DSITANCE LEARNING CENTRE

AHMADU BELLO UNIVERSITY

ZARIA, NIGERIA

COURSE MATERIAL

FOR

Course Code & Title: ACC 329: CORPORATE MANAGEMENT INFORMATION SYSTEM

Programme Title: B.Sc. ACCOUNTING

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COURSE STUDY GUIDE

i. COURSE INFORMATION

Course Code: ACC 329

Course Title: Corporate Information System

Credit Units: 2

Year of Study: 1

Semester: 1st

ii. COURSE INTRODUCTION AND DESCRIPTION

Introduction:

Corporate information system is introduced to students who are willing to be contribute to corporate strategies and corporate system design which could handle and control the use of information for corporate system through the use of computer. These involve the description of data that has to do with transactions, data processing and information for corporate organisations.

Description:

Corporate information system is design to handle the control and use of information for corporate system and strategies through computer usage. These involve the description of data that has to do with transactions, data processing and information for corporate organisations.

iii. COURSE PREREQUISITES

You should note that although this course has no subject pre-requisite, you are expected to have:

1. Satisfactory level of English proficiency
2. Basic Computer Operations proficiency
3. Online interaction proficiency
4. Web 2.0 and Social media interactive skills

iv. COURSE LEARNING RESOURCES

i. Course Textbooks

Bohme, F.; Wyatt, J. P.; Curry, J. P. (1991). *100 Years of Data Processing: The Punch card Century*. United States Bureau of the Census.

Carl, F. (1996). *Data Processing and Information Technology (10th ed.)*. London: Thomson.

Starck, J.L., Murtagh, F. & Bijaoui, A (1998). Image Processing and Data Analysis:

The Multi scale Approach. Washington. Amazon

v. COURSE OUTCOMES

After studying this course, you should be able to:

1. Differentiate between data and information
2. Differentiate between data processing and management information system
3. Identify the components of computer and how it operates
4. Familiar with some computer programming language

vi. ACTIVITIES TO MEET COURSE OBJECTIVES

Specifically, this course shall comprise of the following activities:

1. Studying courseware

2. Listening to course audios
3. Watching relevant course videos
4. Field activities, industrial attachment or internship, laboratory or studio work (whichever is applicable)
5. Course assignments (individual and group)
6. Forum discussion participation
7. Tutorials (optional)
8. Semester examinations (CBT and essay based).

vii. TIME (TO COMPLETE SYLABUS/COURSE)

To cope with this course, you would be expected to commit a minimum of 2 hours weekly for the Course.

viii. GRADING CRITERIA AND SCALE

Grading Criteria

A. Formative assessment

Grades will be based on the following:

Individual assignments/test (CA 1,2 etc)	20
Group assignments (GCA 1, 2 etc)	10
Discussions/Quizzes/Out of class engagements etc	10

B. Summative assessment (Semester examination)

CBT based	30
Essay based	30
TOTAL	**100%**

C. Grading Scale:

A = 70-100

B = 60 – 69

C = 50 - 59

D = 45-49

F = 0-44

D. Feedback

Courseware based:

1. In-text questions and answers (answers preceding references)

2. Self-assessment questions and answers (answers preceding references)

Tutor based:

1. Discussion Forum tutor input

2. Graded Continuous assessments

Student based:

1. Online programme assessment (administration, learning resource, deployment, and assessment).

ix. LINKS TO OPEN EDUCATION RESOURCES

OSS Watch provides tips for selecting open source, or for procuring free or open software.

SchoolForge and SourceForge are good places to find, create, and publish open software. SourceForge, for one, has millions of downloads each day.

Open Source Education Foundation and Open Source Initiative, and other organisation like these, help disseminate knowledge.

Creative Commons has a number of open projects from Khan Academy to Curriki where teachers and parents can find educational materials for children or learn about Creative Commons licenses. Also, they recently launched the School of Open that offers courses on the meaning, application, and impact of "openness."

Numerous open or open educational resource databases and search engines exist. Some examples include:

- OEDb: over 10,000 free courses from universities as well as reviews of colleges and rankings of college degree programmes
- Open Tapestry: over 100,000 open licensed online learning resources for an academic and general audience
- OER Commons: over 40,000 open educational resources from elementary school through to higher education; many of the elementary, middle, and high school resources are aligned to the Common Core State Standards
- Open Content: a blog, definition, and game of open source as well as a friendly search engine for open educational resources from MIT, Stanford, and other universities with subject and description listings
- Academic Earth: over 1,500 video lectures from MIT, Stanford, Berkeley, Harvard, Princeton, and Yale

- JISC: Joint Information Systems Committee works on behalf of UK higher education and is involved in many open resources and open projects including digitising British newspapers from 1620-1900!

Other sources for open education resources

Universities

- The University of Cambridge's guide on Open Educational Resources for Teacher Education (ORBIT)
- OpenLearn from Open University in the UK

Global

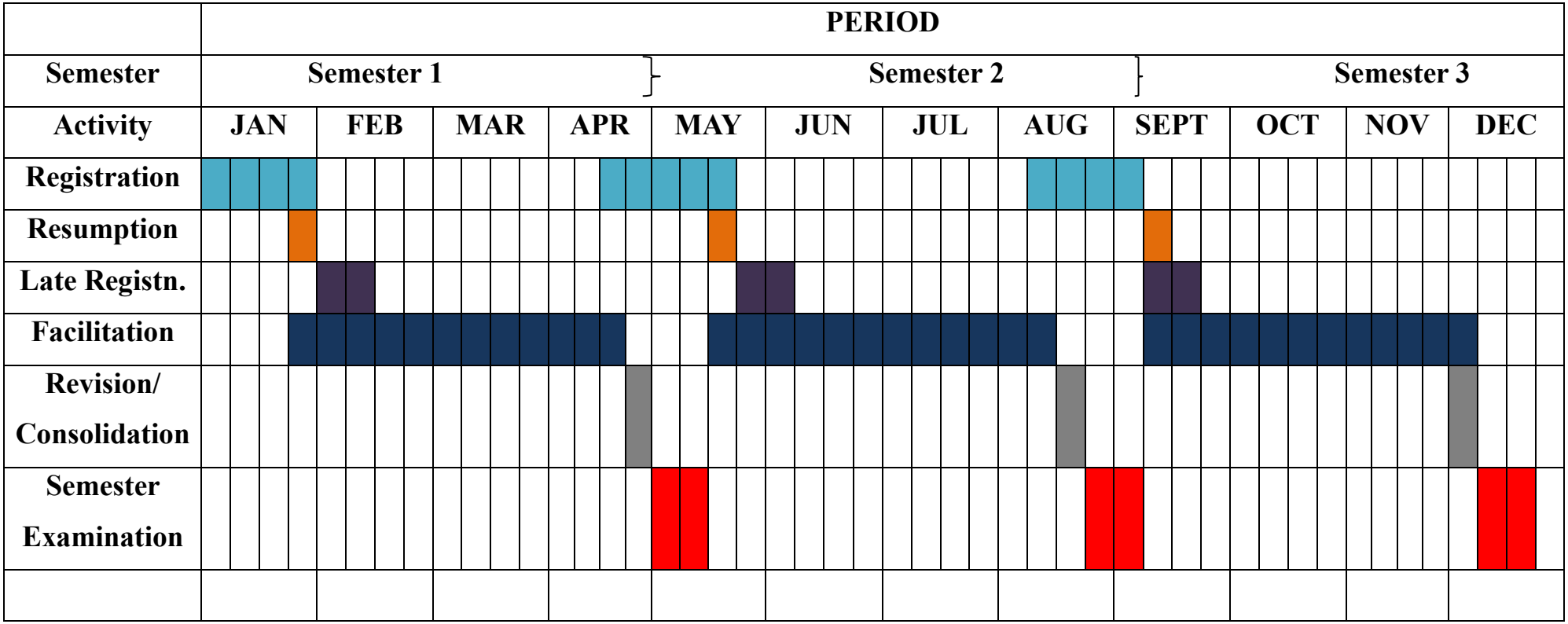
- Unesco's searchable open database is a portal to worldwide courses and research initiatives
- African Virtual University (http://oer.avu.org/) has numerous modules on subjects in English, French, and Portuguese
- https://code.google.com/p/course-builder/ is Google's open source software that is designed to let anyone create online education courses
- Global Voices (http://globalvoicesonline.org/) is an international community of bloggers who report on blogs and citizen media from around the world, including on open source and open educational resources

Individuals (which include OERs)

- Librarian Chick: everything from books to quizzes and videos here, includes directories on open source and open educational resources
- K-12 Tech Tools: OERs, from art to special education

- Web 2.0: Cool Tools for Schools: audio and video tools
- Web 2.0 Guru: animation and various collections of free open source software
- Livebinders: search, create, or organise digital information binders by age, grade, or subject (why re-invent the wheel?

x. ABU DLC ACADEMIC CALENDAR/PLANNER



N.B: - All Sessions commence in January

- 1 Week break between Semesters and 6 Weeks vocation at end of session.

- Semester 3 is OPTIONAL (Fast-tracking, making up carry-overs & deferment

xi. COURSE STRUCTURE AND OUTLINE

Course Structure

WEEK	MODULE	STUDY SESSION	ACTIVITY
Week 1	**STUDY MODULE 1**	**Study Session 1** Title: The Concept and History of Data Processing	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site (https://bit.ly/2KIwvBi https://bit.ly/2z9CXLl) 5. View referred Animation (Address/Site https://bit.ly/30lJKgD & https://bit.ly/2NeXRRo) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 2		**Study Session 2** Title: Methods of data processing	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site https://bit.ly/2zbikOK) 5. View referred Animation (Address/Site https://bit.ly/2C14W1y) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 3		**Study Session 3**	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site

		Title: Electronic Data Processing (EDP)	https://bit.ly/2zbikOK) 5. View referred Animation (Address/Site https://bit.ly/2MqpGq8) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 4	**STUDY MODULE 2**	**Study Session 1** Title: Concept and classification of a system	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site https://bit.ly/2NmYSXA) 5. View referred Animation (Address/Site https://bit.ly/30l9XvZ) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 5		**Study Session 2** Title: The Systems Approach	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site https://bit.ly/33MTseg) 5. View referred Animation (Address/Site https://bit.ly/2Zdacba) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 6		**Study Session 3** Title:	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site https://bit.ly/2NmO8Z5)

		Systems and subsystems	5. View referred Animation (Address/Site https://bit.ly/2HdrbUj) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 7		**Study Session 4** Title: Systems analysis and design	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site https://bit.ly/2KKLhaP) 5. View referred Animation (Address/Site https://bit.ly/2TGWYAs) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 8	**STUDY MODULE 3**	**Study Session 1** Title: Introduction to management information systems (mis)	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site https://bit.ly/2ZcrJVT) 5. View referred Animation (Address/Site https://bit.ly/2NoybBN & https://bit.ly/2MtWMpm) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 9		**Study Session 2** Title: Information needs of	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site https://bit.ly/2EeCiNf & https://bit.ly/2Zd1HN1 https://bit.ly/2SzYpAO)

		management	5. View referred Animation (Address/Site https://bit.ly/2za9NeT) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 10		**Study Session 3** Title: Business system hierarchy	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site https://bit.ly/2KJe934 5. View referred Animation (Address/Site https://bit.ly/2Nk7w9l) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 11	**STUDY**	**Study Session 1** Title: The Evolution of Computers	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site https://bit.ly/2BDA4kM) 5. View referred Animation (Address/Site https://bit.ly/2TNfOaV) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity

	MODULE 4	**Study Session 2** Title: The computer System	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site https://bit.ly/33WiMP8) 5. View referred Animation (Address/Site https://bit.ly/33MW0sQ) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 12		**Study Session 3** Title: Introduction to Computer Programming Languages	1. Read Courseware for the corresponding Study Session. 2. View the Video(s) on this Study Session 3. Listen to the Audio on this Study Session 4. View any other Video/U-tube (address/site https://bit.ly/2EZ3oYC) 5. View referred Animation (Address/Site https://bit.ly/30lB0Hr) 6. Read Chapter/page of Standard/relevant text. 7. Any additional study material 8. Any out of Class Activity
Week 13		**REVISION/TUTORIALS (On Campus or Online) & CONSOLIDATION WEEK**	
Week 14 & 15		**SEMESTER EXAMINATION**	

