of what customers need or want.
- Planning and developing products and services to meet the customers' needs.
- Advertisement and promotion of the products.
- Selling the product, taking orders from customers.

5.9.2 Manufacturing and Production

Responsibilities

- Responsible for manufacturing a firm's goods or services.
- Assembling products, check quality, producing bills of materials

5.9.3 Finance and Accounting

Responsibilities

- Manages the firm's financial assets e.g. cash, stock and other investments.
- Maintains and manages the firm's financial records to account for flow of funds in a firm.
- Paying creditors
- Producing financial statements

5.9.4 Human Resource

Responsibilities

- Attracting, developing and maintaining the business work force
- Identification of potential employees.
- Recruitment or hiring of employees
- Evaluating employees job performance
- Maintain records of existing employees.
- Creating programs to developing talents and skills.
- Enrolling employees in benefits plans

5.10 Types of Information

a) Operational information

Operational information is the one used by clerks and supervisors in the operational level of the organization to ensure that specific operational tasks are properly planned and carried. Employees with operational roles need more detailed information to help them carry out their duties.

Characteristics of operational information

- Relevant to the immediate term

- Concerned with specific tasks
- Detailed, being the processing of raw data
- Prepared frequently
- Largely quantitative
- Derived from internal sources

Examples: the rate of pay per hour, number of hrs worked by each employee, outstanding purchase order.etc

b) Tactical information

This is the information used by middle management in the managerial level of the organization to plan, control and make decisions on how best the resources of the organization can be utilized and monitored to meet the strategic objectives set by senior management

Characteristics of Tactical information

- Relevant to short and medium terms
- Concerned with activities or departments
- Summarized at a lower level
- Prepared routinely and regularly
- Based on quantitative measures

Examples: cash flows, sales projections, staffing levels, labour turnover, short-term purchasing requirement

c) Strategic information

This is information that is relevant to senior management at strategic level of the organisation used to formulate long-term plans or strategic objectives of the organization and assess whether the objectives are being met.

Characteristics of strategic information

- Relevant to long term
- Concerned with the whole organisation
- Uncertain as it normally based on future estimates
- Summarized at high level
- Derived from both external and internal sources
- Often prepared on ad hoc basis

Examples: Capital equipment needs, cost of raising new funds, total cash needs, future market prospects, overall profitability etc

5.11 Good or Valuable Information

Good information is that information which can help to make better decisions and carry out tasks effectively.

Qualities of good information

The main characteristics of good information can be summarized in the mnemonic **ACCURATE**

Accuracy

Information needs to be accurate enough for its purpose. Incorrect information leads to making wrong and poor decisions

Figures should add up correctly and the degree of rounding should be appropriate. Accuracy of information can be improved with use of computerized systems

Complete

Information should include everything that is needed for someone to do his/her job properly and void making wrong decisions. Information should include for example internal and external data, financial and non-financial data as long as it is relevant to the purpose.

Cost-Effective

Information is cost-effective if the benefits derived from the information exceed the cost of acquiring it. Information should also lead to a decision to take action which results in cost reduction, eliminating losses, increasing sales, better utilization of resources, prevention of fraud etc.

User-targeted

Every individual must be given the information he/she needs to carry out certain tasks. The needs of the users must be taken into consideration when preparing information. For example senior managers need summaries, junior managers need detailed information.

Relevant

Information must be relevant to the purpose for which the user wants it. Information that is not needed for a decision must not be included no matter how interesting it might be. Provision of irrelevant information just wastes time and money

For instance if sales information for Region B is requested, sales figures for Region A should be omitted, it is irrelevant

Authoritative (Reliability)

Information must be reliable and trusted by the managers/ user who are expected to use it. It must be collected from reliable sources using reliable collection methods. Information from the Internet for instance may not always be unreliable

Timely

Information should be readily available when it is needed. Time is very crucial. If information is available after a decision is made it will be of little or no value.

Easy-to-use

Information should be clearly presented to ease understandability by the user. Use of computerized systems can increase presentation by use of tables or graphs and charts. It should be easy for the user to take key points at a glance and to find the details if required.

Other qualities:

Clarity – Information must be clear to the user. If the user does not understand it properly, he cannot use it properly.

Consistency - Information must be consistent and use the same basic principles so that comparisons can be made between different reports or periods

Communication- Information must be communicated to the right people using the right medium and communication channel e.g. a Job vacancy must be communicated to the interested people through the right media like local newspapers or professional magazines and not in Parliament

Concise - Volume of information should be manageable. Must be brief but complete & accurate

5.12 The Value of Information

Information is recognized as a valuable resource and a key tool for competitive advantage. Organizations that make good use of information in decision making and use new technologies to access, process and exchange information are best placed for survival in the increasingly competitive markets. Information should have some value; otherwise it is not worth the effort and cost of collecting it.

5.17 Factors that make information Valuable

a) The Source of information

Information should be sourced from a reputable, respected source and trusted sites. Information is worthless if the source data is unsound.

b) Ease of assimilation / Understandability

Information that is presented using modern methods of presentations e.g. graphics, charts, colour, sound and movement more easily and quickly understood.

c) Accessibility

Information should be easily accessible. Users should not spend too much time and effort to retrieve it e.g. searching it on the Internet.

d) Usability

Any information obtained should be used for its purpose. The actions taken or decisions made based on it make the information valuable.

e) Cost /Benefits

The benefits of the information obtained should outweigh the cost of obtaining that information. Information may be of no value if the cost of obtaining it is greater than the benefits that can be realized from it.

Chapter 5 Exercise

1. Managers need to assess the quality and value of information provided to them. What attributes might they consider when they are doing this.

2. What role do computers play in transforming data into information?

3. Information varies as levels of hierarchy go up an organizational chart. Explain why this is so

4. Typically information within an organization can be classified into three levels. Using a typical manufacturing company define the three levels and give examples of information which would be provided at each level. In what way does the destination level influence the presentation of the information?

CHAPTER 6

INFORMATION SYSTEMS

This chapter is aimed at providing a detailed understanding of the different types of information system and the support they provide to different functional areas and management levels in the organisation. The chapter covers Topic 1 of the syllabus

CONTENTS

LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Define information systems
- Explain the components of a Computer- based Information system
- Explain the classification of information systems by Level and by Function
- Explain the main types of information systems and the type of decisions and level of management which they support
- Give example and application of each type of information system

6.1 Introduction

Business organizations need different types of information systems to support decision making and operations for various organizational management levels and functions**.** This is the case because there are different interests and levels in an organization and therefore no single system can provide all the information an organization needs. As we have seen in Chapter 5, the organization is divided into strategic, management (tactical), and operational levels and is further divided into functional areas, such as sales and marketing, manufacturing and production, finance and accounting, and human resources.

6.2 Information Systems

An information system is any functional system whether manual or automated that comprises of people, machines, data, methods and procedures organized to collect, process, store, transmit and distribute information (Loudon &Loudon: Management Information Systems: Managing the digital Firm)

It is a set of interrelated components working together to collect, store, process, analyze and disseminate information for specific purposes. (Turban: Information technology for management: Transforming organizations in the digital economy).

One of the purposes of information systems is to support decision making and control in an organization. Information systems exist to serve business system of which it is a subsystem.

6.2.1 Components of Computer-based Information Systems

A Computerised Information System consists of:

- **Hardware –** computers and other equipment
- **Software –** Programs enabling the hardware to process data
- **Data –**the raw materials
- **People –** to operate the system (Computer users) and use the system outputs (end-users)
- **Procedures –** Set of instructions on how to combine the other components. Procedures are there for people to follow.
- **Resources –** stationery, network resources, storage facilities etc
- **Environment–**Suppliers, Customers, Bankers, etc

Information technology forms the largest part of computerized information systems.

6.2.2 Why organizations require formal Information systems

Organizations need formal systems to manage information

1. Because of the large volume of the information handled
2. For division of labour e.g. different individuals will deal with different aspects of a sales order.
3. Due to the need for continuity since individuals do not do same job forever.

6.3 Classification of Information Systems

There are two main classifications of Information systems

6.3.1 Classification by Level

This classification is based on the different organizational levels that the systems serve: operational-level systems, Knowledge-level, management-level systems, and strategic-level systems.

(a) Operational-Level systems
These systems support operational managers by keeping track of the elementary activities and transactions of the organization, such as sales, receipts, cash deposits, payroll, credit decisions, and the flow of materials in a factory.

The principal purpose of systems at this level is to answer routine questions and to track the flow of transactions through the organization Examples of operational-level systems include a system to record bank deposits from automatic teller machines or one that tracks the number of hours worked each day by employees on a factory floor.

(b) Management-Level systems
These are systems that support the monitoring, controlling, decision-making, and administrative activities of middle managers. Management-level systems provide periodic reports rather than instant information on operations.

Some management-level systems support non- routine decision making. They tend to focus on less-structured decisions for which information requirements are not always clear. These systems often answer "what-if" questions: e.g. what would be the impact on production schedules if we were to double sales in the month of July?

(c) Strategic-Level systems
These are systems that help senior management tackle and address strategic issues and formulate long-term policies of the organization. The principal questions addressed are; what will employment levels be in five years? What are the long-term industry cost trends, where does our firm fit in? What products should we be making in 10 years time?

(b) Knowledge-Level systems
These are systems that support knowledge and data workers in an organization.

Knowledge workers – people who hold formal university degrees and are often members of recognized professionals e.g. doctors, architects, engineers, lawyers – who create knowledge and information

Data workers – people with less formal advanced educational degrees and are mainly concerned with processing and dissemination of information e.g. secretaries, clerks or managers, who only use, manipulate or disseminate information.

Therefore these systems help the business firm integrate new knowledge into the firm and help the firm control the flow of paper work.

6.3.2 Classification by Function

Information systems can also be categorized by their specific organizational functions they serve. These systems support management in all functions of a business at all levels of management

a) Sales & Marketing systems

These are systems that help the firm to:

- Identify customers for the firm's products and services
- Develop services to meet customer needs
- Promote products and services
- Provide on-going customer support
- Marketing decisions

b) Manufacturing/Production Systems

These systems deal with planning, development and production of products and services and controlling the flow of production.

c) Finance & Accounting

These systems help the organisation to keep track of the firm's financial assets, fund flows and maintaining the financial records like receipts, disbursements, depreciations, payroll

d) Human Resources

Systems that maintain employee records, track employee skills, performance & training, support planning for employee compensation and career development and labour requirements.

6.4 Main Types of Information Systems

Organisations require different types of information systems to provide different levels of information in a range of functional areas. The following are the major types of information systems.

6.4.1 Transaction Processing Systems (TPS) or Data Processing Systems

These are systems that are designed to perform and record routine and repetitive transactions on a daily basis. **A transaction** is any task or event that affects an organisation e.g. processing sales or Purchase order, payment of goods or services, withdrawal of money from ATM e.t.c. The systems are mainly used by operational staff and lower level management (clerks & supervisors) and are used for simple, routine and structured decision making. They are the lowest level in an organization's use of information system and are described as most basic form of information systems. The output of TPS is used as input for other systems. Most of these systems have a transaction database and the processing can be batch or on-line. Processes large volume routine business transactions and the information produced may include detailed operational reports on daily activities. TPSs are at the centre of a business and many of them are automated from manual system. A business organisation will sometimes have many TPS. Applications mainly include payroll, inventory, sales, accounting applications etc

Examples:

- Billing systems to send invoices to customers
- Payroll systems to calculate the weekly and monthly payroll and tax payments
- Production and purchasing systems to deal with raw material requirements
- Stock control systems to process all movements into, within and out of the business
- Point of Sale systems in supermarkets
- Registration systems – for recording of student's registration in an institution.
- Cash management systems
- Sale order processing systems
- Pricing systems
- Stock control systems
- Reservation systems

6.4.2. Management Information Systems (MIS)

These are systems that help middle managers and senior supervisors in the function of planning, controlling and decision making by providing routine summaries and exception reports. They converts data mainly from internal sources into information that enable managers to make timely and effective structured (routine) and semi-structured decisions for planning, directing and controlling activities of the organisation. They provide information that can be used for responding to management questions about the status of the business by summarizing and reporting on the company's basic operations. They provides information in form of regular or scheduled reports, responses to queries to managers and exception or demand reports on production (e.g. monthly production figures), Sales (trend analysis reports, monthly sales reports, customer turnover, payment records), Marketing (sales data customer preferences, satisfaction), Purchasing (amount spent on each supplier) and Finance & Accounting (balance sheets, budget summaries, comparison with budget). Most of these systems use interactive databases and usually take data from the transaction processing systems and summarize it into a series of regular management reports. These systems have an internal focus with little analytical capabilities and designed to report on existing operations. The applications may include production control, sales forecasting, and resource monitoring e.t.c.

Examples

Inventory control systems, Sales management system, cost analysis, Budget control system, production management, systems

6.4.3 Decision Support System (DSS)

DSS are information systems that combine data and analytical models or data analysis tools to support semi-structured and unstructured decision making. They are used by middle and senior management to assist them in making decisions on unstructured issues which are subject to high levels of uncertainty about the true nature of a problem. Because of the analytical capabilities, they allow managers to *consider different alternatives* and evaluate them under a variety of potential conditions. Managers set up possible scenarios and ask the system to predict possible consequences and then the manager will use his judgment to reach the decision by weighing

several assumptions. DSS often involves use of complex spreadsheet and databases to create "what-if" analysis for forecasting and short term strategic planning and complex problem solving. DSS does not make decisions for the manager but just provide support and assistance in the decision-making process. DSS that support decision making by a group of people are called Group Decision Support Systems (GDSS). They are interactive, computer-based systems that facilitate solution of semi-structured and unstructured problems by a designated set of decision-makers working together as a group.

Examples
Capital Investment Analysis system, Sales Analysis system, Cost analysis system, employee performance analysis system

6.4.4. Executive support System (ESS) or Executive Information Systems (EIS)

These are systems designed to help senior management to make strategic, unstructured decisions using summary level data. The system gathers, analyses and summarizes the key internal (e.g. financial data) and external information (e.g. competitors, legislation, share prices) used in the business. They support Top-level managers who have special information needs that are different from those of other managers. ESSs are required for long-term strategic planning applications. They provide senior executives with a summarized form of information in a variety formats and also give options to drill down to greater level details. They make less use of analytical tools and models.

Main Features
- Ability to select summary items from a more detailed level.
- Ability to manipulate summary data e.g. making comparisons with similar data.
- Built-in graphics and charts
- Ability to set up templates for presenting data so that information from different areas is always summarized in the same format.
- Flexibility - Be easy to use and make less use of analytical models
- Ability to call up summary data from main computer system.
- Quick response time to allow senior managers to access information faster
- Interactive access databases
- Sophisticated data modeling tools e.g. graphical facilities for user-friendly presentation of data,
- Summary level data captured from organisation's main system

Examples
Budget forecasting systems, Profit planning systems, Personnel planning systems, Sales trend forecasting systems.

6.4.5. Knowledge Work Systems (KWS)

These are systems that facilitate the creation and integration of new knowledge into the organization. **KWS** help knowledge workers create new knowledge and expertise. Support highly skilled knowledge workers in the creation and integration of new knowledge into the company. For example, Computer Aided Design (CAD) systems which are used by product designers. Surgeons use sophisticated CAD systems to design operations. Financial institutions are using knowledge work systems to support trading and portfolio management with powerful Personal Computers (PC's).The knowledge itself might be contained in word processing documents, spreadsheets, PowerPoint presentations, Internet pages or whatever. To share the knowledge, a KMS would use group collaboration systems such as an Intranet.