Course Outline

MODULE 1: Understanding Data Processing

Study Session 1 - The Concept and History of Data Processing
Study Session 2 - Methods of data processing
Study Session 3 - Electronic Data Processing (EDP)

MODULE 2: Understanding a System

Study Session 1 - Concept and classification of a system
Study Session 2 - The Systems Approach
Study Session 3 - Systems and subsystems
Study Session 4 - Systems analysis and design

MODULE 3: Understanding Management Information Systems

Study Session 1 - Introduction to management information systems (MIS)
Study Session 2 - Information needs of management
Study Session 3 - Business system hierarchy

MODULE 4: Understanding Computer System

Study Session 1 - The Evolution of Computers
Study Session 2 - The Computer System
Study Session 3 - Introduction to Computer Programming Languages

xii. STUDY MODULES

MODULE 1: Understanding Data Processing

Contents:

Study Session 1 - Concept and History of Data Processing

Study Session 2 - Methods of data processing

Study Session 3 - Electronic Data Processing (EDP)

STUDY SESSION 1

Concept and History Of Data Processing

Section and Subsection Headings:

Introduction

1.0 Learning Outcomes

2.0 Main Content

2.1- Definition of Data, Information and Data Processing

2.1.1 Data

2.1.2 Information

2.1.3 Data Processing

2.1.4 Data processing functions

2.2- Historical Perspectives of Data Processing

2.1.1 Manual Data Processing

2.1.2 Automatic Data Processing

2.1.3 Electronic Data Processing

2.1.4 Further Evolution

3.0 Study Session Summary and Conclusion

4.0 Self-Assessment Questions

5.0 Additional Activities (Videos, Animations & Out of Class activities)

6.0 References/Further Readings

Introduction

I believe by now you should have read through the course guidelines which are in your tablet or the hard copy sent to you. If you have not, I strongly recommend you to do so right now before reading your study materials. It is important that you do

so because it provides a comprehensive outline of the materials you will cover on a Session-to-Session basis, starting with the topic you are about to study. The Session guides you through history of data processing across the ages. Let us look at what you will learn in this Session, starting first with the objectives.

1.0 Learning Outcomes

By the end of this session, the student is expected be able to

1. Differentiate between data and information
2. Define the term data processing
3. Discuss the historical perspective in data processing

2.0 Main Content

2.1 Definition of Data, Information and Data Processing

2.1.1 Data

Data are any **facts, numbers, or text** that can be processed by a **computer**. Today, organisations are accumulating vast and growing amounts of data in different formats and different databases.

This includes:

- **Operational or transactional data** such as, sales, cost, inventory, payroll, and accounting
- **Non-operational data**, such as industry sales, forecast data, and macro-economic data
- **Meta data** - data about the data itself, such as logical database design or data dictionary definitions

2.1.2 Information

The patterns, associations, or relationships among all this data can provide **information**. Information **is the output element of a data processing system**; it is derived from data, which has been subjected to data processing operations converting **meaningless data into a useful form** for its recipients.

Information is an important part in the **day-to-day management of a business** and the **decision-making process**. Information flows must be designed and integrated into the business systems.

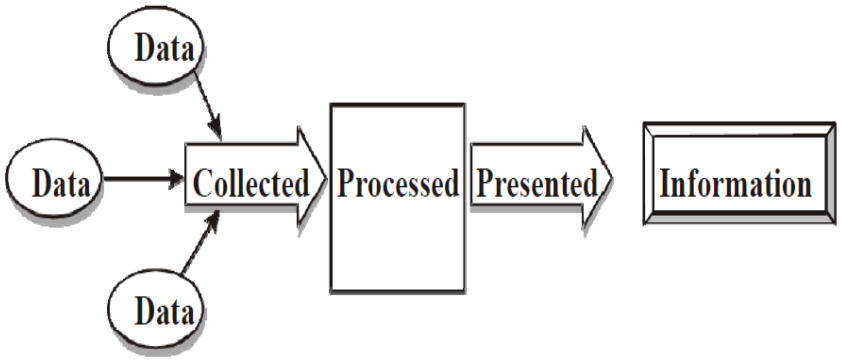


Fig 1.1.1: Information

2.1.3 Data Processing

Data are a collection of **facts — unorganised but able to be organised into useful information**.

Processing **is a series of actions or operations that convert inputs into outputs**. When we speak of data processing, the input is data, and the output is useful information. **What then is data processing?** So, we can define **data processing** as a series of actions or operations that converts data into useful information.

According to **Carl (1996)** data processing is, broadly, **"the collection and manipulation of items of data to produce meaningful information"**. In this

sense it can be considered a subset of ***information processing***, the change (**processing**) of information in any manner detectable by an observer. The term is often used more specifically in the context of a business or other organisation to refer to the class of commercial data processing applications.

Data processing (**numerical and non-numerical**) includes the analysis of various, sorting, calculating, editing, processing and handling data.

2.1.4 Data processing functions

Data processing may involve various processes. This includes:

- **Validation** – It ensures that supplied data is clean, correct and useful
- **Sorting** – It arranges items in some sequence and/or in different sets.
- **Summarisation** – It reduces detail data to its main points.
- **Aggregation** – It combines multiple pieces of data.
- **Analysis** – It involves collection, organisation, analysis, interpretation and presentation of data.
- **Reporting** – It lists detail or summary data or computed information.
- **Classification** – It separates data into various categories.

2.2 Historical Evolution of Data Processing

2.1.1 Manual Data Processing

Although widespread use of the term data processing dates only from the **nineteen-fifties** data processing functions have been performed manually for millennia. **For example**, bookkeeping involves functions such as posting transactions and producing reports like **the balance sheet and the cash flow**

statement. Completely manual methods were augmented by the application of mechanical or electronic calculators. A person whose job it was to perform calculations manually or using a calculator was called a **"computer".**

The **1850 United States Census schedule** was the first to gather data by individual rather than household. A number of questions could be answered by making a check in the appropriate box on the form. **From 1850 through 1880 the Census Bureau** employed **"a system of tallying, which, by reason of the increasing number of combinations of classifications required, became increasingly complex"**. Only a limited number of combinations could be recorded in one tally, so it was necessary to handle the **schedules 5 or 6 times**, for as many **independent tallies**. It took over **7 years** to publish the results of the **1880 census** using **manual processing methods**.

2.1.2 Automatic Data Processing

The term **automatic data processing** was applied to operations performed by means of unit record equipment, such as **Herman Hollerith's application of punched card equipment** for the **1890 United States Census**. **"Using Hollerith's punch card equipment",** the Census Office was able to complete tabulating most of the **1890 census data in 2 to 3 years, compared with 7 to 8 years for the 1880 census...** It is also estimated that using **Herman Hollerith's system saved time**.

Fig 1.1.2 Automatic Data Processing

2.1.3 Electronic Data Processing (EDP)

Computerised data processing, or **Electronic data processing** represents the further evolution, with the computer taking the place of several independent pieces of equipment. The **Census Bureau** first made limited use of **electronic computers** for the **1950 United States Census**, using a **UNIVAC I system**, delivered in **1952**. The rapid increase in the **EDP** profession was frequently accomplished by taking employees without a degree in computer science and using on the job training and training by equipment manufacturers [**Lundell, 1973, p. 2**].

2.1.4 Further Evolution

Data processing (DP) has also previously been used to refer to the department within an organisation responsible for the operation of data processing applications. The term data processing has mostly been subsumed under the newer and somewhat more general term **information technology (IT)**. Data processing has acquired a negative connotation, suggesting use of older technologies. As an example, in **1996** the **Data Processing Management Association (DPMA)** changed its name to **Association of Information Technology Professionals**. Nevertheless, the terms are roughly **synonymous**.

In-text Question
1. Define what is meant by data and information.
2. List 5 Data processing functions.

In-text Answer
1. *Data are any facts, numbers, or text that can be processed by a computer while on the other hand, Information is an important part in the day-to-day management of a business and the decision-making process.*
2. Validation; Sorting; Summarisation; Aggregation; and Analysis.

3.0 Conclusion/Summary

The unit 1 you have studied had exposed you to meaning of data, information, data processing and historical evolution of data processing. From what we have said thus far, Data processing (**numerical and non-numerical**) includes the analysis of various, sorting, calculating, editing, processing and handling data. Data processing had passed through stages of development in which electronic data processing had taken over all forms of manual data processing. We will see in Session 2 the methods of data processing we have. But wait, it is time to assess yourself and find out what you have learnt so far.

Now assess yourself on the progress you have made in this course by answering this question. Now take a 10-minute break, we must continue now.

4.0 Self-Assessment Questions

1. Differentiate between data and information.
2. Describe the term data processing.
3. Highlight the 3 stages of evolution of data processing.

Self-Assessment Answers

1. Data are any facts, numbers, or text that can be processed by a computer while Information is the output element of a data processing system. In a nutshell, Information is derived from processed data.

2. Data processing is, broadly, “the collection and manipulation of items of data to produce meaningful information”. In this sense it can be considered a subset of information processing, the change (processing) of information in any manner

detectable by an observer. The term is often used more specifically in the context of a business or other organisation to refer to the class of commercial data processing applications. Data processing (numerical and non-numerical) includes the analysis of various, sorting, calculating, editing, processing and handling data.

3. The 3 stages of evolution of data processing are as follows:

- Manual Data Processing
- Automatic Data Processing
- Electronic Data Processing (EDP)

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add **https://bit.ly/2KIwvBi** & **https://bit.ly/2z9CXLl**. Watch the video & summarise in 1 paragraph

b. View the animation on add/site **https://bit.ly/30lJKgD** & https://bit.ly/2NeXRRo) and critique it in the discussion forum

6.0 References/Further Readings

Bohme, F.; Wyatt, J. P.; Curry, J. P. (1991). *100 Years of Data Processing: The Punch card Century*. United States Bureau of the Census.

Carl, F. (1996). *Data Processing and Information Technology (10th ed.)*. London: Thomson.

Starck, J.L., Murtagh, F. & Bijaoui, A (1998). Image Processing and Data Analysis:

The Multi scale Approach. Washington. Amazon

STUDY SESSION 2

Methods of Data Processing

Section and Subsection Headings:

Introduction

In **Study Session 1**, we discussed **descriptions and evolution of data processing**. You can now describe and define data processing from your own understanding. You are about to study another interesting Session: **the methods of data processing**. This Session guides you through these approaches. Let us look at what other content you should learn in this Session as specified in the Session objectives

below.

1.0 Learning Outcomes

By the end of this session, the student is expected be able to

1. Understand the differences between the methods of data processing
2. Advantages and disadvantages of the methods.

2.0 Main Content

2.1 Methods of Data Processing

Enterprises require **data processing**, in order to convert **raw data into useful information** in the appropriate form. When it comes to the different types of data processing available, your business can choose from manual data processing, mechanical data processing or electronic data processing. We may also use the term **Levels of data processing**. **First level of data processing was manual data processing** when there were no calculating devices (**before the invention of calculators**).

Therefore, all processing jobs were performed manually by hand with the help of pen, paper and mind. In **second level of data processing**, machines like calculators were used for data processing. The level is called **mechanical data processing**. In **third level of data processing**, computers were used for data processing hence the name **Electronic data processing**. Now a days all data processing is performed with the help of computers.

In-text Question
1. …… is the process of converting raw data into useful information in the appropriate form.
2. Electronic Data Processing is also known as ……

In-text Answer
1. Data Processing
2. Computerised data processing

2.2 Manual Data Processing

In **manual data processing,** data is processed manually. No machine or tool is used. In manual data processing, most tasks are done manually with a pen and a paper. In manual data processing, all the calculations and logical operations are performed manually on the data. Similarly, data is transferred manually from one place to another. This method of data processing is very slow, and errors may occur in the output. Mostly, is processed manually in many small business firms as well as government offices & institutions. This type of data processing forms the very primitive stage when technology was not available, or it was not affordable. With the advancement of technology, the dependency on manual methods has drastically decreased. **Example:** A book seller (**a small book shop**) records his daily transactions manually. He prepares bills by pen, paper and carbon paper (**no doubt, brain is the main data processor in this case**). At the end of day he will use carbon copies made on a particular date to know how many books he sold and how much income

he got.

Fig 1.2.1: Manual Data Processing

Advantages of Manual Data Processing

1. It is a **low cost method** of data processing since the tools required to perform manual data processing are just **pen and paper only**.

Disadvantages of Manual Data Processing

1. Manual Data Processing method is the **slowest of all** types of data processing.
2. This method is **more error prone**. Chances of errors in results produced by manual data processing are more than other two methods.
3. Manual data processing is a **time consuming** process. More is the amount of data, more is the time required to process data.

In-text Question
1. …… is the slowest of all types of data processing.
2. One of the advantage of manual method data processing is ……..
In-text Answer
1. Manual Data Processing method
2. It is a low cost method of data processing.

2.3 Mechanical Data Processing

In mechanical data processing data is processed with the help of **devices or machines**. These machines that help the people in data processing may be **calculators and type writers** etc. Obviously, this method is **faster easier and more accurate** than manual data processing.

Fig 1.2.2: Mechanical Data Processing

Example: Book seller can **use a calculator to speed up his data processing system**. There will be a less chance of errors in calculations. Bill calculations will be much faster with a calculator and easier too. This method, when compared to manual data processing is more reliable and time saving. However, the output can still be very limited. Any other mechanical device which facilitates data processing can be considered under this category. These are faster than the manual mode but still forms the early stages of data processing. With **invention and evolution** of more complex machines with better **computing power** this type of processing also started fading away. Examination boards and printing press use mechanical data processing devices frequently.

Advantages of Mechanical Data Processing:

1. Mechanical data processing is **more accurate method** of data processing, since it uses machines like calculators for accurate data processing and results.
2. Mechanical data processing is **less time consuming** than manual data processing. Due to the use of calculator, calculations are performed quickly.
3. There are **less chances of error** in calculations.

Disadvantages of Mechanical data Processing:

1. It is **more costly** method that manual data processing.
2. It is **not automated process**, with the increase of data, number of calculations increases making the whole process difficult and complex.

In-text Question
1. Briefly Explain Mechanical method data processing
2. List out the disadvantages of mechanical data processing
In-text Answer
1. In mechanical data processing data is processed with the help of devices or machines. These machines that help the people in data processing may be calculators and type writers etc. Obviously, this method is faster easier and more accurate than manual data processing.
2. It is more costly method that manual data processing
It is not automated process, with the increase of data, number of calculations increases making the whole process difficult and complex.

2.4 Electronic Data Processing

It is the **latest and fastest method of data processing**. Data is processed with the help of computer.

First of all, data and set of instructions are given to the computer. Computer gives output results after processing the data according to instructions. This method of data processing is **very fast and accurate**. **Electronic data processing** is used in banks and business firms, Government offices, colleges, schools, universities, businesses and other institutes. Electronic data processing is being used in almost every field of life.

Fig 1.2.3: Electronic Data Processing

Advantages of Electronic Data Processing

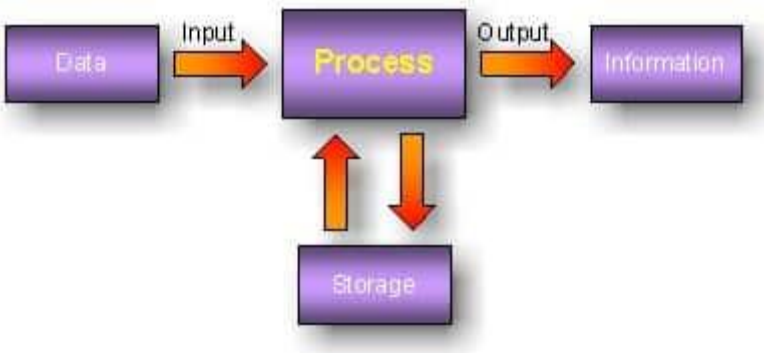
1. Electronic data processing is the **fastest and most efficient** method of data processing.
2. Electronic data processing is **less time consuming** of all other methods.
3. Electronic data processing systems can **process large amounts of data easily.**
4. Electronic data processing can **present information in more attractive way.**
5. Electronic data processing will give **100 % correct results**, without any errors if input and instructions are accurate.

Disadvantages of Electronic Data Processing

1. Electronic data processing is the **most expensive** method among all other types of data processing.
2. **High setup Cost:** Computer systems - Hardware and software requires a lot of money to setup and to operate further.
3. **Qualified Computer personnel are required** to run an electronic data processing system which results in more money requirements for employee pay roll systems.

2.5 Data Processing Cycle

The **Data Processing Cycle** is a series of steps carried out to extract information from raw data. Although each step must be taken in order, the order is cyclic. The output and storage stage can lead to the repeat of the data collection stage, resulting in another cycle of data processing. The cycle provides a view on how the



data travels and transforms from collection to interpretation, and ultimately, used in effective business decisions.

Fig 1.2.4: Data Processing Cycle

2.5.1 Stages of the Data Processing Cycle

1) Collection

It is the first stage of the cycle and is very crucial since the quality of data collected will impact heavily on the output. The collection process needs to ensure that the data gathered are both defined and accurate so that subsequent decisions based on the findings are valid. This stage provides both the baseline from which to measure and a target on what to improve. Some types of data collection include census (**data collection about everything in a group or statistical population**), sample survey (**collection method that contains only part of the total population**), and administrative by-product (**data collection is a byproduct of an organisation's day-to-day operations**).

2) Preparation

It is the manipulation of data into a form suitable for further analysis and processing. **Raw data** cannot be processed and must be checked for accuracy. Preparation is about constructing a dataset from **one or more data sources** to be used for further exploration and processing. Analysing data that has not been carefully screened for problems can produce highly misleading results that are heavily dependent on the quality of data prepared.

3) Input

It is the task where verified data is coded or converted into **machine-readable** form so that it can be processed through a computer. Data entry is done through the use of a keyboard, digitizer, scanner, or data entry from an existing source. This **time-consuming** process requires **speed and accuracy**. Most data need to follow a formal and strict syntax since a great deal of processing power is needed to break down the complex data at this stage. Due to the costs, many businesses are resorting to outsourcing this stage.

4) Processing

It is when the data is subjected to various means and methods of manipulation, the point where a computer program is being executed, and it contains the program code and its current activity. The **process** may be made up of multiple threads of execution that simultaneously execute instructions, depending on the operating system. While a computer program is a **passive collection of instructions**, a process is the actual execution of those instructions. Many software programs are available for **processing large volumes of data within very short periods**.

5) Output and Interpretation

It is the stage where processed information is now transmitted to the user. The **output** is presented to users in various report formats like a printed report, audio, video, or on the monitor. Output needs to be **interpreted** so that it can provide meaningful information that will guide future decisions of the company.

6) Storage

It is the last stage in the data processing cycle, where data, instruction, and information are held for future use. The importance of this cycle is that it allows **quick access and retrieval** of the processed information, allowing it to be passed on to the next stage directly when needed. Every computer uses **storage** to hold system and application software.

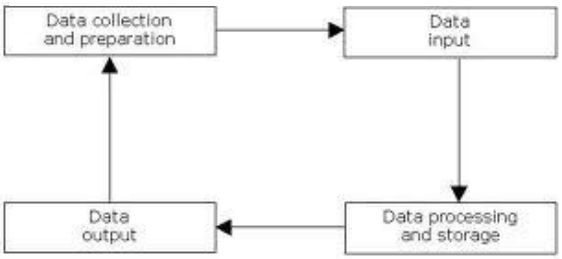


Fig 1.2.5: Storage

3.0 Conclusion/Summary

In this Session you have learnt the methods of data processing. You have also learnt about the series of steps carried out to extract information from raw data.

4.0 Self- Assessment Questions

1. Explain the method of data processing used before the invention of calculators.
2. Outline the stages of the Data Processing Cycle.

Self- Assessment Answers

1. Manual method of data processing was used before the invention of calculators. In manual data processing, data is processed manually. No machine or tool is used. In manual data processing, most tasks are done manually with a pen and a paper. In

manual data processing, all the calculations and logical operations are performed manually on the data. Similarly, data is transferred manually from one place to another. This method of data processing is very slow, and errors may occur in the output. Mostly, is processed manually in many small business firms as well as government offices & institutions. This type of data processing forms the very primitive stage when technology was not available, or it was not affordable. With the advancement of technology, the dependency on manual methods has drastically decreased.

2. The stages of the Data Processing Cycle are as follows:

- Collection
- Preparation
- Input
- Processing
- Output and Interpretation
- Storage

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add https://bit.ly/2zbikOK. Watch the video & summarise in 1 paragraph

b. View the animation on add/site https://bit.ly/2C14W1y and critique it in the discussion forum

6.0 References/Further Readings

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STUDY SESSION 3

Electronic Data Processing (EDP) Methods

Section and Subsection Headings:

Introduction

1.0 Learning outcomes

2.0 Main Content

- 2.1- Concept of Electronic Data Processing (EDP)
  - 2.1.1 Elements of Electronic Data Processing
  - 2.1.2 Stages of Electronic Data Processing
- 2.2- Batch Processing
- 2.3- Real-Time Processing
- 2.4- Online Processing
- 2.5- Distributed Processing

3.0 Summary and Conclusion

4.0 Self-Assessment Questions

5.0 Additional Activities (Videos, Animations & Out of Class activities)

6.0 References/Further Readings

Introduction

Earlier in this class we learnt about data processing. In **Study Session 2** we studied the various method of data processing. We learned that there are many methods

which include **manual, mechanised and electronic data processing**. In this Session, we will go further to explore electronic data processing and its types.

1.0 Learning Outcomes

After studying this session, I expect you to be able to:

1. Explain the types of electronic data processing
2. Explain the management of electronic data processing

2.0 Main Content

2.1. Concept of Electronic Data Processing

Electronic Data Processing (EDP) can refer to the use of automated methods to process commercial data. This means that, data processing, retrieval, storage, manipulation, sorting and part of analysis is done through automated methods using devices like **computers**.

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

i. Master file
ii. Transaction file
iii. Reference file
iv. Output file
v. Back-up file
vi. Archival file
vii. Table file

The **electronic data processing (EDP) system** has the advantage of being capable of producing information (**such as financial statements and budgets**) much **more accurately speedily and cheaply**. Thus management of efficiency and effectiveness can be improved considerably by a mechanised data processing system.

2.1.1 Elements of Electronic Data Processing

Hardware, Software, procedure, personnel is **the basic elements of electronic data processing**. In the **hardware section**, scanners, barcode scanners, cash registers, personal computers, medical device, servers, video and audio equipment are the elements of electronic data processing. In the **software section**, accounting software, data entry, scheduling software, analytics, and software are **the elements of electronic data processing**. In the **procedure section**, sorting, analysis, reporting, conversion, data collection, aggregation be the **elements of EDP**.

Fig 1.3.1: Elements of Electronic Data Processing

In **personnel**, the programmer uses the electronic data processing to create the components and spreadsheets. The data entry specialists use to scan the **barcodes**.

2.1.2 Stages of Electronic Data Processing

A **collection is the first stage** of electronic data processing. It is a very crucial part. This process ensures that accurate data gathering. Census, sample survey, and administrative **by-product** are some types of data collection. **Preparation is the**

second stage of electronic data processing. Preparation is used to analyze the data processing.

Input is the third stage in electronic data processing. Data entry is done by the use of a scanner, keyboard, and digitizer. The **fourth stage is processing**. It has various methods. The **last stage is storage**. Every computer has the use to store the file.