KWS can be extended into **Expert System**

6.4.6. Expert Systems

An Expert System is information system that performs a task that would otherwise require a human expert. The system is used to solve problems by capturing knowledge from a very specific and limited domain of human expertise.

An Expert System is a type of Knowledge Work Systems. The system consists of a database holding a large volume of specialized data in a particular discipline for example on legal, medical diagnosis, engineering or tax information and allows non-experts to interrogate the system for information advice and recommend decisions.

The user keys in certain facts and the programs uses its rules (i.e. rules about what to do or how to interpret a given set of circumstances) to produce decisions e.g. processing loan applications. The user sits at a terminal and takes part in a question and answer session in which data about the problem is typed in. Answers to a series of questions are given by ticking boxes or drop down menus. At the end of the session the system makes an assessment of the problem and suggests actions to be taken.

Mainly used by Specialists in certain fields and managers to make complex or unstructured decisions. The systems are programmed with decision making strategies which have been developed by consulting people who are experts in the field. The system can be used by staff when an expert is not available (or has retired and not been replaced). For example a user without tax knowledge can consults a Tax Expert system for taxation for guidance on particular matters of tax, Doctors can use Medical Expert system to arrive at a medical diagnosis. Common tasks that are carried by experts systems may include diagnosis, strategic planning, internal control operations, PC fault finding and the information produced may include diagnosis, advice, explanations and ad hoc reports. Expert systems are knowledgebase systems that use techniques from the field of Artificial intelligence (AI). AI mimics human intelligence by using a computer.AI programs have been developed to play complex computer games like Chess, Bawo etc

Components of Expert Systems

a) **Knowledge base**
Contains knowledge and experiences of humans which include facts and rules held in the system's database (e.g. Acts of Parliament and Case Laws

b) **A user Interface**
An interface that support diagnostics or similar discussions with the user

c) **Inference Engine**
Software, process that and applies the knowledge base to the users problems and produce advice and recommends solution.

d) **Explanation Program**
Provides explanation of the reasoning applied by the system in reaching specific recommendation and decisions. At various stages during the session, the system makes an assessment of the problem and recommends actions to be taken.

e) **Knowledge Acquisition Program**
Programs which enables the knowledge base to be updated, expanded and entering relevant facts

Advantages of Expert Systems

- Capture and dissemination of scarce expertise
- Can increase the productivity of help-desk employees or automate their function
- Decreased decision-making time – computers can be faster in decision-making than human beings
- AI expertise is permanent where as human expertise may leave the organization
- Can be documented and used by others i.e. AI is easily copied and transferred
- Can be used by less highly trained staff when an expert is not available
- It is consistent than human expertise on decisions
- Increased output and productivity for those using the systems
- Increased quality – can provide consistent advice and reduce error rates
- Free from human feelings of fatigue, tiredness and cannot get bored.

Limitations Expert Systems

- They are costly to implement
- They cannot apply common sense and judgment
- They have narrow focus – cannot use wide context of experience
- People are naturally more creative

Chapter 6 Exercise

1. Define an Information System

2. What are the main components of an information system

3. How do information systems support business organizations?

4. How would the attributes of information provided at the lower levels of an organization differ from those provided at higher levels?

5. What are common departments you can find in a production organization , mention levels of managers in the organization, and what type of decisions do they make

6. What are the six computer based information systems, and what are their purposes?

CHAPTER 7

COMPUTER NETWORKS

This chapter gives the basics of computer networks and the different types of networks that exist.

CONTENTS

LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Define a computer network
- Differentiate a LAN and a WAN
- Define a network topology
- Differentiate the different types of data processing options
- Differentiate the generation of programming languages

7.1 COMPUTER NETWORKS

Computers can be connected to other computers in what is referred to as a network.
A Computer network is made up of a number of connected computers each having its own processor.

A network allows computers to connect or communicate with each other to share resources e.g. files, printers, software, therefore a network allow computing resources to be used more efficiently between groups of users.

The computers on a network may be linked through cables, telephone lines, radio waves, satellites, or infrared light beams.

A ***Networked computer*** is a computer that is connected to other computers whilst ***Stand alone*** computer is a computer that is not connected to other computers.

Advantages of being on a network.

- Expensive resources e.g. printers can be shared
- Files stored on a single hard disk can be shared
- Incompatible hardware can be linked and share things between them.
- Data is less likely to be lost because of such things as backup
- Memos or messages can be passed from one machine to another providing a fast, low messaging system.
- Greater power, because each additional machine will bring in additional processing power.
- If one machine breaks down the other will continue providing services.
- Can be used for mailing

Benefits of Client/Server Computing)
A Client/server LAN consists of requesting micro computers, called clients and supplying devices that provide a service called servers.

Processing power is spread over several computers (Greater resilience). If the server or one PC breaks down, other locations can carry on the processing.

(i) Shared data & programs - Programs and data are centrally held on the server and shared by all PCs – no duplication of data on individual printers.
(ii) Shared work-load. Each PC in the network can do the same work i.e. operators can share the work.
(iii) Shared peripherals. Expensive resources like printers can be shared.
(iv) Incompatible hardware such as PCs and Macs can be linked by means of the network and files passed between them
(v) Information stored on remote computers can be accessed
(vi) Data is less likely to be lost or accidentally erased because formal housekeeping procedures like regular backups are regularly instituted
(vii) Improved communications. Memos and other massages can be passed from one machine to another. e-mails can be used to send messages
(viii) Cheaper – by use of shared resources and can use diskless terminals
(ix) Scalability – computing power can be added as necessary and the network can be extended as the organisation grows.

7.2 Two main types of networks are local area network (LAN) and wide area network (WAN).

Local Area Networks

This is a computer network covering a small physical area like a home, office or small group of buildings such as school or an airport, a LAN is located in a single building or on a single site.

LANs are mostly used to connect personal computers and workstations in a company offices and factories to share resources.
LANs are restricted in size, they may use a transmission technology consisting of a cable to which all the machines are attached.
LANs often use microcomputers (PCs) as the ones that keep the data messages circulating.

Wide Area Networks

A wide area network spans a large geographical area, often a country or continent, WANs run on a number of sites i.e. on a wide geographical scales.

WANs often use minicomputers or mainframes as the ones that keep the data messages circulating

DIFFERENCES BETWEEN LANs AND WANs

The geographical area covered by the network is greater in WANs, not limited to a single building or site as it is in LANs.

WANs often use larger computers as their file servers (a file server is a computer whose hard disk is accessible to other computers on a network, its job is to serve the computers on a network that are connected to it, the other computers are referred to as nodes or terminals).

WANs will often be larger than LANs with more terminals or computers linked to the network path.

WAN can link two or more LANs.

7.3. NETWORK HARDWARE

Networking hardware includes all networked-computers, peripherals, interface cards and other equipment needed to perform data-processing and communications within the network.

File Servers

A file server stands at the heart of most networks. It is a very fast computer with a large amount of RAM and storage space, along with a network interface card. The network operating system software resides on this computer, along with any software applications and data files that need to be shared.

The file server controls the communication of information between the nodes on a network. For example, it may be asked to send a word processor program to one workstation, receive a database file from another workstation, and store an e-mail message during the same time period. This requires a computer that can store a lot of information and share it very quickly.

Work stations

All computers connected to a network are called workstations. A typical workstation is a computer that is configured with a network interface card, networking software, and the appropriate cables. Workstations can access files that are saved on the file server.

Network Interface Cards

The network interface card (NIC) provides the physical connection between the network and the computer workstation. Most NICs are internal, and they are included in the purchase of most computers.

The most common network interface connections are Ethernet cards.

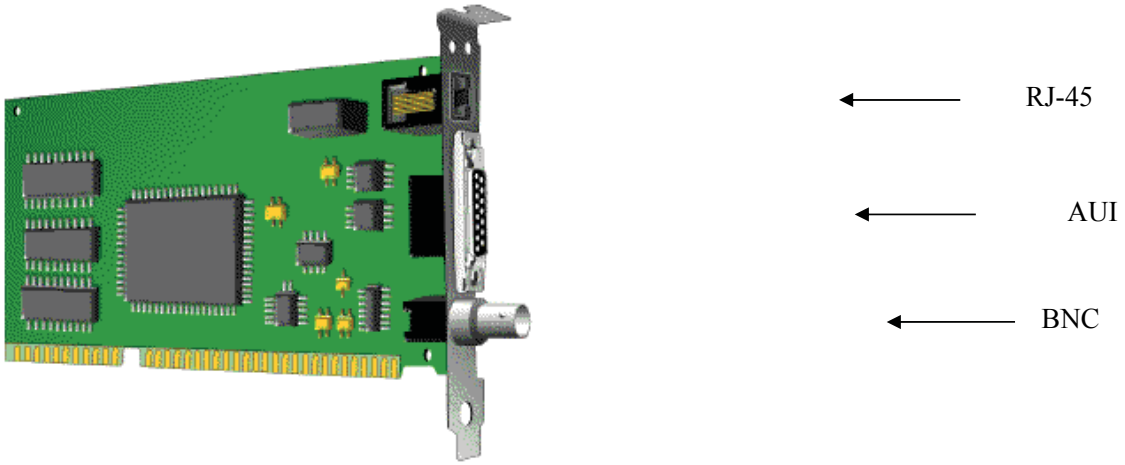


Fig 5.2 : Network Interface Card (NIC)

Hubs

In computer networking, a **hub** is a small, simple, inexpensive device that joins multiple computers together. Many network hubs available today support the Ethernet standard. Other types including USB hubs also exist, but Ethernet is the type traditionally used in home networking.

Switches

A **network switch** is a small hardware device that joins multiple computers together within one local area network (LAN).

Network switches appear nearly identical to network hubs, but a switch generally contains more intelligence (and a slightly higher price tag) than a hub. Unlike hubs, network switches are capable of inspecting data packets as they are received, determining the source and destination device of each

packet, and forwarding them appropriately. By delivering messages only to the connected device intended, a network switch conserves network bandwidth and offers generally better performance than a hub.

Repeaters

A network device used to regenerate or replicate a signal. Repeaters are used in transmission systems to regenerate analog or digital signals distorted by transmission loss. Analog repeaters frequently can only amplify the signal while digital repeaters can reconstruct a signal to near its original quality.

A repeater cannot do the intelligent routing performed by bridges and router

Bridges

In computer networking, a bridge connects two or more local area networks (LANs) together. The data in this case, use the bridge to travel to and from different areas of the network. The device is similar to a router, but it does not analyze the data being forwarded. Because of this, bridges are typically fast at transferring data, but not as versatile as a router.

Routers

A router translates information from one network to another; it is similar to a super intelligent bridge. Routers select the best path to route a message, based on the destination address and origin. The router can direct traffic to prevent head-on collisions, and it knows when to direct traffic along back roads and shortcuts.

While bridges know the addresses of all computers on each side of the network, routers know the addresses of computers, bridges, and other routers on the network. Routers can even "listen" to the entire network to determine which sections are busiest -- they can then redirect data around those sections until they clear up.

If you have a school LAN that you want to connect to the Internet, you will need to purchase a router. In this case, the router serves as the translator between the information on your LAN and the Internet. It also determines the best route to send the data over the Internet. Routers can:

- Direct signal traffic efficiently
- Route messages between any two protocols
- Route messages between linear bus, star, and star-wired ring topologies
- Route messages across fiber optic, coaxial, and twisted-pair cabling

7.4 NETWORK SOFTWARE

- Network Software is designed to help set up, manage, and/or monitor computer networks. Networking software applications are available to manage and monitor networks of all sizes, from the smallest home networks to the largest enterprise networks.

7.5 Network Architecture

7.5.1 Peer-to-Peer

A network of personal computers, each of which acts as both client and sever, so that each can exchange files and email directly with every other computer on the network. Each computer can access any of the others, although access can be restricted to those files that a computer's user chooses to make available. Peer-to-peer networks are less expensive than client/server networks but less efficient when large amounts of data need to be exchanged. Compare client/server network.

7.5.2 Client/Server

A client server is when a number of workstations are connected to a central computer which provides different facilities/services e.g. printing, processing, storage etc.

7.6. NETWORK TOPOLOGY

In networking the term topology refers to the layout of connected devices on a network. A network topology should be thought of as a network's virtual shape or structure.

The network can have a physical or a logical topology. The physical topology describes the layout of computers and where the workstations are positioned. The logical network topology describes how the information flows through the network.

Choosing your physical topology is important because if it is not chosen correctly, this could cause your network to not operate properly. There are several terms that describe the type of physical topology that a network can have. The most common topologies are bus, ring, star, tree and mesh.

Bus topology.

A bus topology is a type of network setup where each computer and network device is connected to a single cable or backbone. Below, is a visual example of a simple computer setup on a network using the **bus topology**.

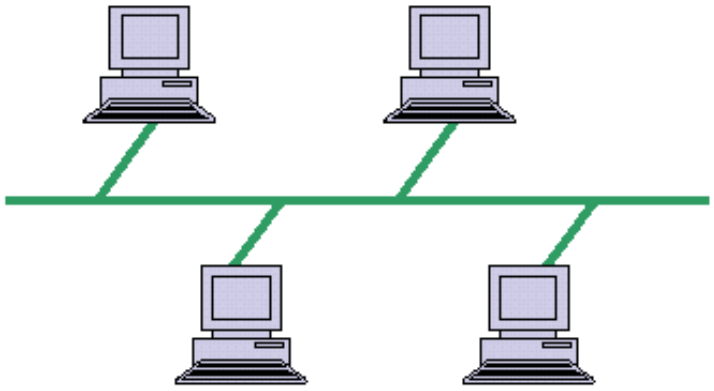


Fig 5.6: a bus network topology.

Advantages of a Bus Topology

- Easy to connect a computer or peripheral to a linear bus.
- Requires less cable length than a star topology.

Disadvantages of a Bus Topology

- Entire network shuts down if there is a break in the main cable.
- Terminators are required at both ends of the backbone cable.
- Difficult to identify the problem if the entire network shuts down.
- Not meant to be used as a stand-alone solution in a large building.

Star topology

A star topology is designed with each node (file server, workstations, and peripherals) connected directly to a central network hub, switch, or concentrator

Data on a star network passes through the hub, switch, or concentrator before continuing to its destination. The hub, switch, or concentrator manages and controls all functions of the network. It also acts as a repeater for the data flow.

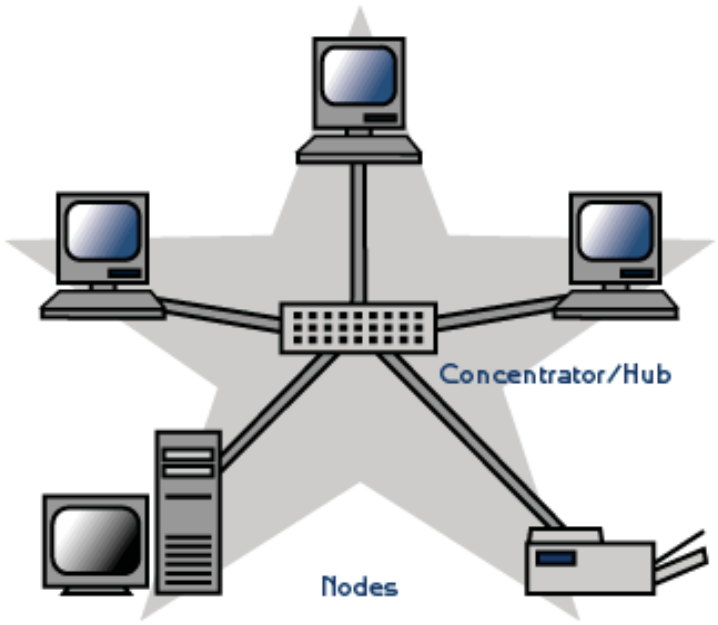


Fig 5.7: a star network topology.