2.2 Batch Processing

Batch Processing is a method where the information to be organised is sorted into groups to allow for efficient and sequential processing.

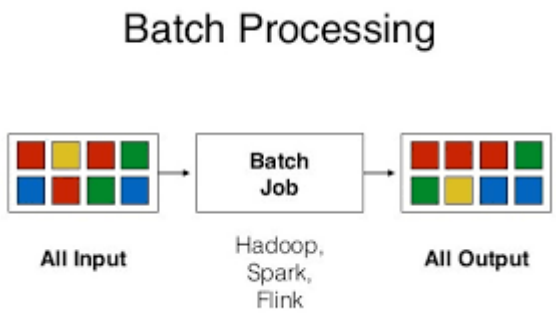

Fig 1.3.2 Batch Processing

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

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

Such systems are associated with considerable use of **manual recording on input documents** with processing being undertaken through the transfer of batches from

users to data preparation, to data control, and then to operator. Much of the control is **clerical checking and reconciliation of input fields to output**.

Batch processing gives **good internal control**, but it only lends itself to systems where processing need not be immediate and reports and enquiries are standard and known in advance. The most obvious batch applications are ledger processing in large Organisations where rapid processing and response are not essential **i.e. routine high-volume applications**: Invoicing, Payroll, Sales ledger updating, Stock ledger updating, Nominal ledger updating, etc

Features of Batch Processing

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

2.3 Real-Time Processing

Real time system describes the processing situation where computer is able to respond to urgent signals realistic in human reaction time. For a computer system

to be **real-time**, the devices must be **on-line**. Thus, **Real-time is an On-line system** that allows immediate processing such that the results of any processing step can be obtained immediately, i.e. transactions are subject to immediate processing upon data capture on the transaction taking place Data is processed immediately and the appropriate master file is updated after input validation. That is, a transaction is entered, it passes through all processing stages at once such as validation, updating and reporting. Time saved is maximum in this case as the output is seen in real time. **For example**, in banking transactions.

Real-time systems are used for: Airline (**seat**) ticket reservation, Stock control, Steel making, Hotel and holiday booking system, Theatre tickets, Space exploration, Retail banking for processing drawings against current/savings accounts.

Features of the Real-time system:

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

Requirements for Real-time system:

- Immediate access to the computer when required (**under password control**).
- Immediate availability of programs (**and protection of program integrity**)
- Immediate availability of master files from direct access storage (**with proper file security procedures of dumping, restricted access to authorised users**).
- Accurately assessed response times – the system must cope with all loads it is likely to encounter.
- Direct access files are **permanently on-line**.

2.4 Online Processing

On-line processing involves the connection of a computer with user oriented terminals. If a terminal is in direct communication with the main unit (**CPU**) then the processing is on-line. This is a method that utilises internet connections and equipment directly attached to a computer. This allows for the data stored in one place and being used at an altogether different place. **Cloud computing** can be considered as an example which uses this type of processing. It is used mainly for information recording and research. It is a system that has some or all data files directly accessible to users via application software for interrogation purposes. It is a technique of processing data in which data entry equipment (**e.g. terminal**) are connected to and controlled by the **CPU** of a computer, input is of individual transactions by users. This may take one form of **direct-entry input**, via interactive terminals with immediate input validation and updating in integrated

systems. It may also take the form of individual transactions entry with **front-end** processing and subsequent updating at a later or predetermined time.

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

- **Sales Order Processing and Stock Control Systems:** Terminals located in Warehouse provides the means for automatic **re-ordering of stocks**, follow-up of outstanding orders.
- **Banking:** Informing bank customers of the status of their account by assessing the relevant file using an **on-line terminal**.
- **Stock Exchange:** Terminals are located in major stock exchange throughout the country and the offices of participation brokerage firms enable the speedy processing of share dealings.
- **Insurance: On-line policy maintenance** by means of terminals located in branch offices.

Advantages of On-line System

- It assists in harnessing the activities of clerical staff to the computer by the use of terminals.
- It eliminates routine clerical tedious tasks thereby increasing the degree of operating efficiency and job satisfaction.
- It reduces the volume of printouts required for management report as information may be displayed on terminal screens on demand thereby reducing associated administrative costs.

- It improves the level of computer service especially with account enquiries, holiday bookings, etc.
- It reduces data preparation costs since data can be input directly without the need to **convert human-sensible data into machine sensible form manually**. This process eliminates encoding and verifying operations.
- Management information becomes more readily available by direct access facilities, which enables managers to obtain a greater degree of control over the operations for which they are responsible.

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

2.5 Distributed Processing

This method is commonly utilised by remote workstations connected to one big central workstation or server. **ATMs** are good examples of this data processing method. All the end machines run on a fixed software located at a particular place and make use of exactly same information and sets of instruction.

So far, you have learnt about the types **Electronic Data Processing**. Let us test what you have learnt so far.

In-text Question
1. Define Electronic Data Processing
2. List 3 types of electronic data processing
3. List 5 categories of electronic data file
In-text Answer
1. Electronic Data Processing (EDP) can refer to the use of automated methods to process commercial data.
2. Batch processing; real-time processing; and Online Processing.

3. Master file; Transaction file; Reference file; Output file; and Back-up file.

3.0 Conclusion/Summary

Electronic data processing or EDP is the modern technique to process data. In your study of the Electronic data processing, you must understand the methods that can be used.

4.0 Self-Assessment Questions

1. What is electronic data processing?
2. Highlight the stages of electronic data processing.

Self-Assessment Answers

1. Electronic Data Processing (EDP) can refer to the use of automated methods to process commercial data. This means that, data processing, retrieval, storage, manipulation, sorting and part of analysis is done through automated methods using devices like computers. The electronic data processing (EDP) system has the advantage of being capable of producing information (such as financial statements and budgets) much more accurately speedily and cheaply. Thus management of efficiency and effectiveness can be improved considerably by a mechanised data processing system.

2. The stages of electronic data processing are as follows:

- Collection;
- Preparation;
- Input;
- Processing;
- Storage.

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add https://bit.ly/2zbikOK. Watch the video & summarise in 1 paragraph

b. View the animation on add/site https://bit.ly/2MqpGq8 and critique it in the discussion forum

6.0 References/Further Readings

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Laudon, K.C. and J.P. Laudon *Management information systems: managing the digital firm*. (Boston; London: Pearson, 2012) Twelfth edition.

MODULE 2

Understanding a System

Contents:

STUDY SESSION 1

Concept and Classification of A System

Section and Subsection Headings:

Introduction

The Session introduces you to the basic concepts of systems and classification of system. Let us look at what other contents you should learn in this session as specified in the objective below:

1.0 Learning Outcomes

After studying this session, I expect you to be able to:

1. Explain the meaning of system
2. Explain the different classification of system

2.0 Main Content

2.1 Meaning of System

A **system** is a **set of interacting or interdependent components** forming an integrated whole or a set of elements (**often called 'components'**) and relationships which are different from relationships of the set or its elements to other elements or sets. Every system is delineated by its spatial and temporal boundaries, surrounded and influenced by its environment, described by its structure and purpose and expressed in its functioning. A system a **collection of elements or components** that are organised for a common purpose.

Characteristics of a system

- A system is made of individual parts that work together as a whole.
- A system is usually connected to one or more systems.
- If one part of a system is missing or damaged, the system will not function well or may not function at all.

Key Elements of a System

All systems consist of input, process and output:

- **Input:** Capturing and assembling elements that enter the system to be processed e.g. raw materials, people, skills, money.
- **Processing:** The transformation processes which convert input into output, e.g. a production process, a mathematical calculation, a meeting of people.
- **Output:** Transferring elements that have been produced by a transformation process to their ultimate destination in a form which will be meaningful to its recipient, e.g. a product, a piece of information. In the case of information, output in the form of a report, a telephone call etc.

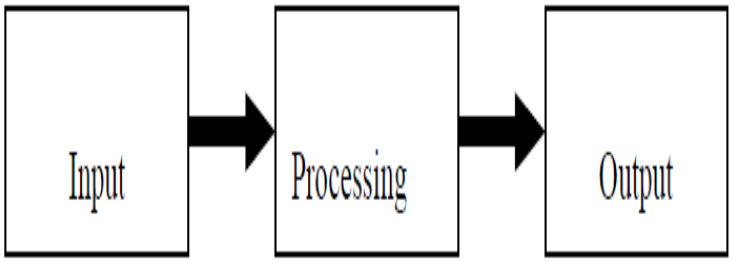


Fig 2.1.1: Key Elements of a System

In-text Question
1. Briefly define system.
2. Outline the key elements of a system.
In-text Answer
1. A system a collection of elements or components that are organised for a common purpose.
2. Input; Processing; and Output.

2.2 Classification of System

There are various types of system. To have a good understanding of these systems, these can be categorised in many ways.

2.2.1 Open vs. Closed Systems

Closed Systems: A system that is **cut off from its environment**. A **closed system** is defined as a system which is **self-contained**. These systems have no exchange with the environment, i.e. all interaction goes on within the system's own boundaries. This term normally applies to machinery where, if inputs are known, then **outputs can be accurately predicted**. Systems within organisations cannot be described in this way - interaction with other systems is an inherent characteristic of organisational systems. A closed community would be an example of a (**social**) closed system.

Open Systems: A system that **interacts freely with its environment**. It receives inputs from its environment, processes or transforms these inputs and passes outputs of various types back into its environment. In this type of system, only some of the relevant **inputs can be identified**, others may occur unexpectedly, for example, a company's competitor may unexpectedly lower prices etc. Open systems exchange information, material, or energy with the environment including random and undefined inputs. Practically most of the systems are open systems. An open system has many interfaces with its environment. It can also adapt to changing environmental conditions. It can receive inputs from, and delivers output to the outside of system. An information system is an example of this category.

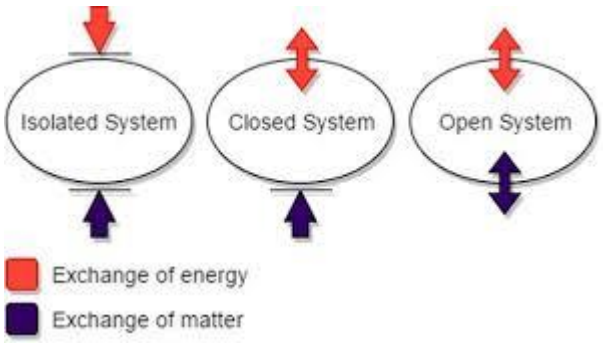


Fig 2.1.2 Open Systems

2.2.2 Deterministic vs. Probabilistic Systems

Deterministic/Mechanistic Systems: These are predictable systems where, if the inputs are known, as well as the present state of the system, then the system's outputs can be accurately forecast. **Machines and computer programs** are examples. A deterministic system operates in a predictable manner. The interaction among the parts is known with certainty. A **deterministic system also called mechanistic system** is one whose behavioural patterns can be predicted if its present state and operation characteristics are known. Such a system operates according to a predetermined set of rules. A good example of a **deterministic system** is **a computer program**. The computer programmer knows in advance the output his program will produce, if the program is error free.

Probabilistic/Stochastic Systems: The **output of these systems can only be predicted as a probability rather than a certainty**. This is true of almost all social or organisational systems as it is always impossible to account for all inputs. The probabilistic system can be described in terms of probable behaviour, but a certain degree of error is always attached to the predication of what the system will do. **Probabilistic system is also called stochastic system** is the one whose outcome cannot be predicted with Precision. That is, not certain what outputs will be achieved from specific input because these systems are subjected to random influences from the **internal and external environment**. Therefore, it cannot be predicted precisely. Examples include the business system, economic system and particularly agricultural system.

2.2.3 Shared and Overlapping Sub-Systems

Systems consist of **sub-systems**, or in commercial terms, organisations are composed of **departments and sections** and these sections interact and are therefore **inter-dependent**. One sub-system can belong to **one or more systems**; therefore, it can be inferred that a change to **one sub-system** may affect more than one system. The use of **overlapping systems** is often a sound economical arrangement, for example, a centralised computer facility can be used by a number of departments in an organisation to reduce overall costs. Shared systems do however cause some problems.

There is a need for a **high level of co-ordination** and in the event of change, approval will need to be sought from a number of sources, making shared systems less flexible where rapid change is needed.

2.2.4 Cybernetic or Adaptive or Self-organising System

It is one which adapts and reacts to stimuli – i.e. adapts to its environment by adjusting its behaviours on a **self-organising basis**. The system alerts it's input as a result of measuring its performance (**outputs**) by monitoring its own behaviour. Human, plants and Organisations are examples of **adaptive system**. In order to survive in a competitive world, they must react, if they do not react, then they die. The most suitable system is **the adaptive system**. In the human body, a number of adaptive systems control temperature, blood pressure and motor reactions. In **electrical systems** such as a **voltage regulator**, the principle of feedback is used.

A system that has the ability to change itself or its environment in order to Survive. These are dynamic system which responds to changing circumstances by adjusting its behaviour on a **self-organising basis**. The system alters its parameters as a result of measuring output. Example includes organisational systems such as **human beings**. The degree to which a business is adaptive depends to a great extent on the calibre of its management.

2.2.5 Physical or Abstract System

Physical systems are **tangible entities** that we can feel and touch. These may be **static or dynamic in nature**. **For example**, take a computer center. Desks and chairs are the static parts, which assist in the working of the center. **Static parts** don't change. The **dynamic systems** are constantly changing. Computer systems are dynamic system. Programs, data, and applications can change according to the user's needs.

Abstract systems are conceptual. These are not physical entities. They may be formulas, representation or model of a real system.

In-text Question
Physical system may be …… and ….. in nature.
In-text Answer
Static and dynamic

3.0 Conclusion/Summary

A system is the smallest conceptual unit of a holistic structure. It is made up of many components, and each component operates on a specific set of rules and regulations. In this Session, you have learnt the meaning, key element and classification of a system. You have also learnt about the features of systems, as well as how systems are generally classified.

4.0 Self -Assessment Questions

1. Define the concept System
2. What are the characteristics of a system?
3. Highlight the various types of system.

Self -Assessment Answers

1. A system is a set of interacting or interdependent components forming an integrated whole or a set of elements (often called *'*components*')* and relationships which are different from relationships of the set or its elements to other elements or sets. Every system is delineated by its spatial and temporal boundaries, surrounded and influenced by its environment, described by its structure and purpose and expressed in its functioning.

2. The characteristics of a system are as follows:

- A system is made of individual parts that work together as a whole.
- A system is usually connected to one or more systems.
- If one part of a system is missing or damaged, the system will not function well or may not function at all.

3. The various types of system are as follows:

- Open vs. Closed Systems
- Deterministic vs. Probabilistic Systems
- Probabilistic/Stochastic Systems
- Shared and Overlapping Sub-Systems
- Cybernetic or Adaptive or Self-organising System
- Physical or Abstract System

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add https://bit.ly/2NmYSXA. Watch the video & summarise in 1 paragraph

b. View the animation on add/site https://bit.ly/30l9XvZ and critique it in the discussion forum

6.0 References/Further Readings

Laudon, K.C. and J.P. Laudon *Management information systems: managing the digital firm*. (Boston; London: Pearson, 2012) twelfth edition.

STUDY SESSION 2

The Systems Approach

Section and Subsection Headings:

Introduction

This session introduces you to the total system approach. It also explains the difference between **close loop and open loop system**. Let us look at what you will learn in this Session, starting first with the objectives.

1.0 Learning Outcomes

By the end of this session, the student is expected to be able to:

1. Distinguish between close loop and open loop system
2. Define the total system approach

2.0 Main Content

2.1 Closed loop and Open loop systems

Control is important in any information system. The two main types of control are **open and closed loop control**.

2.1.1 Closed Loop Control System

Closed loop control has inbuilt control very much like **a thermostat in a heating system**, they are not responsive to changes in the environment. A business example which has inbuilt control is **a stock or a credit control system** where the system automatically checks responses.

Closed loop control is most suitable for the type of system that is stable. Systems which exist in a **relatively dynamic environment** are not suitable for this type of control.

A system whose function and behaviour not affected by its environment is a closed system. That is, it is **self-contained** and the **input/output elements** do not interface with environmental elements outside it. Example includes chemical reactions in a controlled laboratory. A closed system is isolated from environment influences. Generally, to obtain a more accurate or more adaptive control, it is

necessary to feed the output of the system back to the inputs of the controller. This type of system is called **a closed-loop system**.

2.1.2 Open Loop System

Open loop control systems do not have inbuilt control as control comes from outside the system - **no thermostat** as you have in the closed loop control.

A business example would be the whole organisation. Open control systems are responsive to the environment and they often involve interaction from users.

The elements of a control system include:

- **Input, process, output**
- **Sensor** - measures the output from the system and determines a new value
- **Comparator** - compares the new value with that of the standard
- **Standard** - the predetermined limit set within the system
- **Effector** - effects of the feedback into the system can be positive or negative.

A system that interacts with other systems by exchanging **input and output components** with its environmental elements such as customers, suppliers, competitors, the labour force, government and global community is called **open system.** A firm and most systems that occur **naturally in business** are examples of **open system**. It has to adapt to its changing environments where necessary in order to ensure its continued existence. Also, a business system must be capable of reorganisation in order to cope with the changing market situations. An

information system must also be able to adapt to changing demands for information. An **open system** continually interacts with its environment. It receives input from the outside and delivers output to outside. An **open-loop controller** is often used in simple processes because of its simplicity and low cost, especially in systems where feedback is not critical.

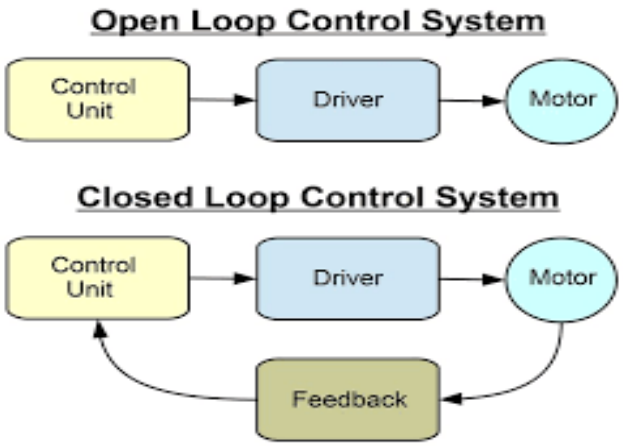


Fig 2.2.1 Open Loop System & Closed Loop Control System

2.1.3 Difference between Open Loop and Closed Loop System

One of the significant differences between the **open loop and closed loop control system** is that in an **open loop system** the **desired output does not depend on the control action**. While in the **closed loop system** the **desired output depends on the control action of the system**.

2.2 The Total Systems Approach

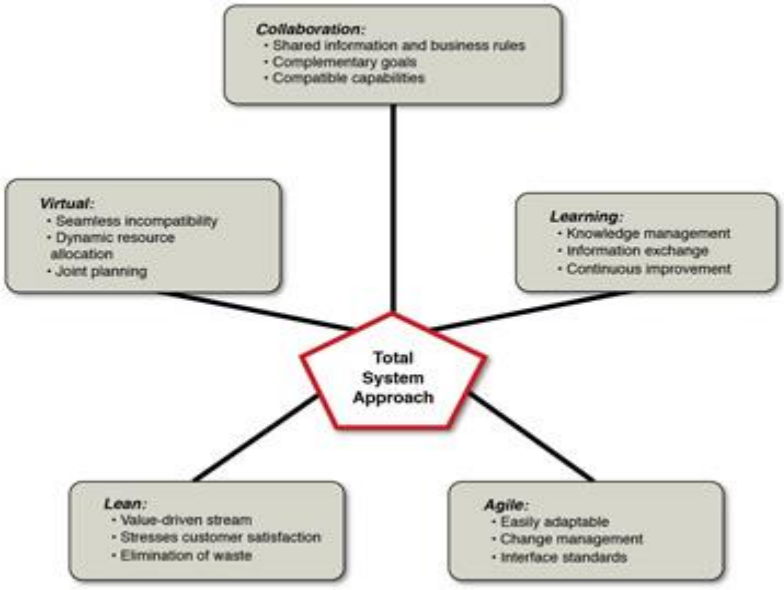
The **systems approach** is simply a way of thinking about these total systems and their components. The Systems Approach or **Systems Theory** has a set of ideas with which we can view systems. This set of ideas can be summarised as follows: All systems are composed of **inter-related parts or sub-systems and the system itself** can only be fully explained and understood when viewed as a whole. This is known as **holism or synergy**.

Systems **are hierarchical in structure**, **i.e. a system is made up of subsystems and each subsystem is made up of further sub-systems**. **Sub-systems** need to work towards the goals of the system to which they belong and not pursue their own goals independently. Where this **latter situation does occur**, a condition of **sub-optimisation occurs**. The systems approach is commonly operationalised through learning organisations. The systems approach is a way of analysing business problems. This approach views the business organisation as a system of interrelated parts designed to accomplish goals. Each subsystem is both a **self-contained unit and a part of a larger system**. Managers must understand the goals of the total system and design the function and subsystems within the total system to accomplish the goals. More specifically, management is the practice of organising resources including people, materials, procedures and machines to achieve objectives. In other words, it entails organising subsystems to accomplish specific tasks. Using a system approach, a manager organises various activities of the business into **separate organisational subsystems**.

To consider an example, the market research subsystem of the business may obtain information from the customers about modifications that are about to be made in the firm's products and services. The market research subsystem can transmit this information to the manufacturing subsystem that builds product design changes into its processes. **Finally**, the marketing subsystem sells the finished products to the customers. If technical problems occur, the service subsystem may need to provide **follow-up support**.

The **total systems approach** regards the supply chain as an entity that is composed of interdependent or interrelated subsystems, each with its own provincial goals, but which integrates the activities of each segment so as to **optimise the system-wide strategic objectives**.

To elaborate, the total systems approach is referred to as a **"holistic, integrated approach"** whereby all the business processes involving demand planning, purchasing, production, transportation, warehousing, and marketing are coordinated to make the **best trade-offs** within them so as to achieve the optimal outcome for the whole system. That is to say, the **total systems approach** recognises the fact that a decision made in one of the business functions can impact other functions of the organisation. As such, the total systems approach enables the firm to assess how changes in business strategy and decisions affect the **firm's across-the-board total costs and benefits**.



The total systems approach to supply chain integration is often predicated on the five essential attributes displayed in **Figure 1.3 (Miller & Berger, 2001, p. 13)**. As shown in this figure, collaboration is at the centre of the total systems approach.

Fig 2.2.2: ***The five essentials of the total systems approach to supply chain integration***

As the extended enterprise perspective brought by the total systems approach has become the important foundation of supply chain thinking, we have witnessed increasing boundary-spanning activities across the supply chain.

2.2.1 The Objectives of a Total System

The main objective of **MIS** is to **improve the management decision making**, by providing **accurate and up-to date information** about the key aspects of organisational performance. The total system objectives and, more specifically, the performance measures of the whole system have the following objective.

The **major objectives of performance management** are discussed below:

- To enable the employees towards achievement of **superior standards of work performance**.
- To help the employees in identifying the knowledge and skills required for performing the job efficiently as this would drive their focus towards performing the right task in the right way.
- Boosting the performance of the employees by encouraging employee empowerment, motivation and implementation of **an effective reward mechanism**.
- Promoting a **two-way system of communication** between the supervisors and the employees for clarifying expectations about the roles and accountabilities, communicating the functional and organisational goals, providing a regular and a transparent feedback for improving employee performance and continuous coaching.
- Identifying the barriers to effective performance and resolving those barriers through constant monitoring, coaching and development interventions.

- Creating a basis for several administrative decisions strategic planning, succession planning, promotions and performance based payment.
- Promoting personal growth and advancement in the career of the employees by helping them in acquiring the desired knowledge and skills.