Advantages of a Star Topology

- Easy to install and wire.
- No disruptions to the network when connecting or removing devices.
- Easy to detect faults and to remove parts.

Disadvantages of a Star Topology

- Requires more cable length than a linear topology.
- If the hub or concentrator fails, nodes attached are disabled.
- More expensive than linear bus topologies because of the cost of the concentrators

Ring topology

In a ring topology devices are connected from one to another, in a loop. A data token is used to grant permission for each computer to communicate.

In a ring network, every device has exactly two neighbors for communication purposes. All messages travel through a ring in the same direction (either "clockwise" or "counterclockwise"). The data that are transmitted over the network pass through each of the nodes in the ring until they reach the destination node. A failure in any cable or device breaks the loop and can take down the entire network.

Adding a new device to an existing physical Ring network can be complicated as any new device needs to go in between the existing devices.

In a ring topology each computer retransmits what it receives from the previous computer. The message flows around the ring in one direction. The ring network does not subject to signal loss problem as a bus network experiences. There is no termination because there is no end to the ring.

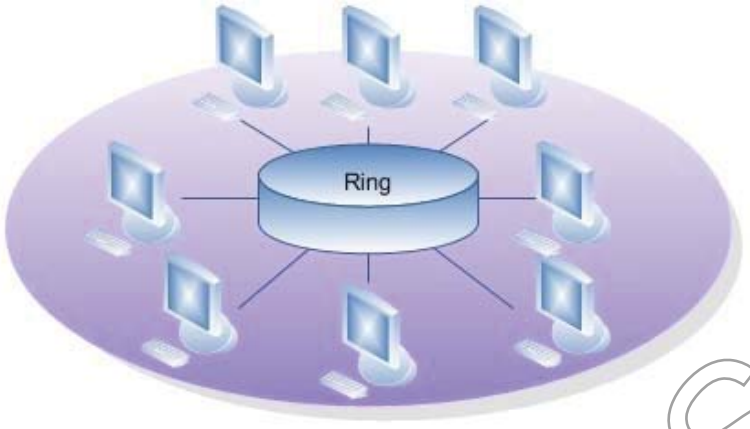


Fig 5.8: a ring network topology.

Advantages

- Each node has equal access
- Capable of high speed data transfer

Disadvantages

- Failure of one computer on a the ring can affect the whole network
- Difficult to troubleshoot the network when there is failure

Tree topology

Tree topologies integrate multiple star topologies together onto a bus. In its simplest form, only hub devices connect directly to the tree bus, and each hub functions as the "root" of a tree of devices. This bus/star hybrid approach supports future expandability of the network much better than a bus (limited in the number of devices due to the broadcast traffic it generates) or a star (limited by the number of hub connection points) alone.

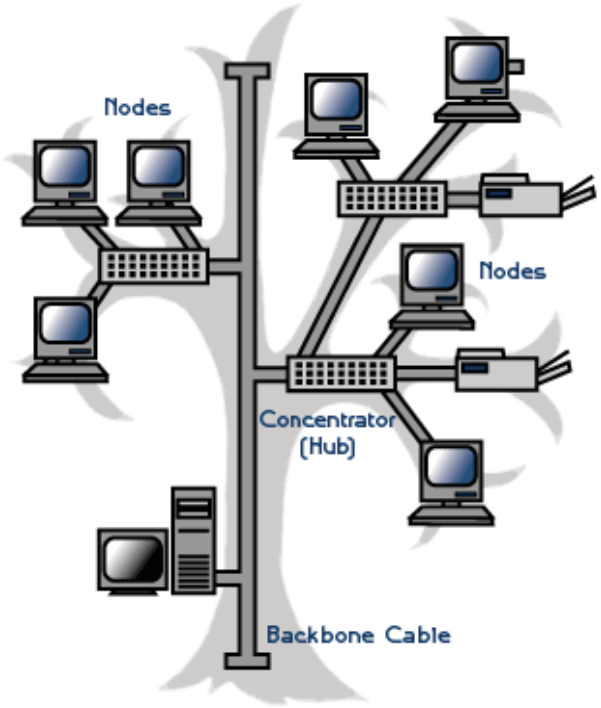


Fig 5.9: a tree network topology.

Advantages of a Tree Topology

- Point-to-point wiring for individual segments.
- Supported by several hardware and software venders.

Disadvantages of a Tree Topology

- Overall length of each segment is limited by the type of cabling used.
- If the backbone line breaks, the entire segment goes down.
- More difficult to configure and connect than other topologies.

Mesh topology

Mesh topology involve the concept of routes. Unlike each of the previous topologies, messages sent on a mesh network can take any of several possible paths from source to destination. (Recall that even in a ring, although two cable paths exist, messages can only travel in one direction.) Some WANs, most notably the Internet, employ mesh routing.

A mesh network in which every device connects to every other is called a full mesh. Partial mesh networks also exist in which some devices connect only indirectly to others.

In a full mesh network, each network node is connected to every other node in the network. Due to this arrangement of nodes, it becomes possible for a simultaneous transmission of signals from one node to several other nodes. In a partially connected mesh network, only some of the network nodes are connected to more than one node. This is beneficial over a fully connected mesh in terms of redundancy caused by the point-to-point links between all the nodes. The nodes of a mesh network require possessing some kind of routing logic so that the signals and the data traveling over the network take the shortest path during each of the transmissions.

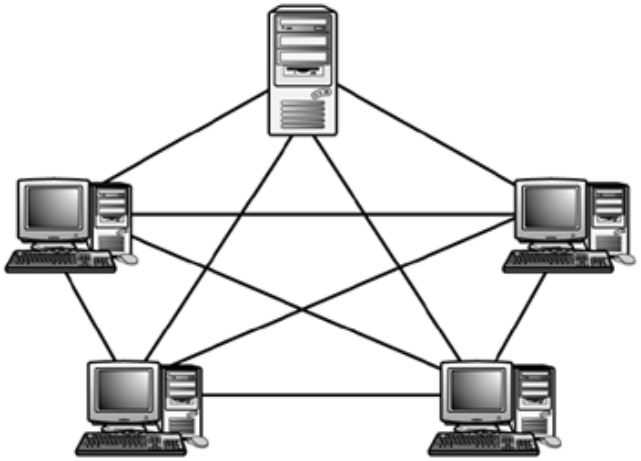


Fig 5.10: a mesh network topology.

Advantages

- The arrangement of the network nodes is such that it is possible to transmit data from one node to many other nodes at the same time.
- The network can be expanded without disruption to current users.
- Robust as failure of one link does not affect the entire system.
- Points to point links make fault identification easy.

Disadvantages

- Complicated implementation.
- Requires more cable than the other LAN topologies.
- The arrangement wherein every network node is connected to every other node of the network, many of the connections serve no major purpose. This leads to the redundancy of many of the network connections.

Chapter 7 Exercises

1. Describe major components of a network?
2. Describe how a PC can be attached to file server as a terminal?
3. When do online systems process as batch systems?
4. Describe the following terms bridge, router, gateway
5. Describe network topology and explain advantages of each topology?

CHAPTER 8

NETWORK AND DATA COMMUNICATION

This chapter introduces network technologies and the data communication modes. The chapter covers Topic 5 of the syllabus

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CONTENTS

LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Differentiate different types of data transmission signals
- Define multiplexors, gateways and line concentrators
- Differentiate the modes of communication parallel and serial
- Differentiate simplex, duplex and full duplex

8.1 DATA TRANSMISSION

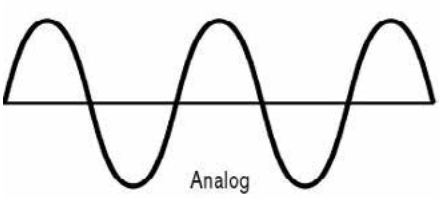
Data transmission is the movement of data from one electronic device to another through a data link. Data transmission can take place within a single computer or between different computers.

Computer communication is the transfer of data from one computer to another through data links or channels

TYPES OF SIGNALS

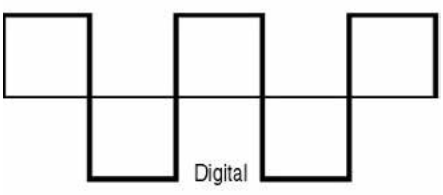
There are two types of signals, ***analog*** and ***digital signals.***

Analog signals are represented in a continuous wave form and are mostly used for wave transmission **e.g**.



A ***digital signal*** on the other hand is represented in a discrete form and has values of 0's and 1's. A 0 represents off and a 1 represents on.

e.g.



- ***A frequency*** of a signal is the number of cycles per second, and it is often expressed in hertz.
- A ***channel*** is a transmission link between the connecting devices
- A channel has a range of frequencies it would handle, the range of frequencies over which a transmission may take place over a channel is called ***bandwidth.***
- Those channels with a broader bandwidth are called ***broadband*** bandwidth and they can carry more data.
- ***Baud rate*** is the number of pulses per second and it is measured in bits or characters per second, it describes how fast your transmission is, that is how long it takes to transmit data.

Transmitted signals become degraded during transmission because of the following:

- Noise: unwanted signals picked up by the channel, the quality of the channel may be expressed in terms of its signal to noise ratio measures in decibels dB
- Distortion: changes to the shape of the signal caused by things as attenuation (absorption of the signal) and delays by the medium.

Analog repeaters restore only the amplitude and they amplify the noise as well, making the analog signals not to be preferable.

8.2. MULTIPLEXING

Multiplexing is the usage of one data link to carry a number of separate data signals at the same time.

Methods of multiplexing

Time division multiplexing (TDM)
Time-division multiplexing (**TDM**) is a method of transmitting and receiving independent signals over a common signal path by means of synchronized switches at each end of the transmission line so that each signal appears on the line only a fraction of time in an alternating pattern. This form of signal multiplexing was developed in telecommunications for telegraphy systems in the late 1800s, but found its most common application in digital telephony in the second half of the 20th century
.

Frequency division multiplexing (FDM)
Frequency-division multiplexing (FDM) is a scheme in which numerous signals are combined for transmission on a single communications line or channel. Each signal is assigned a different frequency (sub channel) within the main channel.

8.3. TRANSMISSION EQUIPMENT

MODEM: this is a short form for modulator – demodulator.
MODEM
Modulator-demodulator is an electronic device that allows computers to communicate over telephone wires. One computer's modem converts its digital signals into analog signals . The other computer's modem reconverts the analog signals into digital signals (that it can). Conversion of one type of signals to another is called modulation; their reconversion to the original type is called demodulation. Modern modems work at 56 thousand bits per second (Kbps) or higher data transfer speeds,.

Multiplexors are also needed when a number of terminals are linked to a central computer, they deal with the routine work of handling incoming and outgoing messages which would occupy an excessive amount of processor time

8.4. MODES OF COMMUNICATION

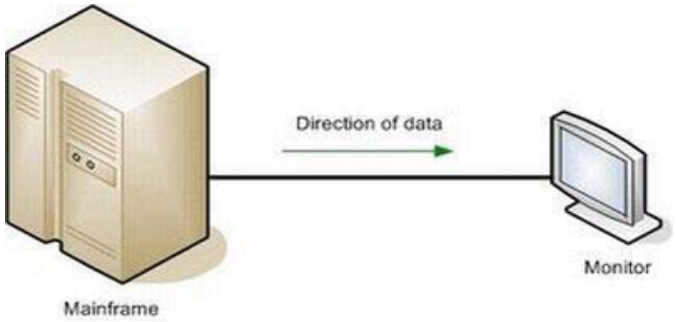
Another aspect of network performance is the mode of operation on the network connection. Obviously, wherever we connect together device A and device B, there must be some way for A to send to B and B to send to A.

Networking technologies can differ in terms of how these two directions of communication are handled.

BASIC MODES OF ELECTRONIC COMMUNICATION

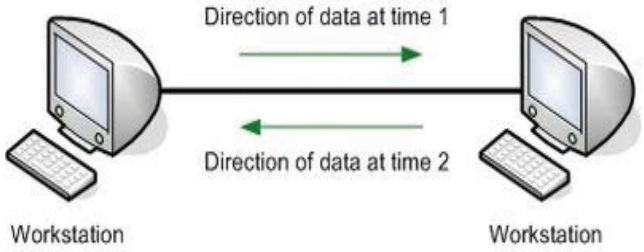
Simplex operation

In simplex operation a network cable or communication channel can only send information in one direction “it is one way street”.
Simplex operation can be used when two distinct channels are used for communication, one transmitting from one device to another.
An example of simplex operation would be that of a television transmission or the transmission of burglar alarm messages.



Half duplex

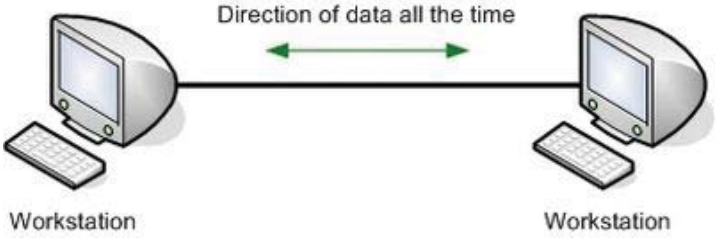
Technologies that employ half-duplex operation are capable of sending information in both direction between two nodes, but only one direction or the other can be utilized at a time.
This is common mode of operation when there is only a single network medium e.g. Radio Telecommunication systems (Press to Talk Radios),



Full duplex

On full duplex the connection between two devices is capable of sending in both directions simultaneously.
Full duplex channels can be constructed either as a pair of simplex links or using one channel designed to permit bidirectional simultaneous transmission.

A full duplex link can only connect two devices, so many links are required if multiple devices are to be connected together.
Telephone line is capable of full duplex transmission, although most human users choose to adopt a half duplex procedure to listen to what the remote person has to say.



8.5 PARALLEL AND SERIAL TRANSMISSION

Parallel Transmission

In parallel transmission, multiple **bits** (usually 8 bits or a byte/character) are sent simultaneously on different channels (wires, frequency channels) within the same cable, or radio path, and synchronized to a clock. Parallel devices have a wider data bus than serial devices and can therefore transfer data in words of one or more bytes at a time. As a result, there is a speedup in parallel transmission bit rate over serial transmission bit rate. However, this speedup is a tradeoff versus cost since multiple wires cost more than a single wire, and as a parallel cable gets longer, the synchronization timing between multiple channels becomes more sensitive to distance. The timing for parallel transmission is provided by a constant clocking signal sent over a separate wire within the parallel cable; thus parallel transmission is considered synchronous.

Serial Transmission

In serial transmission, bits are sent *sequentially* on the same channel (wire) which reduces costs for wire but also slows the speed of transmission. Also, for serial transmission, some overhead time is needed since bits must be assembled and sent as a unit and then disassembled at the receiver.

Cross talk is less an issue in serial transmission because there are fewer conductors in proximity (cross talk refers to any phenomenon by which a signal transmitted on one circuit or channel of a transmission system creates an undesired effect in another circuit or channel).

In many cases serial is a better option because it is cheaper to implement.

Serial transmission can be either synchronous or asynchronous. In synchronous transmission, groups of bits are combined into frames and frames are sent continuously with or without data to be transmitted. In asynchronous transmission, groups of bits are sent as independent units with start/stop flags and no data link synchronization, to allow for arbitrary size gaps between frames. However, start/stop bits maintain physical bit level synchronization once detected.