2.3 Analysing a System

Important questions to be answered when analysing a system are:

- What are its **boundaries**?
- What are its **inputs, processes and outputs**?
- What **feedback and control mechanisms** are in place?
- How can its **efficiency and effectiveness** be measured?

The systems approach recommends the following steps:

- **Decompose** a system into smaller, more manageable and understandable subsystems, preferably of uniform size. This facilitates the focusing of attention on one area (**subsystem**) at a time without interference from other parts.
- **Analyse** each subsystem separately. This allows attention to concentrate on the part of the system pertinent to a particular audience, without confusing people with details irrelevant to their interest.
- **Describe** the subsystems/components and their relationships with each other and the external environment.

2.4 The Effect of Time Lag on Inputs

Lag is a failure of an application to respond in a timely fashion to inputs. In distributed applications (**such as MMORPGs**), lag is often **caused by**

communication latency, which is the time taken for a sent packet of data to be received at the other end. It includes the time to encode the packet for transmission and transmit it, the time for that data to traverse the network equipment between the nodes, and the time to receive and decode the data. This is also known as **"one-way latency"**. A minimum bound on latency is determined by the distance between communicating devices and the speed at which the signal propagates in the circuits (**typically 70–95% of the speed of light in vacuum**). Actual latency is often much higher because of packet processing in networking equipment, and other traffic.

The term lag is often also used **as a synonym for communication latency**. This can be misleading because there can be other causes for the symptom. Lag on inputs is the delay between a button press on your controller and what results on the display. The amount of delay varies between different displays (**and is one of the reasons this website was founded, to fight this ignorance**), and it can be very hard to detect without lots of experience. It is also something that was not easy to measure, due to the complications of old methods. Thankfully, we have a new method that simplifies this process.

In-text Question
1. Distinguish between close loop and open loop system
2. Define the total system approach
In-text Answer
1. In the closed loop system, the desired output depends on the control action of the system while in the open loop system, the desired output does not depend on the control action.
2. Total system approach is simply a way of thinking about these total systems and their components.

3.0 Conclusion/Summary

From what we have said thus far, the systems approach is a way of analysing business problems. But wait, it is time to assess yourself and find out what you have learnt so far.

Now assess yourself on the progress you have made in this course by answering this question.

4.0 Self-Assessment Question

1. Outline the elements of a control system.
2. What are the important questions to be answered when analysing a system?

Self-Assessment Answer

1. The elements of a control system include:
    - Input, process, output
    - Sensor
    - Comparator
    - Standard
    - Effector
2. The important questions to be answered when analysing a system are:
    - What are its boundaries?
    - What are its inputs, processes and outputs?
    - What feedback and control mechanisms are in place?
    - How can its efficiency and effectiveness be measured?

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add https://bit.ly/33MTseg. Watch the video & summarise in 1 paragraph

b. View the animation on add/site https://bit.ly/2Zdacba and critique it in the discussion forum

6.0 References/Further Readings

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STUDY SESSION 3

Systems and Subsystems

Section and Subsection Headings:

Introduction

1.0 Learning outcomes

2.0 Main Content

- 2.1- Systems and subsystems
  - 2.1.1 Outside and Inside the System
  - 2.1.2 System versus Subsystem
  - 2.1.3 Subsystem Interdependency
  - 2.1.4 Subsystem Interface
- 2.2- Introduction to data base
  - 2.2.1 The concept of Database
  - 2.2.2 Classification of Database
  - 2.2.3 Features of Database
  - 2.2.4 Managing a database
  - 2.2.5 Creating a Database
  - 2.2.6 Database Management Systems

3.0 Study Session Summary and Conclusion

4.0 Self-Assessment Questions

5.0 Additional Activities (Videos, Animations & Out of Class activities)

6.0 References/Further Readings

Introduction

This session introduces you to the relationship between system and subsystem. In this Study Session we will also study the introduction to data base.

1.0 Learning Outcomes

By the end of this session, the student is expected to be able to:

1. Explain the relationship between system and subsystem.
2. Explain the meaning of database
3. Understand the concept of database management system

2.0 Main Content

2.1 Systems and Sub Systems

Systems may consist of **numerous subsystems**, each of which has elements, interactions, and objectives. A **Subsystem** is simply a system within a system. Subsystems perform specialised tasks related to the overall objectives of the total system. In a business system, various functions are subsystems. Marketing, finance, and manufacturing, **for example, are subsystems**. Within the marketing subsystem, the sales order entry and credit checking functions are subsystems. Each subsystem uses its resources to meet specific objectives. Successful achievement of these goals requires good management of internal resources. **For instance**, in managing the **sales order-entry function**, the supervisor needs to develop sales order procedures, maintain sales order records, and train sales order personnel.

2.1.1 Outside and Inside the System

Environment: All those **external elements**, whose changes in behaviour, attitude etc., effect the working of the system and all those external elements, which are effected by the system's **environment**.

Boundaries: The separation of a system from its environment i.e. the features or constraints which depict the scope of activities for a system and delineate areas of responsibility. The system is inside the **boundary**, whereas the environment lies outside. **Boundaries** can be imposed by the nature of the system itself or can be decided upon by management. They may be flexible, changing over time or as the wider organisation changes.

Interfaces: It is the area of contact between one system boundary and another. Several systems may share the same environment and may be connected to one another by means of a shared boundary or interface.

Each subsystem has elements, interactions with other subsystems, and objectives.

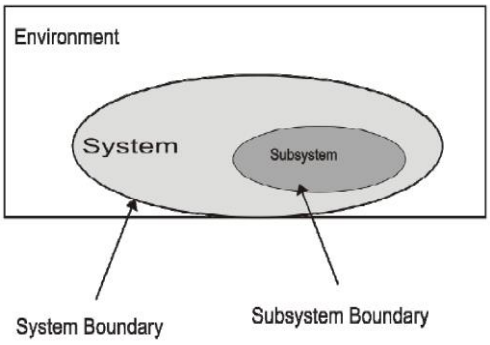


Fig 2.3.1: Outside and Inside the System

2.1.2 System versus Subsystem

The distinction between the terms ***system*** and ***subsystem*** is a matter of **perspective.** For our purposes, these terms are **interchangeable**. A **system is called a subsystem** when it is viewed in relation to the **larger system** of which it is a part.

Likewise, **a subsystem is called a system when it is the focus of attention**. Animals, plants, and other life forms are systems. They are also subsystems of the ecosystem in which they exist. From a different perspective, animals are systems composed of many smaller subsystems, such as the circulatory subsystem and the respiratory subsystem.

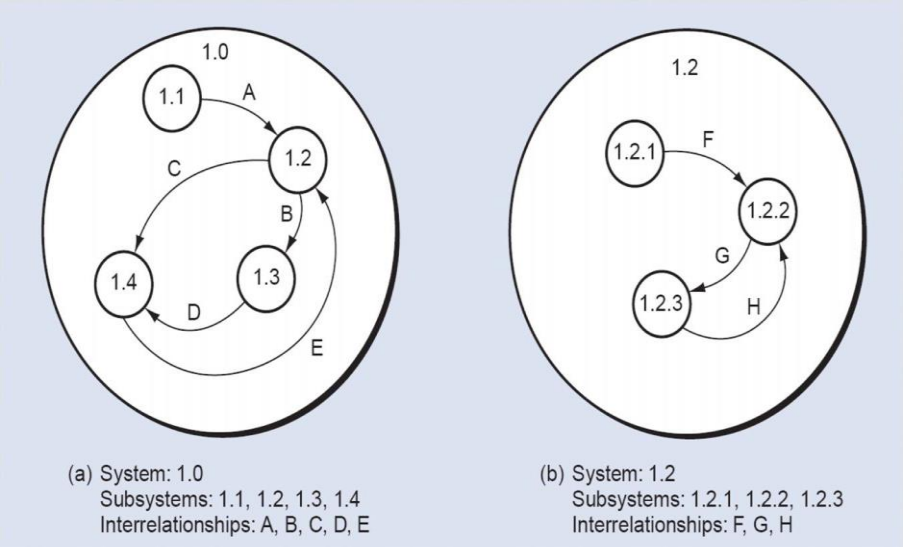


Fig 2.3.2: System versus Subsystem

2.1.3 Subsystem Interdependency

A system's ability to achieve its goal depends on the effective functioning and harmonious interaction of its subsystems. If a vital subsystem fails or becomes defective and can no longer meet its specific objective, the overall system will fail to meet its objective. **For example**, if the fuel pump (**a vital subsystem of the fuel system**) fails, then the fuel system fails. With the failure of the fuel system (**a vital**

subsystem of the automobile), the entire system fails. On the other hand, when a **non-vital** subsystem fails, the primary objective of the overall system can still be met. **For instance**, if the radio (**a subsystem of the electrical system**) fails, the automobile can still convey passengers.

Designers of all types of systems need to recognise the consequences of subsystem failure and provide the appropriate level of control. **For example**, a systems designer may provide control by designing a backup (**redundant**) subsystem that comes into play when the primary subsystem fails. Control should be provided on a **cost-benefit basis**. It is neither economical nor necessary to back up every subsystem. Backup is essential, however, when excessive negative consequences result from a subsystem failure. Hence, virtually every modern automobile has a backup braking system, whereas very few have backup stereo systems.

Like automobile designers, information system designers need to identify critical subsystems, anticipate the risk of their failure, and design **cost-effective** control procedures to mitigate that risk. As we shall see in subsequent chapters, accountants feature prominently in this activity.

2.1.4 Subsystem Interface

An **interface** is a connection at **system or subsystem boundaries**. An interface serves as a medium to convey the output from one system to the input of another system. An **example** will help clarify this concept. Two typical business systems that **interface** with each other are **inventory control and purchasing**. If inventory levels drop below a certain level, then additional stock of these items should be

purchased. Purchasing will need to know what quantity of a particular item to obtain to replenish the stock and information on sales and inventory turnover to learn which items are in greatest demand so these items can be replenished on a timely basis.

An **inventory control system** will provide information on stock to be reordered based on **sales and inventory turnover trends**. However, if the inventory control subsystem triggers erroneous information about the amount of stock to be reordered, then inputs into purchasing will be wrong. This problem can be partially overcome by establishing an **economic order quantity**, or the quantity of an item that is most economical to buy, for each item in inventory. This quantity, derived from order history and inventory turnover rate, can serve as a standard and prevent reordering too much or too little stock.

2.2 Introduction to Database

2.2.1 The concept of Database

In general, a database system is a **computer-based** record keeping system i.e. a system whose overall purpose is to record and maintain information and make that information available to user on demand. As a matter of fact, the information concerned can be anything that is deemed to be of significance to the organisation system is serving i.e. anything that may be necessary to the decision making processes involved in the management of that organisation.

A **database** is an organised collection of related information. It is an ***organised*** collection, because in a database, all data is described and associated with other

data. All information in a database should be ***related*** as well; separate databases should be created to manage **unrelated information**. **For example**, a database that contains information about students should not also hold information about company stock prices. **Databases** are not always digital – a filing cabinet, **for instance**, might be considered a form of database. For the purposes of this text, we will only consider digital databases.

Databases are useful at both the managerial and clerical levels in an organisation. At the managerial level are a **decision-support tool**, for reports can be produced from them which summarise what is going on and give pointers for the future. At the clerical level they provide an easy way of entering and retrieving data, and dealing with inquires. So in many situations a clerk will require access to a database to carry out the latter type of task, and a manager will require access to it to get out a report.

Typical business database applications include:

- Stock records
- Personnel records.
- Customer records
- Accounts
- Mailing lists.

2.2.2 Classification of Database

Database are classified according to the approaches taken to database organisation.

The classes include: -

(a) Relational

(b) Network

(c) Hierarchical

Relational database is a sequential representation of the files inform of a table having rows and columns where each row represents a record and the columns corresponding to the fields.

The **hierarchical database** is a tree like representation of the database files. The records of a file are represented in a tree like structure with the fields subordinate to the records in the hierarchy.