Chapter 8 Exercises

1. What are factors affecting data transmission?
2. What is the importance of data transmission ?
3. Data is transmitted in two ways, explain these two ways in detail.
4. Describe the following terms simplex, half duplex , full duplex and baud rate?
5. Distinguish between parallel and serial transmission

CHAPTER 9

INTERNET AND E-MAIL

This aims at introducing the internet technology and e-mail systems. The chapter covers Section I of the syllabus

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CONTENTS

LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Define the internet
- Understand the different tools on the internet
- Differentiate between the intranet and extranet
- Define e-mail
- State advantages and disadvantages of e-mail

9.1. THE INTERNET

Internet is a worldwide system of computer networks, a network of networks, where users at any one computer can get information from any other computer.
The internet has no central controlling entity, no individual or organization controls the internet.

KEY TERMS USED ON WORLD WIDE WEB (WWW)

Encryption
This is a method to ensure that network exchanges are secure and reliable. In the case of data, both sender and the receiver use a special electronic key to lock (encrypt) and unlock (decrypt) the data.

Gateway
This is a computer that converts data transmission protocols between networks or applications that use different protocols.

TCP/IP
This stands for transmission control protocol/ internet protocol, this is a protocol used by all computers on the internet for them to be able to communicate.

IP address
This is a unique address for every computer on TCP/IP network. An IP address consists of four sets of numbers separated by periods, e.g. 192.168.2.1.

Host
A host can be a mainframe, minicomputer, workstation or PC that is connected to the internet.

Universal Resource Locator (URL)
This is an electronic address for a web page or resource on the internet.

Web server
A web server is a computer that provides internet services and includes hardware, operating system, web server software and TCP/IP protocols.

Connecting to the Internet

There are three ways to connect your microcomputer with the internet

Through school or work: Colleges and large businesses have high speed phone line that provides a direct connection to internet. This type of connection is known as dedicated access. Dedicated access means a communication line is used

Through online information services: here subscribing to a commercial online information service. This provides you with its own communication software, in this case the online service acts as an electronic gateway to the internet

Through internet service providers (ISP) : the ISP are local companies that will provide public access to the internet for a flat monthly fee. Essentially an ISP is network connected to the high speed communication links that make up the internet backbone.

9.2. INTRANET

An intranet is the use of web technology to create a private network usually within one enterprise.
This is a private network designed exclusively to meet the internal needs of an organization that general public cannot access.

Although an intranet may be a single LAN segment that uses the TCP/IP protocol, it is typically a complete LAN or several interconnected LANS.

A ***Firewall*** is used to segregate the intranet from the internet and to selectively allow access from outside the intranet.

A firewall is a piece of hardware and software installed between two or more networks to ensure that only authorized users access the network.

Intranet applications

- Intranets allow for secure online distribution of many forms of internal company information.
- Intranets are used for workgroup activities and the distributed sharing of projects within the enterprise.
- They also offer controlled access to company financial documents.
- Intranets help organizations save money by eliminating paper and mailing costs.
- They improve communication
- Intranets can be used to train and reeducate employees.
- They enhance the efficiency of a business.

9.3. EXTRANETS

An extranet is a corporate password-protected network that provides information to people or entities in the environment of the business. Extranets form a larger virtual network that allows remote users (e.g. business partners or customers) to securely connect over the internet to the enterprise's main intranet. Typically remote access software is used to authenticate and encrypt the data that pass between the remote user and the intranet.

Extranet applications

- Increases business productivity
  Extranets offer speed and round-the-clock access to valuable information
- Change business partners' practices
  Constructing an extranet to handle an aspect of a business will force others, who want to maintain a business relationship, to use it as well
- Extranets help in empowering customers
  As well as forcing outsiders to change, extranets can also spur change in organizations (through rapid and efficient dissemination of information and customer response)

9.4. E-MAIL

E-mail stands for electronic mail, it is a method of sending and receiving electronic messages. E-mails are typically written and read in a special mail reader program OR from websites which provide free e-mail facilities and do not require any special software other than a web browser.
Management of e-mails involves developing procedures and using systems to ensure that inbound and outbound mails are processed efficiently.

Inbound e-mail is that e-mail received from outside the organisation such as customer and supplier inquiries.

Outbound mail is that e-mail sent from the company to other organizations.
Many organizations use e-mails instead of internal memos or telephone calls.

Advantages of e-mail

- *Speed:* e-mail messages can be transmitted very quickly.
- *Cost*: the cost of sending or receiving messages is considered to be very low especially for overseas e-mails.
- *Multiple copies:* e-mail allows multiple copies of the same basic message to be created and transmitted.
- *Sharing data:* Email messages can be used to transmit data files to other users.
- Files can be attached to messages and transmitted in the usual way.
- *Multimedia:* messages that include different elements, including graphics, video and hyperlinks to information on the internet and sound files can be included in e-mail messages.
- *Storage:* with e-mail, messages can be stored or kept for future use.

Disadvantages of e-mail

- *Technical use:* since using email service requires a certain level of technical knowledge, novice users may find it difficult to operate the hardware and software involved.
- This can place a burden on an organization in terms of training and technical support requirements.
- *Spam:* spam is the term used to describe unwanted mail such as advertisements received by most e-mail users. Spam is also called unsolicited mail.
- *Security:* unless encrypted, email messages can be intercepted relatively easily. This makes e-mail unsuitable for sending confidential information unless special precautions are taken.

Chapter 9 Exercises

1) Describe the following terms Internet, firewall, E-mail, Intranet and Extranet
2) Mention different ways how you can connect your microcomputer to internet

3) Describe major features of the internet
4) What are the basic elements of an e-mail message?
5) Describe a search engine and how it is used

CHAPTER 10

SYSTEMS DEVELOPMENT

This chapter introduces the development of computer-based information systems and then looks at Feasibility Study and System Investigation in detail. .

CONTENTS

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LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Understand how Information Systems (IS) are developed
- Understand that change introduced by a new Information may be resisted
- Explain the need for proper project management for IS development projects
- Describe the composition of a typical IS development project.
- Describe the Stages of the System Development Life Cycle (SDLC)
- Explain the need for a Feasibility Study.
- Describe the different areas of Feasibility Study.
- Describe the Costs and Benefits of a new Information System.
- Describe the Contents of a Feasibility Report.

10.1 Introduction

An organisation using a computerised system for its operations will have had involved itself in a process of developing and adopting the computerised system.

If, for example, an organisation is using a computerized stock control system, it means there was a time when the stock control system was being developed or considered for adoption.

The process of developing a computer-based system such as a computer-based stock control system and a computer-based payroll system is what is called system development.

To develop a computer – based information system that meets the needs of an organization, the developers must understand the current systems. This means that they will need to find facts about the current system and analyse those facts. Once the current (existing) systems are analysed, the developers will design a new system and implement it.

Clearly, therefore, system development involves the following stages: Problem Identification, Feasibility Study, Systems Investigation, systems analysis, systems design, Systems Implementation and Systems Review.

10.2 Systems Development and Change

Introduction

System development is about change – changing from old way of doing things i.e. the current or existing system to a new way of doing things i.e. to a new system.

This change would usually mean changing from a manual system to a computerized one. However don't be fooled to think that computerization is the only solution to problems in current (existing) systems being replaced. Some problems, upon analysis, may well turn out to be administrative, for example.

On the other hand, changing to a new system could mean moving from a less efficient user-unfriendly computer-based system to a more efficient and user-friendlier system.

Resistance to Change

Employees who are working with the current system can resist the introduction of computer-based systems. Some of the reasons might include:

- Ignorance
- Fear of the unknown
- Fear to lose one's job
- Fear of inability to learn new things

10.3 The System Development Life Cycle (SDLC)

What is the System Development Life Cycle?

Simply put, it is a series of activities that one is involved in as (s)he develops a computer based information system. The activities include Problem Identification, Feasibility Study, Systems Investigation, systems analysis, systems design, Systems Implementation and Systems Review.

10.4 The Stages in Brief

10.4.1 Problem Identification

In this stage, the actual problem is identified and defined. The information needs of the organisation are established.

10.4.2 Feasibility Study

Is a preliminary study undertaken before the real work of a project starts in order to ascertain the likelihood of the project's success. It is an analysis of possible solutions to a problem and a recommendation on the best solution to use. It involves evaluating how the solution will fit into the corporation. For example, can decide whether an order processing be carried out by a new system more efficiently than the previous on

.

It involves identification of a number of alternative solutions to the problems identified, evaluation of these alternatives, and the choosing of the best possible solution. The evaluation of the alternative solutions is based mainly on cost-benefit analysis.

A feasibility report is produced summarizing all activities in the study.

Feasibility Study

Introduction

Before a new system is developed, it is important that the development of the new system is evaluated so as to ensure it is a worthwhile activity. System development must be justified on the basis of *economic viability* of the project. It is also common for the system development project to be evaluated in terms of technical achievability, social achievability as well as operational achievability.

As already stated, during feasibility study a number of alternative solutions are identified. These are evaluated in terms of social, economic, technical, and operational feasibility. The most feasible solution is the one that is chosen.

Feasibility Study ends with a detailed document called a **Feasibility Report**.

Areas of Feasibility (Types of Feasibility Studies)[2]

Economic Feasibility

Perhaps one of the most important types of feasibility study is economic feasibility. It involves carrying out a *cost/benefit analysis* of each of the alternative solutions. The most cost effective solution is the one that is selected.

[2] Points on types of feasibility adopted from BPP Text For Paper B3 of CAT

Methods of Carrying Out the Analysis

Methods of carrying out cost/benefit analysis include:

- Payback Period Method
- Accounting Rate Of Return (ARR)
- Discounted Cash Flows
    - Internal Rate of Return (IRR)
    - Net Present Value (NPV)

The project with the shortest repayment period is selected if the Payback Period Method adopted.

The project with the highest rate (of accounting profit as a percentage of the initial capital) selected if ARR is used.

The alternatives with IRR value greater than the cost of capital are considered worthwhile.
If the NPV calculated is greater than zero i.e. it is positive, the project is considered worthwh
If NPV < 0, then the project is not worthwhile. If NPV = 0 , it is breaking even.

Detailed discussion of the methods is beyond the scope of this manual although the knowled can be assumed by the examiner based on *Business Mathematicss and Statistics* – another ICA Technician Paper.

Likely costs and Benefits of a System

- **Costs** include
    - Equipment costs
    - Installation costs
    - Development costs
    - Personnel costs
    - Operating costs

- **Tangible Benefits** include
    - Savings in staff costs
    - Extra revenue due to use of an improved system
    - Revenue from sale of equipment no longer useful in the new system

- **Intangible Benefits** include
    - Greater customer satisfaction
    - Improved staff morale
    - Better decision making

Technical Feasibility

This study aims at ensuring that the solutions are achievable using the available hardware and software. Current hardware and software technology must be able to support the suggested solutions.

Factors that affect the technical feasibility of solutions include:

- Volumes of transactions
- Capacity to hold files
- Required response times
- Number of simultaneous users that can be supported before deterioration in some other criteria

Operational Feasibility

This is done so as to ensure that the solutions are not in conflict with the way the organisation does its business.

Potential areas of conflict include:

- Change in management responsibilities
- Change in management status
- Change in management chains of commands
- Not suiting regional reporting structure
- Too high costs of redundancies, reorganization or retraining.

Social Feasibility

This is done to ensure that the solutions do not have unnecessary adverse effects on personnel.
Areas addressed include:

- Personnel policies
- Redrawing of job specifications
- Threats to industrial relations
- Expected skills requirements
- Employee motivation

The Feasibility Report

A feasibility report is likely to include the following

Introduction

Background to the project and a brief review of the layout of the presented report.

Terms of Reference

Reference back to the preliminary analysis and an explanation of how the system under discussion was selected as a candidate for investigation.
Included will also be details about the scope, resources, timescales, and the client of the study.

Existing System

A description of the current system(s).

System Requirements

Requirements as established from the users of the current system
Proposed logical System
Described using relevant tools such as DFDs and ELHs
Development Plan
Plan for detailed analysis, design and implementation.
Costs and Benefits
As discussed above.
Conclusion stating the recommended solution and why it has been selected.

10.4.3 Systems Investigation

This stage involves finding facts about the current system. The fact-finding techniques include Interviews, Questionnaires, Observation and Record Inspection (Document Review).

The facts found are formally recorded.

Systems Investigation

Systems investigation is the fact finding exercise to gather information about the current system with the view to determine the requirements of the new system.

Interviews

Interviews are the most widely used technique for finding facts about the current system. The systems analyst asks questions relating to the system under study and the interviewee gives answers.

There is need for the interview to be planned for it to be effective. The systems analyst must agree with the interviewee the purpose, time, duration, and venue of the interview after.. If the systems analyst is to interview a junior, permission must be sought from superiors. This will clear any possible suspicions and will enhance support for the project.

Advantages of Interviewing

Advantages of interviewing as a fact-finding method over other methods include the following:
It gives chance to the analyst to meet and overcome resistance
It gives the opportunity to probe further. The analyst can find more information from the interviewee than originally planned in form of follow-up questions.

Disadvantages of Interviews

Disadvantages of interviewing as a fact-finding method over the other methods include the following:

- It may result into an argument if not properly conducted
- Interviews are generally time-consuming
- Facts obtained are difficult to analyse

Post-Interview activities

After the Interview, it is very important that the systems analyst prepares and give a resume of the facts obtained to the interviewee for verification of the facts obtained. It is also important to send a thank-you note to the interviewee

Questionnaires

Where there are a large number of geographically dispersed users, it is more cost effective to administer a questionnaire than to conduct interviews. However, questionnaires may be used to *short-list* people for subsequent interviews.

Advantages of questionnaires

These include:
It is very cost-effective for numerous users who are to be questioned
It gives chance for checking reference documents

Disadvantages of questionnaires

These include:
It is difficult to design a good questionnaire.
It supplies limited factual information.

Observation

Sometimes information about a system can be obtained by observing.
The technique may reveal certain aspects of the system such as the level of lighting and the level of supervision – aspects that may not be easy to obtain otherwise.

However observation is very time-consuming and requires special skills to be effective. Additionally, the users may change behaviour upon being observed leading to wrong information being obtained.

Document Review

Investigating documents in the system can help the systems analyst to get information about the current system.

Documents that may be investigated include organisation charts, job descriptions and procedure manuals.

One way of getting information from documents is by using what is a ***document description form***.

10.4.4 Systems Analysis

This stage involves an assessment of the current system so as to establish

- Why current methods are used
- If there are any alternative methods that can achieve the same or better results

- The bottlenecks in the current system
- The problems of the current system and the requirements of the new system

At the end of this stage, User Requirements Specification is produced.

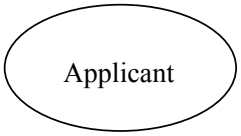
Data Flow Diagrams (DFDs)

The current system can be represented by DFDs. A DFD describes a system from the perspective of the processes that take place in it i.e. it ***gives a process view*** of the system.

DFD Constructs

The diagram is constructed using four basic constructs:

External Entity

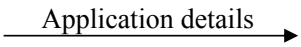


The figure above shows the symbol with the external entity's name –applicant, as it would appear in a DFD.

An external entity represents a source or destination of system data. The symbol above represents an external entity for a College Enrolment System. Applicants bring in application forms for enrolment purposes.
The application forms are then evaluated. The application is either rejected, or accepted. In either case, the applicant is notified.

Because the applicant is notified, it means he is also the destination of data. In the complete DFD this fact will be reflected.

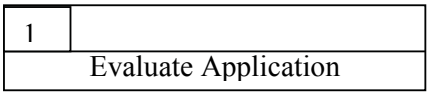
Data Flow



The figure above shows a data flow with its name (*Application Details)* as it would appear in the complete DFD for the College Enrolment System.
A data flow represents movement of data in the system.

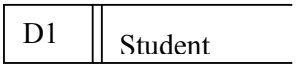
Process

The figure above shows a process symbol with the process name (*Evaluate Application)* and process ID (1.) as it would appear in a complete DFD for the College Enrolment System.



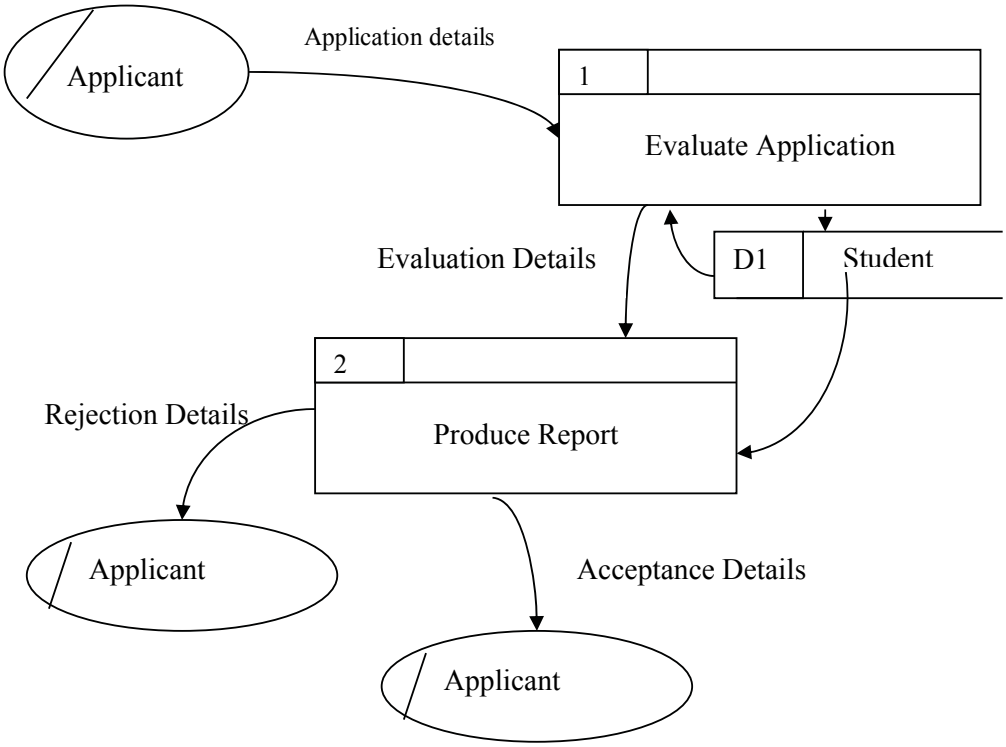
A process represents data transformation in the system.

Data Store



The figure above shows a data store construct with its name and ID as it would appear in a complete DFD for the College Enrolment System.

Example of a (Simplified) DFD: Enrolment System for Miyovano College



The line inside the external entity *applicant* shows that *applicant* appears more than once in the DFD.

Data flow diagrams are usually constructed in levels. The DFD shown is a level one DFD. Lower level DFDs can be constructed by "expanding" any of the processes in this DFD. For example if

it is felt we need more detailed information about the process Evaluate Application, we may show the constituent processes in a **level two DFD.** The processes in the resultant DFD will have IDs as 1.1, 1.2, 1.3, etc.

More detailed coverage of the construction of DFDs is beyond the scope of this manual.

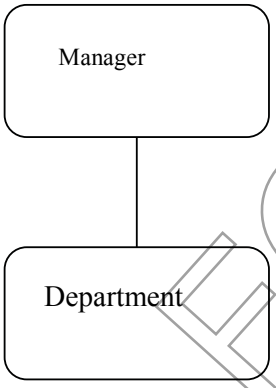
Entity Relationship Diagrams (ERDs)

Entity Relationship Diagrams show a system from the perspective of the data in the system i.e. they give a logical data view of the system.

An ERD shows the data in the system (i.e. the ***entities*** in the system) and their ***logical relationship***. *An entity is anything information about which an organisation records*.

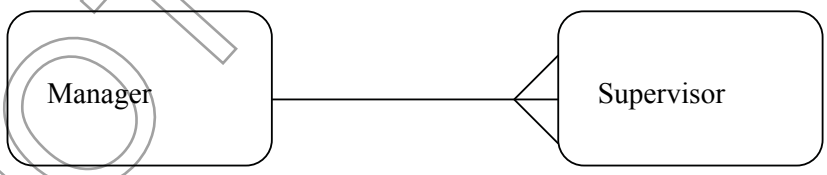
The Logical Relationships: Types

One to One (1:1) Relationships



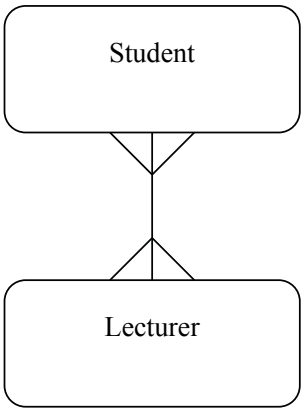
In this relationship, one Manager controls one department and one department is controlled by one manager

One to Many (1: n) Relationships



In the above relationship, one manager controls one or more supervisors but each supervisor is controlled by one manager

Many to Many (m:n) Relationships



In this relationship, One student can be taught by one or more lecturers and a lecturer can teach one student or many students

Named, Mandatory and Optional Relationships

It is possible to have named relationships in an ERD. Additionally it is also possible to include an indication of whether or not the relationship is optional or mandatory. Detailed discussion of these is considered outside the scope of this manual, however.

10.4.5 Systems Design

This is technical phase which considers both the computerised and the non-computerised parts of the system.

This involves:

Input Design, Output Design and Human – Computer Interface (HCI)
File or Database Design
Process Design
Security Design

At the end of this stage a System Specification is produced.

10.4.6. System Implementation

Implementation takes system development from design to operation. It involves a number of activities including:

Hardware and Software acquisition and installation
File conversion
Testing
Training
Changeover (Going Live)

Installation Activities

Site Selection

Factors to consider include the following:
Adequate space for computer and peripherals
Room for expansion
Proximity to user departments

Site Preparation

Things to be considered include:
Air conditioning
Back-up power
Fire protection devices

The Installation: Who does it?

Mainframe computers are commonly installed by the manufacturer or the supplier does the installation. The customers usually install microcomputers themselves.

. **Software Acquisition and Installation**

The decision on the type of software to be implemented will have already been made during design. One of the key questions during this time would be ***whether to usebespoke software or off-the-shelf packages.***

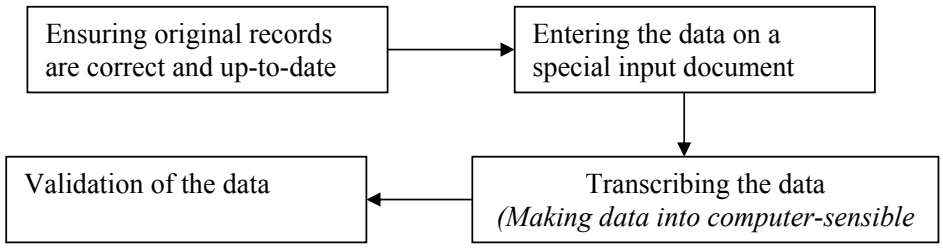
Installation of software is very simple as it involves using an installation guide (manual) and on-screen help.

. **File Conversion**

The new system will usually require a different format of data from the old data format. File conversion is the process of converting data from the old format to the new format that suits the new system.

Data preparation clerks can do data conversion manually. Alternatively, a conversion program can be used.

The following activities are involved when converting from a manual system:



Testing

In broadest sense, testing is about checking if the system developed meets its specification and the user requirements. The aim is to establish if there is proper coordination between the new system and hardware

User Acceptance Testing

The main purpose is to determine whether or not the customer will accept the system. Unlike the above-mentioned three testing stages, this involves user departments.

More specifically, the purpose is for User department's managers to:
Find errors not yet detected
Find out exactly what demands of the new system are for the users
Find out whether operating procedures are as expected.

The tests involve a number of checks including:
Error correction procedures
The link between manual and computerised procedures
Duration of processing routines
Capacity of files, file handling, updating and amendment
System controls
Data capture, preparation and input procedures

Changeover

Implementation of a new system cannot be complete without putting the new system into operation. The process of putting the new system into operation and abandoning the old system is called changeover.

Changeover can be done in several ways culminating into the following types of implementation:
Direct Changeover
Parallel Running
Pilot Run
Phased Implementation

Direct Changeover / Immediate Cutover

Direct changeover is where an old system is replaced by a new system at one go. The old system is completely phased out and is replaced with a new system.

Advantages
It's simple and quick
Inexpensive if no problems are experienced.

Disadvantages
Risky
Very costly if it fails.

Parallel Running

In this type of implementation, both the old and the new system are run in parallel for a predetermined period of time during which time data is fed into both systems and the results compared.

If the performance is satisfactory after the period, the old system is then fully abandoned and operation continues with the new system.

Advantages

- Very safe
- Provides a means for verifying results of the new system

Disadvantages

- Running two systems in parallel is costly
- It is time consuming

Pilot Run

This type of implementation involves selecting one section, department or division of an organisation and then implementing the new system in this part of the organisation to run in parallel with the old system.

When performance of the new system is satisfactory, that part of the organisation ceases to use the old system.

This is repeated for all parts, one at a time, until the whole organisation uses the new system.

Advantages

- Less risky than single direct changeover
- Less costly than complete parallel running

Disadvantages

- Can take long time to achieve total changeover.
- Not as safe as complete parallel running

Phased Changeover / Staged Implementation

This involves taking a complete logical part of the system and replacing it with the new system in that part. In other words it is implementing the new system sub-system by sub-system.

When this part is satisfactory, another part is switched.

Advantages

- Less risky than single direct changeover
- Any problems should be in one area –other operations in one area

Disadvantages

- Can take long time to achieve total changeover.
- Links between subsystems may make this impractical

10.4.7 Review and Maintenance

Review involves assessing the implemented system so as to check if the system is behaving as expected. Any discrepancy is investigated and, if need arises, the system is modified.

Modifying a system which is already in operation is what is called system maintenance.

10.5 System Documentation

Any computer-based system will not be considered complete unless it has documentation. There are two types of documentation – *technical and non-technical*.

Technical documentation relates mainly to the system development process and is primarily produced to help system analysts and programmers who will modify (maintain) the system. Most technical documentation therefore is produced as the system is being developed.
Examples of technical documentation include a Project Initiation Document (PID), a Feasibility Report, User Requirements Specification, System Specification, Code Design (Using Pseudo code [Structured English], Flow Charts, or Structure Charts), Code Listing, Test Data and Test Results.

The commonest non-technical documentation is a ***User Manual***, which among other things contains the following typical contents:

- Input responsibilities and procedures
- Error Reports
- File amendment procedures
- Output formats, content and use

Another equally important item of documentation is a ***computer operations manual*** which should contain among other thing the following:

- System set-up procedures
- Security procedures
- Reconstruction control procedures
- System Messages

Documentation Standards

A well-organized IT Department will have it documents standardized. Such a department will follow particular standards during the production of documentation. Additionally all its documents will have particular structures as governed by some agreed standards.

Benefits of Using Standards in Documentation

- Documents have consistent appearance

- The quality of documents is consistent even if they are produced by different individuals.
- Documentation is easier to read and understand
- Communication among different stakeholders of a system development project is more effective and efficient.
- Systems are easier to modify once the standards are known

10.6 System Development Projects

Introduction

It is normally the case that system development takes place as a project – a system development project.

Any project has a definite beginning and end i.e. there is a time constraint in every project – a project has a prescribed duration.

Apart from the time constraint every project will have a budgetary constraint.

It is of no use for a project to be completed on time and within budget but fail to meet the requirements agreed during the inception of the project.

Projects must therefore be completed on time, within budget and must meet its requirements fully. System development projects are no exception – the information system being developed **must be delivered on time, within budget and must meet the user requirements**. To achieve this, there is need for **proper project management**.

Composition of a System Development Project Team

In a project team of this kind, you would expect to find System Analysts, Programmers, client representatives and some administrative staff such as secretaries. Like any project the team is headed by a Project Manager who oversees the project from inception to completion.

The project manager is therefore responsible for planning, scheduling tasks, and controlling the project so as to ensure that it is completed on time, within budget, and that it meets the users' requirements.

The project manager also co-ordinates work done by different members of the team. Additionally, he solves any conflicts that may arise among the team members.

Normally the Project Manger reports to a **steering committee** which comprises of top-level management. It is the steering committee which is the ultimate decision-maker for the project. During feasibility study, for example, the project team simply recommends a solution. The steering committee makes the decision either to adopt the recommended solution or to reject it or call off the project.

Chapter 10 Exercise

1. An important part of any feasibility report is a section giving a financial justification for the proposed system. Describe in detail the matters dealt with in this section and the role of the management accountant in its preparation.
2. You have been asked to conduct an investigation into the efficiency and cost effectiveness of data processing within your organization. To which five aspects would you direct your attention. Give a brief explanation of each
3. Describe fully the work carried by systems analyst during systems investigation and analysis of a business system
4. What advice would you give to a systems analyst with regard to preparation for, and conduct of , a fact finding interview?
5. Outline the basic principles which should be borne in mind when designing a form for use in an organization.

CHAPTER 11

SOFTWARE DEVELOPMENT

This chapter introduces the stages and tools used in software development.

CONTENTS

LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Describe the stages involved when developing software.
- List program design tools such as program
- Construct decision tables and flowcharts.
- Describe file, database, input and output design.
- Describe structured programming and modular programming
- Describe program documentation

11.1. Introduction

This chapter looks at software development stages which are the major component of any computer-based Information System.

11.2. The Software Development Lifecycle.

The software development lifecycle is a series of stages involved in developing software. The stages include Program Specification, Problem Analysis, Program Design, Coding, Testing and Program Documentation. The following are brief explanations of the activities.

Program Specification

Every program is written to solve some problem. This problem has to be specified. The specification is a description of what the program is to do or achieve. For example, payroll software is to be written, the specification could include something like the following: A program specification indicates the following : the input files to be used in the program, the processing to be carried out, sample layout of the report

Once the specification is produced, the programmer has to understand the problem. He has to think of the program data and algorithms. For example he has to think of the data structures that will be required.

Program Design
Program design involves **designing the algorithm** (step-by-step method of solution) using flowcharts or pseudo code, or some other suitable design tool as stated earlier in the introduction section(1) above. This is the design of the logic of the program.
Program design also involves design of the program user interfaces i.e. **the design of the program's input and output screens** as well as **the design of data structures** (such as files and database).

Coding
Once the logic of the program has been produced using a flowchart, for example, the programmer translates the program design to actual program code (in the chosen language of implementation e.g. Visual Basic or Java).

Testing and Debugging
As the program is written it is checked to see if it is running according to its specification. If not, it means the program has bugs. A **bug** is an error in a program. **Testing** is the process of detecting errors in a program.
Any detected errors need to be located and removed. **Debugging** is the process of locating and removing program errors. Only after a program is thoroughly tested and debugged it is considered ready for commissioning to the client.

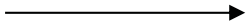
Documentation
Program documentation includes all descriptions, textual or in diagrams, relating to the development and operation of the program. This includes program design documentation (e.g. pseudo code and flowchart), test data and test results, and the program's user manual.