The **Network database** is the representation of the database files. The records relationships are shown by linking.

2.2.3 Features of Database

1. Create and maintain (**add, delete, and revise records**) a database.
2. Extract and list all records or only those records that meet certain conditions.
3. Make an inquiry.
4. Sort record in ascending or descending order by primary, secondary and tertiary fields.
5. Generated formatted reports with **sub-totals and total**.

2.2.4 Managing a database

Managing a data base primarily involves the following **six (6)** tasks

1. **ADD** new data to the database
2. **SORT** the database into some meaningful order
3. **SEARCH** the database for types of information
4. **PRINT** data from our database onto formatted reports
5. **EDIT** data on the database
6. **DELETE** data from the database.

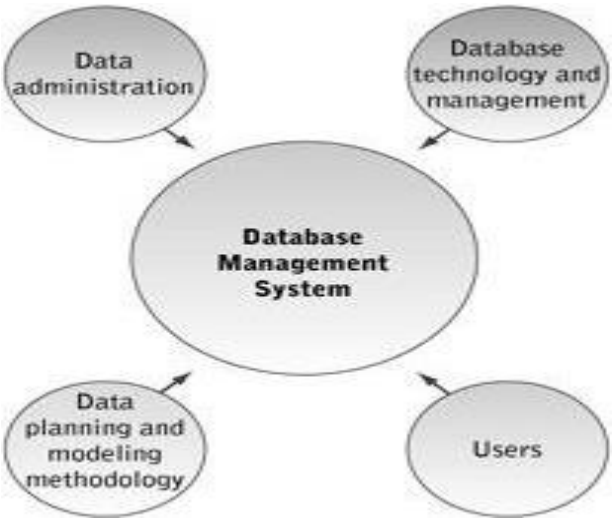
2.2.5 Creating a Database

First, you should **think long and hard** about how you use the **available information** in your **current situation**. Think of **the good and the bad** of how it is organised, stored, and used. Now imagine how this information could be organised better and used more easily throughout the organisation. What part of the current system would you be willing to get rid of and what would you add? Involve as many users in this **planning stage** as possible. They are the ones who will prosper or suffer because of the decisions you make at this point.

Determine the relationships between each data element that you currently have (**entity-relationship diagram**). The data don't necessarily have to be in a computer for you to consider the impact. Determine which data elements work best together and how you will organise them in tables. Break your groups of data into as small a unit as possible (**normalization**). Even when you say it's as small as it can get, go back again. Avoid redundancy between tables. Decide what the key identifier will be for each record. See, you've done all this and you haven't even touched the computer yet!

2.2.6 Database Management Systems

To the computer, a database looks like one or more files. In order for the data in the database to be read, changed, added, or removed, a software program must access it. Many software applications have this ability: iTunes can read its database to give you a listing of its songs (**and play the songs**); your **mobile-phone** software can interact with your list of contacts. But what about applications to create or manage a database? What software can you use to create a database, change a database's structure, or simply do analysis? That is the purpose of a category of software applications called **database management systems (DBMS)**.



DBMS packages generally provide an interface to view and change the design of the database, create queries, and develop reports. Most of these packages are designed to work with a specific type of database, but generally are compatible with a wide range of databases.

Figure 2.3.3: Database Structure (Source: http://studynama.com)

In-text Question

1. Briefly explain the relationship between system and subsystem.

2. Briefly explain the meaning of database.

In-text Answer

1. Systems may consist of numerous subsystems, each of which has elements, interactions, and objectives. A Subsystem is simply a system within a system. Subsystems perform specialised tasks related to the overall objectives of the total system.
2. A database is an organised collection of related information. It is an organised collection, because in a database, all data is described and associated with other data. All information in a database should be related as well; separate databases should be created to manage unrelated information.

3.0 Conclusion/Summary

A Subsystem is simply a system within a system. In your study of the database, you must understand some classification and features of database.

4.0 Self-Assessment Questions

1. What is a subsystem?
2. Outline tasks involved in managing a data base.

Self-Assessment Answers

1. A Subsystem is simply a system within a system. Subsystems perform specialised tasks related to the overall objectives of the total system.

2. When managing a data base, the following tasks are involved:

- ADD new data to the database
- SORT the database into some meaningful order
- SEARCH the database for types of information
- PRINT data from our database onto formatted reports
- EDIT data on the database
- DELETE data from the database.

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add https://bit.ly/2NmO8Z5). Watch the video & summarise in 1 paragraph

b. View the animation on add/site https://bit.ly/2HdrbUj and critique it in the discussion forum

6.0 References/Further Readings

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STUDY SESSION 4

Systems Analysis and Design

Section and Subsection Headings:

Introduction

1.0 Learning outcomes

2.0 Main Content

2.1- System flowchart

2.2 - Principles of systems design

2.3 - The System Life Cycle

2.4 - System design

2.5 - System Documentation

3.0 Summary and Conclusion

4.0 Self-Assessment Questions

5.0 Additional Activities (Videos, Animations & Out of Class activities)

6.0 References/Further Readings

Introduction

Earlier in this class we learnt about system and subsystem. In this Session, we will go further to explore the system design and documentation

1.0 Learning Outcomes

After studying this session, I expect you to be able to:

1. Explain system flowchart
2. List some of the Principles of systems design.
3. List the stages in the System Life Cycle

2.0 Main Content

2.1 System Flowchart

System flowcharts are a way of displaying how data flows in a system and how decisions are made to control events. A **system flowchart** is a physical design tool that shows in general terms the operations that will be performed on information in an information system. To illustrate this, **symbols are used**. They are connected together to show what happens to data and where it goes. **Note that system flow charts are very similar to data flow charts**. **Data flow charts** do not include decisions, they just show the path that data takes, where it is held, processed, and then output.

The arrows on a **system flowchart** show the direction that data will flow in around the system rather than the order in which the operations will be carried out. These **system flowchart symbols** are used to reveal, in a general fashion, the relationships among the input data, the programs, and the desired output. **For example**, most realistic payroll applications require multiple computer programs interacting with multiple data files. Many more are used on a system flowchart than on a normal flowchart.

Common Flowchart Symbols

- **Rectangle Shape** - Represents a process
- **Oval or Pill Shape** - Represents the start or end
- **Diamond Shape** - Represents a decision
- **Parallelogram** - Represents input/output

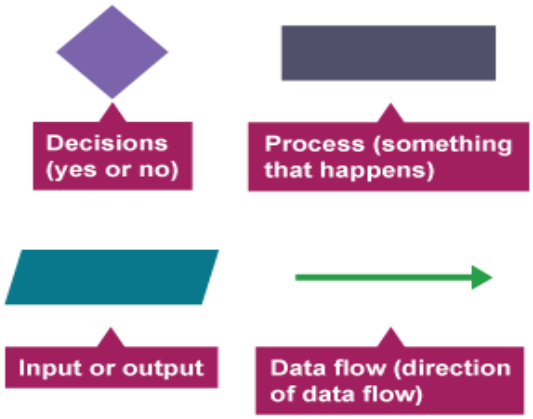

Fig 2.4.1: System flowchart

2.2 Principles of Systems Design

We have dozens of **fundamental principles of good system design** that should help make a product better. Using these principles will also make a product more reusable for future systems and it will help reduce redesign costs when requirements change. **Some of these principles are as follows:**

- Use models to design systems
- Use **hierarchical**, **top-down** design
- Work on **high-risk** items first
- Prioritise
- Control the level of interacting entities
- Design the interfaces
- Produce satisficing designs
- Do not optimise early
- Maintain an updated model of the system
- Develop stable intermediates
- Use evolutionary development

• Understand your enterprise

• List functional requirements in the use cases

• Rapid prototyping

• Develop iteratively and test immediately

• Create modules

• Let anyone comment on the design; you need all the help you can get.

So far, you have learnt about the system flowchart and principle of system design Let us test what you have learnt so far.

In-text Question
1. What is a system flowchart?
2. List some of the Principles of systems design.
In-text Answer
1. System flowcharts are a way of displaying how data flows in a system and how decisions are made to control events.
2. Use models to design systems; Use hierarchical, top-down design; Work on high-risk items first; Prioritise; Control the level of interacting entities; and so on.

2.3 The System Life Cycle

Traditionally, stages involved in **System Life Cycle** can be categorised and in the following order:

- Preliminary survey or initial study
- Feasibility study
- Investigation and fact recording
- Analysis
- Design
- Implementation
- Review and maintenance

The **start of a new system life cycle is normally as result of some problems** such as **failures or limitations of the existing system** causing dissatisfaction or awareness of modern developments. Whatever the reason it is management who will initiate the selection of a project for preliminary study or investigation. Although the detailed study will be done, it is sufficient to know briefly the concept involved in each of the stages as set out below:

Preliminary Survey: The purpose of this study is to establish whether there is a need for a new system and if so specify the objectives of the system. This study is usually carried out by **Steering Committee** which comprises of the Analyst and/or the **data processing (DP)** Manager with the managers of all the departments concerned.

Feasibility study: The aim of feasibility study is to investigate the project in **sufficient depth** to be able to provide information which either justifies the development of the new system or shows why the project should not continue. The questions, which this study addresses, include:

- What are the likely **problem areas**, which will need special attention?
- What are the likely **computer configurations**, which would be suitable?
- What are these configurations likely **to cost in terms of money**, staff and **time-to-design**, to install, to test, and to run?

The **findings of the feasibility study committee** are presented to management in the form of a report, which will make appropriate recommendation. If the report findings are **in favour of the project,** then senior management may decide to move to the next stage.

Investigation and Fact Recording: Detailed study is done in this stage. This study is **more detailed and comprehensive than the feasibility study**. The purpose of this study is to fully understand the existing system and to identify the basic information requirements.

Analysis: Full description of the existing system and the objectives of the proposed system should be analyse to produce specification of the users' requirements. The Requirements Specification should be presented to the management for approval before system design is embarked upon. Greater emphasis is placed upon this stage to avoid **more expensive and frustrating errors**, which failed to meet requirements at the design stage.

Design: If management concludes that it should go ahead with a particular system, or further explore several alternatives, the **systems analyst** will then prepare several proposals which must be complete in every probable and possible detail. The analysis may lead to many possible alternative designs. **Example,** combinations of manual and computerised elements may be considered. Once an alternative is selected the purpose of the design stage is to work from the requirements specification to produce **System Specification**. The system specification will be a detailed set of documents, which provide details of all features of the system.

Implementation: Implementation involves executing the detail set out in the system specification. Two particularly important tasks are **programming and staff training**. Most computer systems are implemented on a **modular basis**, i.e. the overall design system will be broken down into a series of **sub-units (modules)**,

each one being thoroughly tested before becoming operational. As each module proves to be satisfactory it will be integrated into developing overall system.

Maintenance and Review: Once a system is implemented and in full operation it is examined to see if it has met the objectives set out in the original specification. **Unforeseen problems** may need to be overcome and that may involve returning to earlier stages in the cycle to take corrective action.

2.4 System Design

The **design of the new system** will result in the preparation of a **System Specification**. **This stage** would involve **a team of analysts and programmers**, with the approved feasibility report.

Elements of the Design – The design of a new system can be categorised into the following elements:

- Outputs
- Inputs
- Files
- Procedures

Outputs – It is necessary to consider what is required from the system before deciding how to set about producing it. The analyst will need to consider form, types, volumes, and frequencies of reports and documents. Choice of **output** media will also have to be made.

Inputs – Consideration of **input** will be influence greatly by the needs of output, e.g. the necessity for quick response from the system would determine the need for an **on-line** type of input. Consideration would be given to:

- Data collection methods, and validation
- Types of input media available
- Volumes of input documents
- Design of input layouts

Files – File design is linked to **input and output**. Input is processed against the files to produce the necessary output. Considerations involved in designing files are:

- Storage media
- Method of file organisation and access
- File security
- Record layouts

Procedures are the steps which unify the whole process, which link everything together to produce the desired output. These will involve both **computer and clerical procedures**. They will start with the origination of the source document and end with the output document being distributed. The design of the computer programs will constitute a major task in itself.