11.3. Flowcharts

What are flowcharts?
Flowcharts are another major program design tool. A flowchart clearly shows the logic of the program's statements (instructions)-the sequence in which the program statements will (have to) be executed by the computer when the programs is run. This is the same information shown using pseudo code. However, the difference is that the flowchart is a diagrammatical description while pseudo code is a strictly textual description that uses structured English (see Section 3 above).

Symbols
There are, generally, no conventional (standard) symbols for flowcharts and, as such, it is very important that in an exam you include a key for your flowchart. However many authors have used the following symbols.

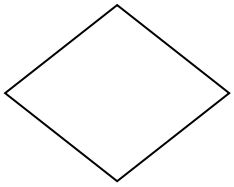
Start/Stop



Logic Flow

Input or Output

Process



Decision

Connector

Example Flowcharts

We shall now produce the flowcharts for Example Specification 1, Example Specification 2, and Example Specification 3 given below:

Example Specification 1

The program should accept an applicant's details (Name, age, academic qualifications, and professional qualifications) and assess whether or not the applicant qualifies or not. Assessment includes checking age, academic and professional qualifications. Results of the assessment must then be viewed and a hard copy produced.

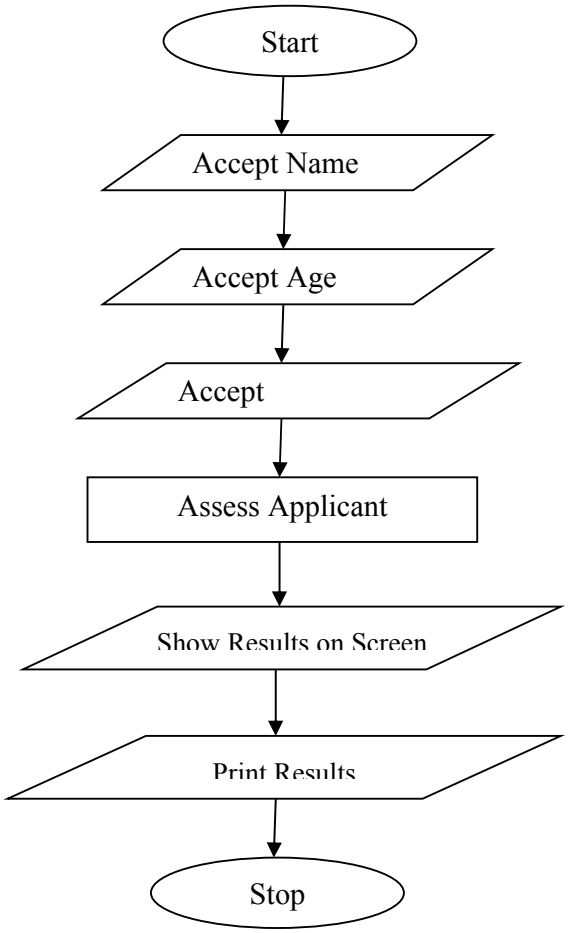
Example Specification 2

The program should accept an applicant's details (Name, age, academic qualifications, and professional qualifications) and assess whether or not the applicant qualifies or not. . Assessment includes checking age, academic and professional qualifications. **If the applicant qualifies, the applicant's record should be marked as "accepted" and as "rejected" otherwise.** Results of the assessment must then be viewed and a hard copy produced.

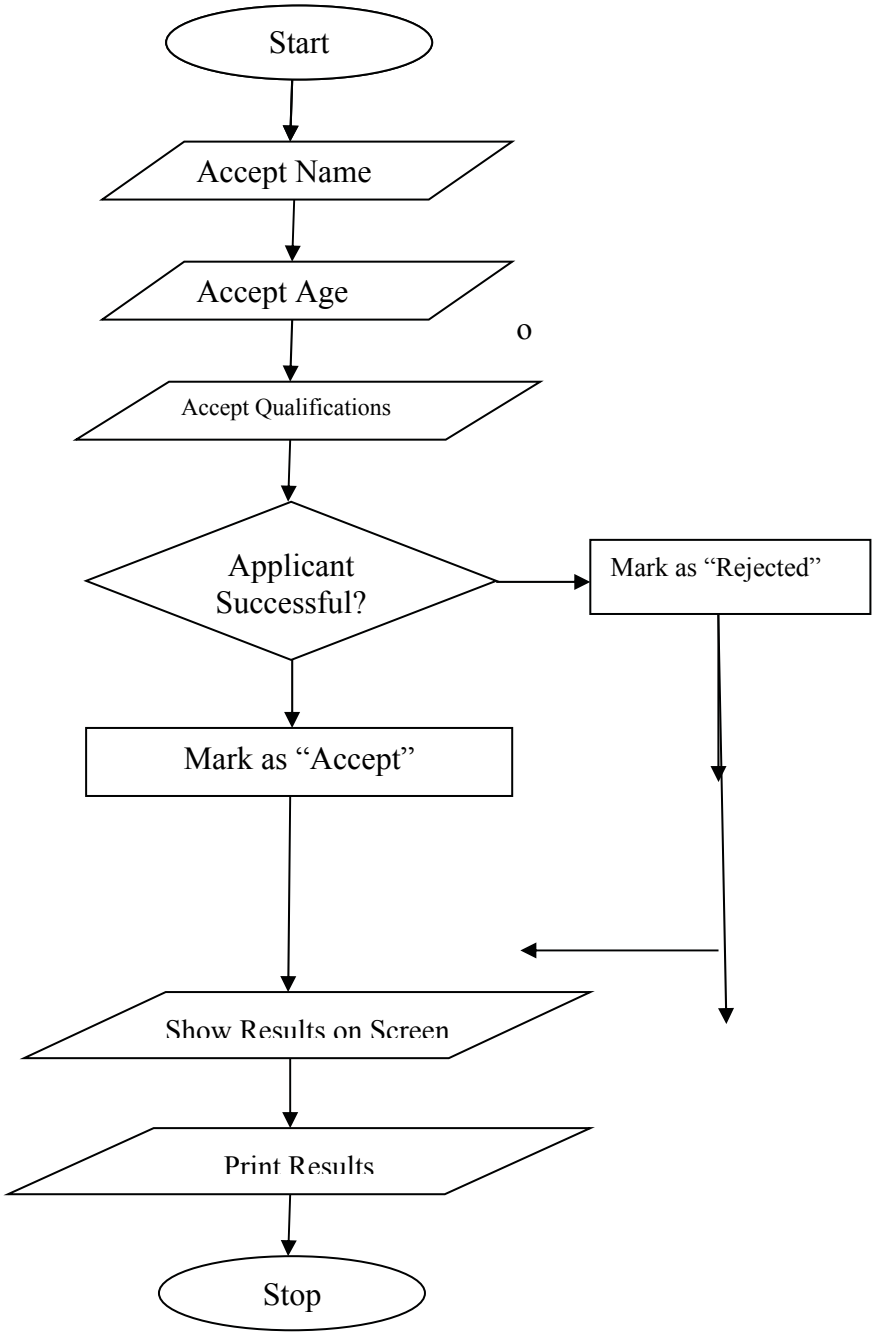
Example Specification 3

The program should accept an applicant's details (Name, age, academic qualifications, and professional qualifications) and assess whether or not the applicant qualifies or not. . Assessment includes checking age, academic and professional qualifications. If the applicant qualifies, the applicant's record should be marked as "accepted" and as "rejected" otherwise Results of the assessment must then be viewed and a hard copy produced. **This is repeated for all applicants (as per the application forms).**

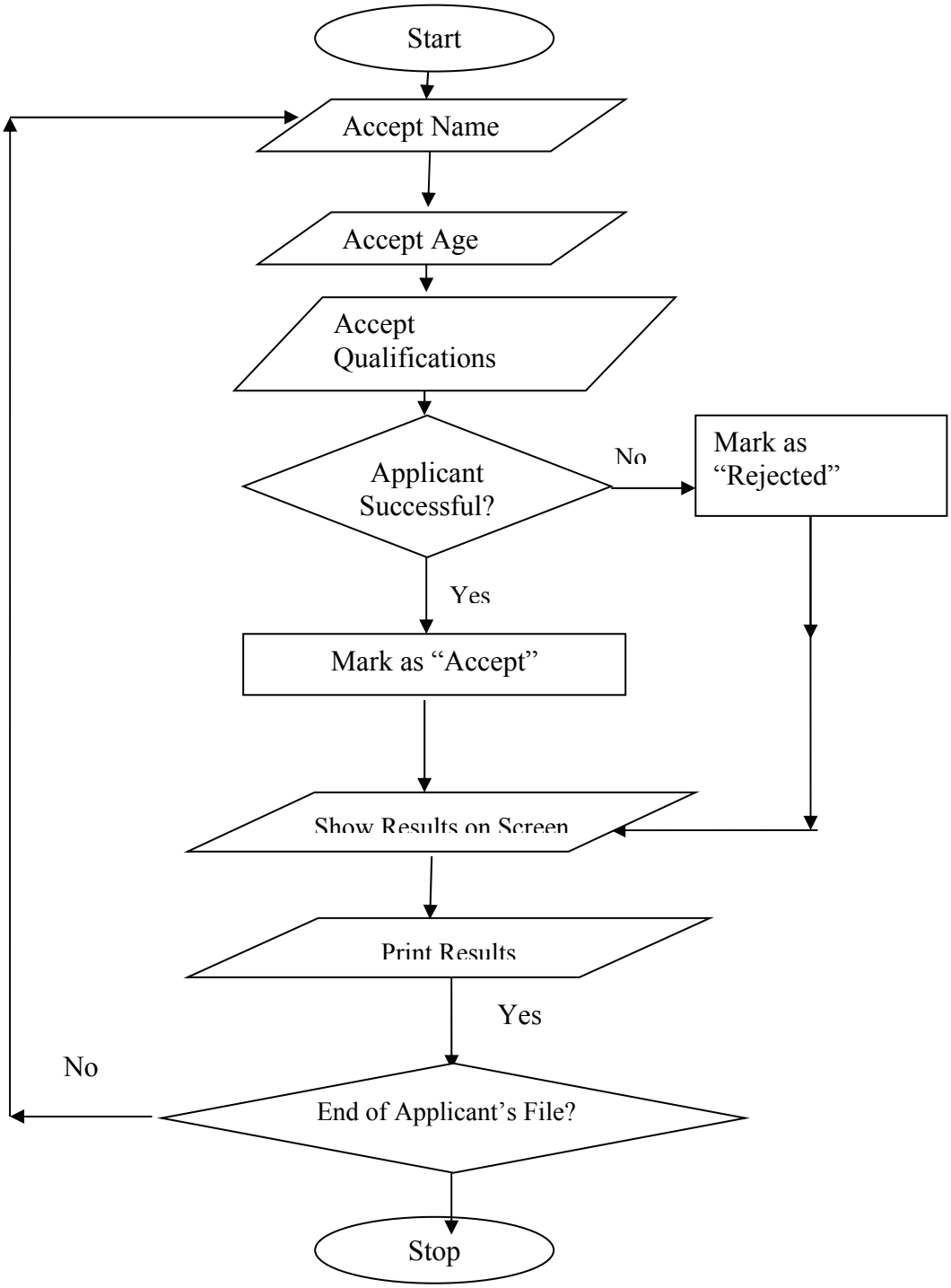
Flowchart for Example Specification 1



Flowchart for Example Specification 2



Flowchart for Specification Example3



Decision
Program Documentation

Importance of Program Documentation

A program is never considered complete until it has the associated documentation. Program documentation is very vital for eventual program maintenance (modification). A program's requirements changes over time and to maintain the program's relevance to the organization's needs the program will need to be changed. Technology changes may also necessitate program maintenance.

To effectively modify a program, there must be adequate information about its original requirements, design, code, test results, etc. This information is the program's documentation.
In addition, users cannot easily use the program if there are no accurate, clear and easy-to-follow instructions. The user manual is therefore very important item of documentation.

Contents of Program Documentation

- Flowcharts indicating the broad characteristics of the system
- All data flow diagrams, if any.
- An entity relationship diagrams if available
- Decision tables (see section on Decision Tables above) outlining the logic of the system regarding the nature of conditions to be provided for and the actions required to deal with them when they arise.
- Program coding sheets of the source program prepared by the programmer and the program listing obtained from compilation
- Operating instructions for running the program
- Input and Output File Formats.
- Data Structure charts
- Charts relating to input, process and output
- Amendment sheet
- Program narrative
- Current version
- Sample listing of the program
- Sample result listing

11.4. File and Database Design

The conventional File System and the Database Approach
A program consists of algorithms and data structures. The instructions work on data. Some data is entered by users while other data is obtained from secondary storage devices such as the hard disk.
There are two approaches in which data can be stored – as a set of files using the conventional file system or as a database the approach of which is called the database approach.

The major differences between these two approaches are summarized in the following table

The Conventional File System	The Database Approach
There is a risk of data redundancy	Data redundancy is minimal through a process of normalization
There are lots of data integrity problems	Data integrity is maintained
Data structure is application-specific	Data is independent of the programs that use it.
Simultaneous multiple views of the same data is not possible	Data supports multiple views of multiple users, allowing simultaneous multiple access of the data by users
New application programs require new files	New applications can be developed which will use the same existing database.

The Conventional File System

Basic Definitions

File
A file is **a set of related records**. , for example an Employee File, consists of Employee Records.

Record
A record is **a collection of related fields**. , for example an Employee record, would consist of such records as Employee Name, Date of Birth, Sex, Date Employed and Basic Salary.

Field
A field is **an attribute of a record**. A field consists of one or more characters.

Types of file
Traditionally, files have been classified as follows:

Master File.
This is a set of related records for an organization which contains the essential data needed to support the organization's operations. It consists of both dynamic as well as relatively static data, for example an Employee Master File, would consist of Employee Records some of fields are relatively static (such as Employee Name) while other fields are changed frequently.

Transaction File
In a batch processing system, transactions are grouped into a batch. The batch file is then processed later to update some master file(s).
A transaction file is a file that is used to update a master file.
Archive File
This is a file that contains information that is for historical purposes.

Reference File
This is a file that is used as a source of information during processing. A good example would be a tax rates file that will be accessed in a payroll processing activity.

Temporary File
This is a file which is created during processing for processing purposes but is not stored after the **processing** is completed.

File Organization
File organization is arrangement of records in a file.

The following are descriptions of some file organization techniques.

Serial File Organization
The records appear in no order at all. Access to the records is serial i.e. to access the n^{th} record, you have to access the first n-1 records.
This organization can be used in a batch processing system since the hit rate is very high.

Sequential File Organization
The records appear in the order of the record's key. Access is therefore sequential in the order of the record's key. Like serial file organization, it can be suitable in batch processing system.

Indexed Sequential File Organization
The records appear in the order of the record's key and in addition an index is maintained to allow direct access to a particular record. Access is sequential or direct.
This is suitable in processing environments where there are usually high hit rates with occasional need to directly access a particular record.

Direct (Random) File Organization
The records of the file do not necessarily appear in the order of the record's key but there exists a direct relationship between the record's key and the location of the record on the secondary storage medium. This direct relationship, called a hushing function, enables direct access to a particular record in the file.

The Database Approach
Database approach is a computer based storage technology in which related data is shared by various application programs. It is an improvement of traditionally file-based approach of storing data or information. It is characterized by a database management system and one or more databases.

What is a database?

A database is a collection of data that is organized so that its contents can easily be accessed, managed, and updated.

Advantages and Drawbacks of databases

Advantages of databases include the following:

- Data redundancy is minimal
- Data independence is achieved
- Data integrity is maintained
- Supports simultaneous multiple access of the data by multiple users
- New applications can be built which use the same data.

Drawbacks include

- Initial design and development can be complex and costly.
- It requires more rigorous security measures since you have only one copy of the data elements.

The Database Management System (DBMS)

All accesses to the database by programs are done via the DBMS. The DBMS is a suite of programs that allows efficient creation and maintenance of, and retrieval of data from a database.

Relational Databases

Relational Database Model Example: Two Tables for a Student System Registration for a Business College

Student Table		
Student ID	**Student Name**	**Course Code**
10023	Phiri Nancy	PAEC-TECH1
10024	Banda Adwel	CFA
10025	Miyovano Kelson	PAEC-TECH1
10026	Muhango Milton	PAEC-TECH2

Courses Table		
Course Code	**Course Description**	**Course Fees Per Subject**
CFA	Certificate in Financial Accounting	12,000
PAEC-TECH1	PAEC Technician Level 1	14,000
PAEC-TECH2	PAEC Technician Level 2	14,000
PAEC-TECH3	PAEC Technician Level 3	14,000
PAEC-FOUND	PAEC/ACCA Joint Foundation Programme	25,000

Note: The two tables, as can be seen, are related by Course Code (the key field for the Courses Table). A database typically consists of several tables all linked up in this way. Other tables in this database could be Subjects Table, Lecturer Table, etc.

The tables shown obviously have other fields (columns) apart from those shown above.
The rows are called **tuples** (or **records**) while the columns are called **attributes** (or **fields**). Thus the courses table has 3 fields and 5records.

Chapter 11 Exercises

1. Why is documentation necessary in the development of programs, explain various documenting techniques which are useful for programmers.
2. Discuss the structure of flowchart? What guidelines should be followed while making a flowchart?
3. Explain the characteristics of a good computer program
4. Enumerate in details fundamentals of a database

CHAPTER 12

DATA PROCESSING OPTIONS

12.0 BATCH AND ONLINE PROCESSING

The manner in which data are input into the computer affects how the data can be processed. Processing can either be in batch or online.

12.1 Batch processing

In batch processing, transactions such as orders or payroll time cards are accumulated and stored in a group of batch until the time when it is efficient or necessary to process them, the transactions are accumulated in a ***transaction file*** which contains all the transactions for a particular time period. Periodically this file is used to update a ***master file*** which contains permanent information on entities.

.

Batch systems often use tape as a storage medium.

Batch systems are used in business systems that require reporting on less frequent bases for example daily, weekly, monthly.

Mostly batch systems are required by high level management, higher level management require more information, more events or transactions to assist them in making decisions, so information collected from batch processing can be used to make decisions since it results from accumulated data.

BATCH PROCESSING

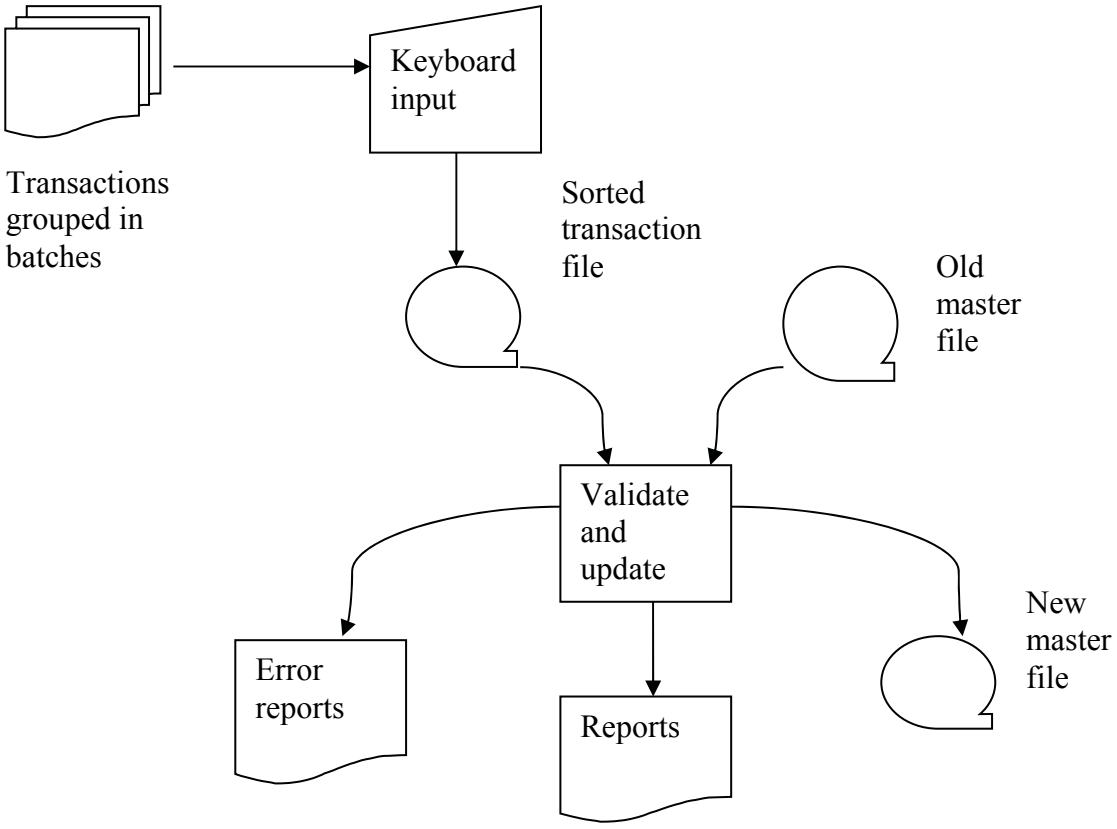


Fig 5.11: Batch processing

12.2 Online processing

Online processing means users directly enter information online it is validated and updated directly onto the master file. No new file is created in this case. Therefore, there is near immediate input process, and output. Imagine a cash dispenser transaction or booking a holiday at a travel agent.

The transactions are usually processed immediately, in online systems the usually responds immediately.

Here the master file is updated continually from transactions e.g. hotel reservations, online reservations. Online systems require minute by minute reporting or spot report.
It holds current information.

These systems are usually used by low level management which requires less data to report on, usually a report of a single transaction.

Information from online systems cannot be used to make strategic decisions.
These systems are more expensive compared to batch processing mainly in terms of equipment used.

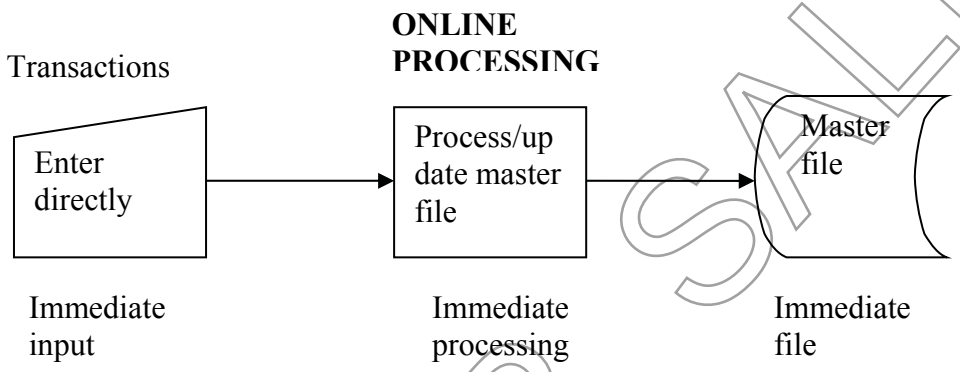


Fig 5.12: Online processing.

Chapter 12 Exercises

1. Briefly describe the stages of software development process.
2. What are flowcharts and what are they used for?
3. List 10 items that program documentation must contain

CHAPTER 13

DATA REPRESENTATION

13.1 Types of Numbering Systems

There are 4 types of numbering systems

a) The Decimal Numbering System

The decimal numbering system has values 0 to 9 i.e. 0 1 2 3 4 5 6 7 8 9. The numbers are to base 10. These are numbers in everyday use.

b) Octal Numbering System

These are numbers to base 8 as there are 8 values used in the numbering system i.e 0 1 2 3 4 5 6 7

c) Hexadecimal Numbering System

These are numbers to base 16 and uses 16 symbols i.e. 0 1 2 3 4 5 6 7 8 9 A B C D E F. the letters A,B,C,D,E,F are equivalent to 10,11,12,13,14 and 15 decimals

d) The Binary Numbering System

- Has values 0 to 1 .i.e. only 0 1
- Binary codes – refer to the binary notation used in computer system

Types of Character Coding System

i) *ASCII (American Standard Code for information Interchange).*
Uses 4 bits to represent a character. It is the code mainly used on magnetic tapes

ii) *BCD (Binary Coded decimal)*
Uses 6 bits to represent a character

iii) *EBCDIC (Extended Binary Coded Decimal Interchange Code)*
An 8-bit code which is used in modern computers

13.2 REPRESENTATION OF DATA

Data is represented on the machine electronically by storage cells which are either charged or discharged. Another way of saying the same thing the cells which may be viewed as electronic switches are either on (charged) or off (discharged). In short the storage is based on the two state idea of the cells, on or off. If an on can be taken to mean 1 and off to mean 0 then use can be made of the binary system which has 0 and 1 as the only digits.

Comparing internal memory with backing storage:

It is always **faster** to access data from **internal memory** than from backing storage.

Data stored in internal memory is **lost** when the computer is turned off but data stored in backing storage is **retained**.

When programs are run or data files are loaded the contents are **copied from** the backing storage **to** the internal memory of the computer.

Internal memory is **much smaller** than backing storage. It is far too small to hold **all** the data/programs that would be on the backing storage of a typical computer.

When you **run** a program or **load** a file they are copied from the backing store into the internal memory.

When you **save** a file it is copied from the internal memory to the backing store.

Data stored in internal memory is **lost** when the computer is turned off.

How memory works:

Programs and data files are stored as binary numbers. Binary is made up of just 0's or 1's unlike decimal numbers (0-9).

To **store** the **0**'s and **1**'s while the computer is running you need a memory chip. This is made up of millions of tiny electrical switches called transistors. They can store a **0** or a **1** by the 'switch' being either **open** or **closed**. This **0** or **1** is the simplest unit of memory and is called a '**bit**' (***B**inary Digi**t***).

Bits are arranged in units of eight to make a **byte**. One byte can therefore store eight **0**'s or **1**'s in **256** different combinations. (00101011 *and* 01110110 *would be just 2 possible combinations for example*).

One byte is a very small amount of memory and it is more usual to refer to **kilobytes** (**KB**), **megabytes** (**MB**) and **gigabytes** (**GB**).

1kB (kilobytes) = 1024 bytes (*approximately 1 thousand bytes*)
1MB (megabytes) = 1024KB (*approximately 1 million bytes*)
1GB(gigabyte) = 1024MB (*approximately 1 thousand million bytes*)
1KB of memory could store roughly one full A4 page of text.
600 MB (on a CD-ROM) could store roughly the text contents of a 10 volume encyclopaedia.

Encoding Data:

Memory chips can **only** store **binary numbers** so other data such as sounds, images or text has to be **encoded** into binary (*digitised*).

If you want to store a **character** from the keyboard the computer gives it a number code made up of eight bits (*1 byte*). These text codes are the same internationally and are called the **ASCII code** (***A**merican **S**tandard **C**ode for **I**nformation **I**nterchange*).

The code for the letter '**a**' is **01100001** (*see below*). **One byte** of memory is therefore used to store the letter '**a**' (*in code*) on a memory chip.

Remember - since computers can only store binary numbers, all computer data has to be in this **digital** format. Images, sounds, video etc. all have to be **digitised** before they can be processed by a computer.

How the letter 'a' is stored in 1 byte of computer memory:

	1 BYTE (*8 bits of memory*)							
Contents of each **bit** =>	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**

BINARY SYSTEM

The binary system of numbers is that which has 0 and 1 as its absolute numbers and value depends on the position of the digits. Each position is a power of 2. The examples below will help to make the concept clear.

The actual presentation is done by arranging the powers of two from right to left.

The value of any number is made by a combination of the powers of two. If there is a 1 in that position it means there is a power of 2 and if there is 0 there is no power of 2 meaning the value in that position is zero. The sum of the values of the powers of 2 gives the binary or decimal number equivalent in value.

What comes out here is that any decimal number can be represented by a combination of the digits 0 and 1 in their appropriate positions. It can be extended here that on the computer the alphabetic characters, and other are given numerical values and therefore are represented by binary digits as well.

Chapter 13 Exercises

1. Define a number system
2. Explain the decimal system, why is it called decimal. What is the base in this system.
3. Why is it easy to convert from binary to hexadecimal and vice versa?
4. Convert 950 decimal to binary equivalent

CHAPTER 14

INFORMATION SYSTEMS SECURITY AND CONTROLS

This chapter tackles the activities involved in the implementation of a system, and post implementation review.

CONTENTS

LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Describe the various security threats to computer-based information systems.
- Explain the significance of disaster recovery plans
- Describe contents of a disaster recovery plan

14.1. What do we mean by Information systems security?

When an organisation uses IT, it exposes itself to business and personal safety and health-related risks that would otherwise not exist if IT were not in use.

For example, if your operations are computerised,

- What happens if the computers are stolen, broken down or destroyed by fire or water?
- What happens if the programs are copied by your competitors behind your back?
- What happens if the data gets destroyed by viruses?
- What if your employees sue you for not protecting them against radiation emissions from VDUs?

When in use, computer-based systems have to be secure. The hardware must be protected from physical damage and theft, for example. The programs must be protected from being misused and from getting corrupted by viruses. The data must not only be accurate but also be protected from being disclosed without authority, from being destroyed accidentally or intentionally and from being corrupted by viruses.

Such risks must be identified and appropriate measures taken that will see the risks being prevented from occurring or that will see the risks being minimised. In other words, we need to be able to identify the risks and decide on how we can minimise the chance of the risks actually

occurring or, in the event that the preventative measures have failed, minimise the effects of risks.

14.2. Risks to hardware

The following table summarises the remedial measures for risks to hardware.

Risk	**Remedy/prevention**
Fire	Smoke Detectors
	Fire Extinguishers
	Use of appropriate building material
Water and Floods	Use of waterproof ceilings
	Avoid building in basement areas
	Avoid liquid spillage
Lightening Storm	Lightening Conductors
	Generators
	Uninterruptable power supply (UPS)
Humidity	Air conditioning
	Humidity sensors or hygrometers placed in the computer room
Theft	Guards
	Door Locks
	Security Cameras
	Burglar alarms

14.3. Risks to data

Human Error

Human error is one of the common sources of errors in data.

Remedies

- Proper training of users
- Data Verification and Data Validation
- Password use

Verification

This is the process of ensuring that the data entered in the computer is the same as that on the source document.

Verification will involve in most cases checking what's on the screen against what's on the source document.

Validation Checks

Validation involves checking that the data entered is suitable for the subsequent processing to which the data will be subjected.

There are a number of validation checks and the table below gives some of them.

Validation Check	Comment
Format Check	Is data in required and correct format?
Range Check	Is the data value within a given range?
Limit Check	Is data value greater than (less than) a certain number?
Existence Check	Does the data exist in the database?
Consistency check	Is entered value consistent with other earlier data limitations?

Password Use

A password is a set of characters that is required to be entered before further access to a program, data or some other facility is allowed.

Passwords provide logical access control to a system.

Dos and Don'ts for Passwords

- Must be kept secret
- Must not be obvious
- Do not write it down
- Must be changed regularly
- Must be changed in privacy

Malicious Damage

Remedies

- Physical access control e.g. use of door locks, burglar alarms, and guards
- Logical access control by use of passwords

14.4 Viruses

A virus is a malicious program. It attacks and destroys data or other programs. It replicates itself as it attacks the programs and data.

Containing the Virus Threat

- Use anti-virus software to detect and remove viruses from your system. Ant-virus software is software that detects and removes ***known*** viruses. To get the best from anti-virus software, you need to continually get the software updated to cater for new viruses
- Avoid playing unlicensed games on company computers.
- Avoid downloading suspect freewares.
- Avoid the use of pirated software. Again, pirated software is a common target for virus writers. Pirated software are illegal copies of software
- Scan any disk from outside the organisation before being used.
- Avoiding opening e-mail from unknown sources.

14.5 Ergonomics and Risks to the User

What is ergonomics?

Ergonomics refers to the interaction of people and machines in the work environment, including the design of jobs, health issues, and the end-user interface of Information Systems.

Health Risks to the User

Risk	Remedy
Eye sores, eye strain	Antiglare filters, Adjusting light on the VDU
Backaches and other posture-related pains	Adjusting VDU tilt angle, proper arrangement of the desk, taking frequent breaks.
Headaches	Take frequent breaks
Electric shock	Proper training; proper wiring,

14.6 Disaster Recovery

Introduction

With regard to information systems, a disaster would be something like this:

- A virus attack on the organisation's file server that has completely destroyed the file server and making all Information System services unavailable.
- A fire accident that has burnt the building housing the organisation's computer systems such that all the computers are burned.
- A fire-fighting activity in the upper floor of a building resulting into all the organisation's computers downstairs being destroyed by the resultant flooding.

Such a disaster would need to be prepared for and, in particular, a disaster recovery plan must be put in place so as to ensure that operations are resumed in the shortest time possible if a disaster occurs. Of course, in the first place as a way of dealing with a disaster, the disaster must be prevented from occurring. A fire accident can be prevented, for example, by avoiding smoking in the computer room.

IT Disaster Recovery (DR) Plans provide step-by-step procedures for recovering disrupted systems and networks, and help them resume normal operations. The goal of these processes is to minimize any negative impacts to company operations. The IT disaster recovery process identifies critical IT systems and networks; prioritizes their recovery time objective; and specifies the steps needed to restart, reconfigure, and recover them. A comprehensive IT DR plan also includes all the relevant supplier contacts, sources of expertise for recovering disrupted systems and a logical sequence of action steps to take for a smooth recovery

Contingency Considerations in a Disaster Recovery Plan

- **Full System Backups**
  All software being used in the organisation should be fully backed up on site. There should also be backup copy of the organisation's database, similarly.

- **Off-site Storage**
  There should also be a full system backup stored off-site.

- **Standardization of Hardware and Software**
  Disaster recovery would be much easier if hardware and software are standardised.

- **Configuration Management**
  Configuration Management is the process of keeping track of all versions and software keys of software. It is important that all changes to the system are properly documented and checked on a regular basis. .

- **Security Policies**
  A formal *IT/IS Security and Disaster Recovery* ***Policy*** should be developed and the organisation must ensure awareness of, and adherence to, the policies therein contained. This should guide what should be done in as far disaster preparedness and recovery is concerned.

  This policy document should be updated on regular basis (e.g. annually) and also as and when there is a major system development.

- **Communication to Customers and Other Stakeholders**
  It is important to ensure that there is someone who is to act as the spokesperson when a disaster occurs.

- **Identification of Disaster Recovery Teams**
  Apart from the spokesperson, there should be identified Disaster Recovery Teams of employees which would be involved in restoring the operations in case of a disaster. Teams to include service providers e.g. vendors, ambulances, police, fire fighters
  Each team member is required to keep this updated policy document at their house and not in the office.

The Disaster Recovery Plan – What Should Be Included

- **A contingency planning policy statement.**

  It is very important to include an approved statement of policy regarding the provision of disaster recovery services A ***formal policy*** provides the authority and guidance necessary to develop an effective contingency plan.

- **Objectives**

  These are the main goals of the plan.

- **Disaster Recovery Team**

  Members and contact information of the DR team.

- **Key Personnel Contact Information**

  It is very important to have key contact data near the front of the plan. It's the information most likely to be used right away, and should be easy to locate. Contacts of hardware, software, and network service providers to be contacted. Contacts of the Disaster Recovery Teams also need to be readily available.

- **Plan Overview –**

  Describes basic aspects of the plan, such as updating.

- **Emergency Response**

  Describes what needs to be done immediately following the onset of an incident

- **Emergency Alert, Escalation and DR Plan Activation –**

  Steps to take through the early phase of the incident, leading to activation of the DR plan.

- **Media**

  Tips for dealing with the media**.**

- **Insurance**

  Summarizes the insurance coverage associated with the IT environment and any other relevant policies.

- **Financial and Legal Issues**

  Actions to take for dealing with financial and legal issues

- **Business Impact Analysis of the Risks**

  The business impact analysis helps to identify and prioritize critical IT systems and components. More resources can then be allocated to critical IT systems appropriately.

- **An IS / IT Security Risk Analysis**

  A brief description of risks and their analysis which can involve classification of the risks as being very high risks, High Risks, Very Low Risks, Low Risks, etc depending on their likelihood and impact on the organisation should they occur.

- **Specification of Preventive controls.**

  These are measures that reduce the effects of system disruptions and can increase system availability and reduce contingency life cycle costs. These include, in case of a fire accident for example, "***no smoking in the computer room***" policy. ***Regular data backups stored off-site*** is another example.

- **Develop recovery strategies.**

  Thorough recovery strategies ensure that the system can be recovered quickly and effectively following a disruption. These include:-

  - Setting up disaster recovery teams.
  - Arrangement with third party suppliers of hardware, software and other IT service providers such as computer bureau.
  - Off-site back-up for key hardware components
  - Off-site data back-up
  - Off-site software back-up
  - Training Disaster Recovery Staff on executing recovery procedures.
  - Regular Updating of the Plan itself.

- **IT contingency plan.**

  The contingency plan should contain detailed guidance and procedures for restoring a damaged system.

- **Testing, Training and Exercising Plan.**

  Testing the plan identifies planning gaps, whereas training prepares recovery personnel for plan activation; both activities improve plan effectiveness and overall agency preparedness.

- **Maintenance Plan.**

  The recovery plan should be a living document that is updated regularly to remain current with system enhancements.

Chapter 14 Exercises

1. Explain, with examples where appropriate , the following methods of checking validity of data entering a computer system : verification, range checks and limit checks
2. Describe in detail the checks and controls that can be applied to input data before it is used to update a master file. Assume a batch processing system
3. In relation to information systems what are viruses and how are they spread?
4. What is computer fraud and state measures that should be in place to guard against computer fraud.?
5. Describe the major components of a disaster recovery plan

CHAPTER 15

INFORMATION SYSTEM MANAGEMENT

This chapter aims at introducing the methods of system management.

CONTENTS

- **Data processing department**
- **End user management/ computing**
- **Computer bureau and other service organisation**

LEARNING OBJECTIVES

On completion of this chapter students should be able to

- Understand the data processing department by function
- Define end user computing
- Understand the role of the information center
- Understand the different types of computer bureau
- Know the advantages and disadvantages of computer bureau.

15.1 DATA PROCESSING DEPARTMENT BY FUNCTION

Main sections of the data processing department

15.1.1 Head of department

This person is also known as the data processing manager.
Responsible to Managing Director or Director of Finance according to specific requirements

Immediate subordinates:

- Chief systems analyst
- Chief programmer
- Operations manager
- Database administrator

These duties include:

- Controlling immediate subordinates in the attainment of project objectives
- Formulating, interpreting and executing data processing policy
- Ensuring that the company policy is adhered to
- Ensuring that computer operating instructions are up to date
- Liaise with users to see to it that their interests are fully provided for
- Assessing the effectiveness of the file maintenance procedures
- Ensuring that staff attend suitable training courses for their continuous professional development
- Assessing performance of staff for and conducting staff appraisals
- Resolving conflicts between subordinates
- Providing guidance on data processing problems
- Developing and implementing data processing standards
- Assessing the suitability of file security procedures
- He/she is also responsible for post-implementation evaluation

15.1.2 Chief systems analyst

Responsible for activities of systems analysts
Below are the duties of a chief systems analyst:

- Reviews the performance of their subordinates (systems analysts)
- Liaising with users to ensure their requirements and problems are taken into account
- Compares the cost and performance of alternative processing techniques
- Organizing and coordinating the activities of system analysts
- Reviews systems documentation to ensure it complies with data processing standards.

15.1.3 Chief programmer

Chief programmer is the one responsible for the activities of programmers.
Below are the duties of the chief programmer

- Reviews programmers' performance
- Reports program status to the data processing manager
- Defines test data and monitors test runs.
- Reviews system requirements/ specification from users to establish the details of system requirements
- Liaise with chief systems analyst to establish the type of programming language to use

15.1.4 Operations manager

Responsible for activities of the computer operator, data preparation supervisor, data control supervisor etc.
His/her duties include:

- Reporting to data processing manager situations such as hardware malfunction, staffing problems and other operational matters
- Maintaining a log of computer operations
- Ensuring that data is received on time from users
- Maintaining records on equipment utilization
- Implementing standard procedures to improve efficiency
- Developing operating schedules for all jobs to be run on the computer
- Control all his subordinate sections.

15.2 Database administrator (DBA)

Database administrator should play an active part in the planning of information systems particularly with regard to feasibility studies.

He/she should be an expert in all file management techniques and be able to advise management and system planners of the capabilities and shortcoming of various file management systems with regard to the application under review.
The DBA liaise and consult with project teams with regard to the development of design specifications, program specifications, system documentation etc.
The DBA is responsible for monitoring the implementation of a database ensuring that time and cost constraints are adhered to.
He/she must ensure that system objectives are achieved.
The initial preparation and maintenance of a data dictionary is also the responsibility of a database administrator.

15.3 End user management and computing

End user computing is also referred to as end user development. End user computing describes a situation in an organization where ordinary end users of systems develop their own application for use in their work.
Traditionally, most users of computer generated information had no control over the computers and applications that produced the information they needed. Information system design and development were controlled by the systems department.
The growth of micro computers and associated software applications has reduced the complexity and cost of computing to the point where now it is possible for end users to have some control of their own processing activities.
For example an accountant can develop a payroll system using MS Excel.
End user computing supports the notion that the person who needs the information should be the person who obtains it from the system. Similarly, the end user who is responsible for obtaining the correct output should be actively involved in the development of the information system that supplies it.

Advantages of end-user computing

- Systems developed meet the user requirements since it is the users themselves who are involved in the development
- End- user computing minimizes the turnaround time from the user request to implementation of an application – end user computing significantly speed up development time.
- End-user computing also relieves programmers of some programming effort, since not all of the work will be performed by the programmers.

Disadvantages of end-user computing

- Quality of systems developed is usually poor since the end-users are not trained professionally to develop systems.
- Incompatible systems can be developed in the organisation since each user usually develops the applications using different standards.
- There is a possibility that users from different department might end up creating redundant applications as such data integrity and security problems could occur.

The information center

An information center is a part of the organization that is created to facilitate end-user computing.
The information center provides instruction in the usage of information systems, allocates computing resources to users.
The information center is responsible for:

- Technical support – helping end users with software , hardware , communications and other technically related processes
- Education – training end users on new hardware and software
- Systems consulting – helping end users to define and solve their systems problems
- Resource allocation - carrying out the functions of software, hardware and information distribution
- Evaluation – looking at the possible applications for new products

The major function of an information center is to encourage the use of distributed processing and end-user computing throughout the organization.

End user computing supports the fact that the person who needs the information should be the person who obtains it from the system and therefore should be involved in the development of information systems. Information centers support end-user computing. Overall end-user computing provides quicker turnaround time from request to delivery of an application and lower development costs.

15.4. Computer bureau

A computer bureau is a company which operates a computer to process work for other companies, a computer bureau can also be defined as a company that offers services related to computing to other organisations or individuals particularly those which cannot justify a computer of their own.

It is necessary to choose a computer bureau which is both reliable and efficient.
When choosing a computer bureau there are factors or steps that need to be considered, below are some of the major factors to be considered:

- Experience, reliability, reputation of the computer bureau
- Confidentiality and security issues
- Turn around time i.e. time taken for your data to be processed
- Availability of stand by facilities
- Caliber of staff employed
- Integrity
- Competitiveness and market standing
- Their approach to technological developments
- Number years established i.e. how long have they been in existence.
- Availability of adequate operating systems and software compatibility.

Services provided by computer service companies

Many bureaus have expanded the range of services they provide and are now called computing service companies, below are some of the services provided by computer bureau and computing service companies.

- **Hardware:** computer service organisations supply and install computer equipment including micro, mini and mainframes
- **Software:** apart from providing software support, some companies develop software packages for distribution or develop customer tailored software for individual companies basing on specifications provided by the customers.
- **Staff provision:** this is where a company transfers all or part of its data processing facility to a contractor, contracts vary according to specific needs of individual customers, this is also called facilities management and can provide an efficient service at a cheaper rate.
- **Consultancy:** some companies require a service of a consultant before embarking on the installation of computerized systems and others will need advice on specific problems of a data processing nature, computing services organisations offer consultancy services
- **Turn key services:**this is the supply and installation of a computer system in such a complete form that the user need only to turn a key for them to commence using the system, here the user figuratively turns a key to gain access to the system.
- **Security and courier services**

Other services offered by computer bureaus

- **Data preparation and conversion:** this involves conversion of source data into a form that a machine can understand and process
- **System investigation and design:** this consists of analyzing the existing procedures and converting them into a form that a computer can process.
- **Hiring computer time:** here the service to the client involves processing the client's data using the programs supplied by the client, the hire charges vary according to the time of the day the service is provided and the length of time taken.

- **Do it yourself service (DIY***):* this is the provision of computing facilities to allow the client's computer operators to process data with their own programs.
- **Time sharing:** this involves accessing the bureau's computer by means of communication links, which provides each user with computing facilities as if he had an in house computer.

Advantages of using a computer bureau

- Computer bureau can be used when computing requirements do not justify obtaining in house facilities.
- Valuable initial experience of processing by computer can be obtained , and this experience can help decide whether or not to install in house computer
- Computer bureau provide facilities for coping with peak data processing loads owing to insufficient capacity of the in house computer.
- They provide stand by facilities by arrangement, in case of breakdown of the in house computer
- Organisations can overcome computer staff shortages
- Computer bureaus can be used when there is need for experts
- They can be used where time and cost saving can be made using already available software packages
- Can be used when space is a limiting factor i.e. if space is restricting the accommodation of new computer installations
- Computer bureaus provide the most efficient techniques and software aids.

Disadvantages of using a computer bureau

- Loss of control over the time taken to process data (turn around time)
- No experience is gained directly in operating a computer installation, this may create indirect benefits to competitors especially in the problem solving application for which a computer is so valuable.
- As the service is not under the control of the customer it can be inflexible and impersonal
- The services of the bureau can be more expensive than in house facilities because the bureau needs to make profits
- There are privacy, secrecy, security problems since a bureau is a facility that is used by many customers (competitors)

Chapter 15 Exercises

1. Describe any four types of services that are provided by a bureau.
2. Mention six instances that may lead to an organization to consider using a computer bureau
3. Describe the duties of the following:
    - Information Systems Manager
    - Systems Analyst
    - Programmer
    - Data Entry Clerk
4. What is end-user computing?

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