Design Factors

The purpose is to meet the set objectives in the Requirements Specification as agreed at the beginning of the project. In the absence of **Requirements Specification** then the objectives as contained in the **System Specification** is

implemented. The following are criteria or issues to be considered in designing a new system:

2.5 System Documentation

System documentation serves as the **technical specifications** for the **IS** and how the objectives of the **IS** are accomplished. Users, managers and IS owners need never reference system documentation. **Documentation** is a process of recording the information for any reference or operational purpose. It helps users, managers, and **IT staff**, who require it. It is important that **prepared document must be updated on regular basis** to trace the progress of the system easily. After the **implementation of system (IS)** if the system is working improperly, then documentation helps the administrator to understand the flow of data in the system to correct the flaws and get the system working.

Fig 2.4.2 System Documentation

Programmers or systems analysts usually **create program and system documentation**. **Systems analysts** usually are responsible for preparing documentation **to help users learn the system**. In large companies, **a technical support team** that includes technical writers might assist in the preparation of user documentation and training materials.

System documentation provides the basis for understanding the technical aspects of the **IS** when modifications are made.

- It describes each program **within the IS and the entire IS itself**.
- It describes the system's functions, the way they are implemented, each program's purpose within the entire **IS** with respect to the order of execution, information passed to and from programs, and overall system flow.
- It includes data dictionary entries, data flow diagrams, object models, screen layouts, source documents, and the systems request that initiated the project.
- Most of the **system documentation** is prepared during the **system analysis and system design phases**.
- During systems implementation, an analyst must review system documentation to verify that it is complete, accurate, and **up-to-date**, and including any changes made during the implementation process.

In-text Question
List and explain the stages in the System Life Cycle
In-text Answer
Preliminary survey or initial study; Feasibility study; Investigation and fact recording; Analysis; Design; Implementation; Review and maintenance.

3.0 Conclusion/Summary

A system flowchart is a physical design tool that shows in general terms the operations that will be performed on information in an information system.

4.0 Self-Assessment Questions

1. What are the things considered in designing files?

2. What are the elements of the design of a system?

Self-Assessment Answers

1. The Considerations involved in designing files are:

- Storage media
- Method of file organisation and access
- File security
- Record layouts

2. The design of a new system can be categorised into the following elements:

- Outputs
- Inputs
- Files
- Procedures

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add https://bit.ly/2KKLhaP. Watch the video & summarise in 1 paragraph

b. View the animation on add/site https://bit.ly/2TGWYAs and critique it in the discussion forum

6.0 References/Further Readings

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MODULE 3

Understanding Management Information Systems

Contents:

STUDY SESSION 1

Introduction to Management Information Systems

Section and Subsection Headings:

Introduction

Introduction

We are now beginning to move towards an understanding of the fundamental concepts of **real-world information systems** in organisation. The corporate structure that deals with the design and access to information is called **Management Information Systems**, In this study session we give the basic definition and relevant concepts of **MIS** such as need of **MIS**, components of **MIS**, impact and factors contributing to the success of it in Organisations. The objective of this unit is to give an overview of management information system.

1.0 Learning Outcomes

By the end of this unit, the student should be able to:

1. Explain the meaning of management information system.
2. Explain the component of management information system.

2.0 Main Content

2.1 Management Information System (MIS)

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

2.1.1 What is MIS?

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

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

MIS refers to the **processing of information** through computers and other intelligent devices to manage and support managerial decisions within an organisation.

MIS is defined as **an integrated system** of man and machine for providing the information to support the operations, the management and the decision-making function in the organisation (**Shodhganga, 2013**) **MIS** is the use of information

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

Fig 3.1.1 Management Information System (MIS)

2.1.2 The need for MIS in Organisations

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

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

2.1.3 Components of MIS

A **management information system** is made up of **five (5) major components** namely; **people, business procedures, data, hardware, and software**. All of these components must work together to achieve business objects.

People – these are the **users who use the information system to record the day to day business transactions**. The users are usually qualified professionals such as

accountants, human resource managers, etc. The **ICT department** usually has the support staff who ensure that the system is running properly.

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

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

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

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

Management information systems are distinct from other information systems because they are used to analyse and facilitate strategic and operational activities. **Academically**, the term is commonly used to refer to the study of how individuals, groups, and Organisations evaluate, design, implement, manage, and utilise systems to generate information to **improve efficiency and effectiveness** of decision making, including systems termed decision support systems, expert systems, and executive information systems.

2.2 The Role of MIS

2.2.1 Organisational Structure and MIS

MIS has been described as a **pyramidal structure**, with **four (4) levels of information resources**. The levels of information would depend upon the **organisational structure**. The **top level** supports strategic planning and policy making at the highest level of management. The second level of information resources aid tactical planning and decision making for management control. The **third level** supports day-to-day operations and control. The **bottom level** consists of information for transaction processing. It then follows that since decision making is specific to **hierarchical levels in an organisation**, the information requirements at each level vary accordingly.

Thus, **MIS** as a support system draws upon:

- concepts of organisation;

- organisational theories, principles, structure, behaviour and processes such as communication, power and decision making; and
- motivation and leadership behaviour**.**

Fig 3.1.2: Pyramid structure of management information system.

2.2.2 Role of MIS in an Organisation

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

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

Modelling Systems and Decision Support Systems, **MIS** helps in Strategic Planning, Management Control, Operational Control and Transaction Processing.

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

2.2.3 The Role of MIS in Business Strategy

A **well-optimised management information system** can pay off beyond operations and management decisions. As the **owner** of a small company, you can review purchases over the past year to determine which markets to explore next. **For example**, suppose your retail website originally sold dresses and other garments and last year you began offering shoes at a good profit margin. Today, however, dresses account for very few sales and a high percentage of returns. Sales of shoes have been steadily increasing. At the same time, your web developers have pointed out that **"handbags"** and **"belts"** are now the most popular search items on your website. Based on this information, you have the information you need to phase out dresses and begin offering these sought-after accessories to your customers.

So far, you have learnt about management information system. Let us test what you have learnt so far.

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

2.3 Developing Accounting System

An ideal accounting system does not come into force automatically. It is to be very much carefully planned, designed, arranged, managed and modified. In developing an ideal accounting system the following **four (4)** steps are necessary;

1. Analysis.
2. Design.
3. Implementation.
4. Follow-up.

Analysis:- At first, it is to be ascertained what information is necessary for **internal and external users**. An **information analyst** is to identify sources of necessary information for collecting data and prepare reports and preserve them properly.

Strength and weakness of an existing information system are to be identified for its analysis.

Design:- For formulating a **new accounting system** designing of forms and documents, sorting of the method and working process, preparing a statement of work, collecting techniques of control, preparing reports and selecting equipment are necessary. Slight changes are required for **redesigning existing accounting information system**.

Implementation:- For the **implementation of a new or modified accounting information system**, necessary documentary evidence of information, the process of methods and installation of necessary equipment etc. are to be activated.
Employees concerned are to be given training and they are to be **monitored closely**.

Follow-up:- After the implementation of the accounting information system and making it workable, **its weakness and breakdown** are to be monitored very closely and **its effectiveness and design** are to be compared with **organisational objectives**. If needed changes are to be brought in its implementation process of design. The above-mentioned steps represent the **life cycle of an accounting information system**. This suggests that some accounting information systems are always unchangeable. But the expansion of knowledge, experience and technology and occurrence of organisational changes might create and change the accounting information system.

2.4 Mechanised Accounting System

What is **"mechanised accounting?"** Broadly, it is any means, other than strictly manual, by which **record-keeping systems** are maintained. **Machine systems** unquestionably possess many superiorities over manual systems, such as in their ability to:

- Enforce an **accurate record** of transactions.
- Perform various **operations simultaneously**, such as adding, subtracting, computing balances, and accumulating control totals.
- Post transactions on **two or more related records** at the same time.

- Provide mechanical **proof of correctness** as a by-product of processing operations.
- Eliminate operations.
- Record a large number of routine transactions faster, more accurately, more legible, and more economically.

Pen and ink accounts maintained in the business organisation – big or small is called **a manual accounting system**. Most of the business concerns use adding a machine, desk calculator, multi-copier, etc. For processing accounting data to save time and labor. Similarly, many business organisations use electronic bookkeeping the machine in keeping accounts.

An electronic bookkeeping machine contains a keyboard like a typewriter, and the board is **a ten-key calculator**. It possesses **'functions keys'** which give instructions regarding the operation of the machine, calculation, table preparation and printing of preserved data, etc.

Bookkeeping machine does accounting work for sales, cash receipts, purchase, cash payment, payroll and other transactions. And it also performs the posting of transactions in the general ledger. But here we will not attempt to describe the operation of bookkeeping the machine in detail. However, when we use this machine for a credit sale, **for example**, the current page of the sales journal is placed with the machine. Then for every credit sale, the operator of the machine **inserts the customer's account and month-end statement in the machine** and presses the proper keys to enter the information about the sale. The **machine** makes the entry in the sales journal posts to the customers' accounts; makes the

accounts balance up-to-date, enters the sale on the buyer's month-end statement and makes the statement up-to-date.

Simultaneously **the machine determines the month-end** total of sales journal and debit accounts receivable and credit sales with the totals. Moreover, it performs all of this in one operation from one entry into the machine of proper data. And the machine is equally efficient to operate other transactions also. The bookkeeping machine can process accounting data fast. This machine **reduces transaction-errors** by printing the same information on several different records in one operation.

However, the **speed and volume of work** the machine can perform efficiently are limited. As a result, many business organisations have started computerised accounting data processing.

In-text Question
List out the stages in developing accounting system.
In-text Answer
Analysis; Design; Implementation; Follow-up.

3.0 Conclusion/Summary

Though there are a number of definitions, all of them converge on one single point, i.e., the MIS is a system to support the decision-making functions in the organisation. The difference lies in defining the elements of the MIS. Management Information System is looked at as ways of processing data of an organisation into

information, which is then used for accurate decision making at strategic, tactical and operational levels of management.

4.0 Self-Assessment Questions

1. What exactly is management information system?
2. List the component of management information system?

Self-Assessment Answers

1. Management Information System refers to the processing of information through computers and other intelligent devices to manage and support managerial decisions within an organisation. In a nutshell, Management Information System is the use of information technology, people, and business processes to record, store and process data to produce information that decision makers can use to make day to day decisions.

2. The components of Management Information System are as follows:

- People
- business procedures
- data
- hardware
- software.

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add https://bit.ly/2ZcrJVT. Watch the video & summarise in 1 paragraph

b. View the animation on add/site https://bit.ly/2NoybBN & https://bit.ly/2MtWMpm and critique it in the discussion forum

6.0 References/Further Readings

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STUDY SESSION 2

Information Needs of Management

Section and Subsection Headings:

Introduction

1.0Learning outcomes

2.0 Main Content

- 2.1- Managerial uses of the information output of MIS
- 2.2- Uses of Management Information System in Finance
- 2.3- Information System in Business
- 2.4- Information needs of management
- 2.5- Design of MIS

3.0 Study Session Summary and Conclusion

4.0 Self-Assessment Questions

5.0 Additional Activities (Videos, Animations & Out of Class activities)

6.0 References/Further Readings

Introduction

Earlier in this class we learnt that **MIS** is a system to support the decision-making functions in the organisation. In this session you will learn the information needs of management and how they use the information.

1.0 Learning Outcomes

After studying this session, I expect you to be able to:

1. Identify the information needed by management.
2. Identify the various types of IS in business

2.0 Main Content

2.1- Managerial Uses of the Information Output of MIS

Management information systems provide the **owner and other decision-makers** at a business with the data needed to make informed decisions for the company. **MIS** provides background, current data and trend analysis so you have ready information on all areas of the business. You can use this detailed data on the company environment and finances to improve business performance in the **long-term and short-term**. The **MIS** may be programmed to automatically produce reports at monthly, quarterly or other specified intervals, and may also be accessed to produce special reports when needed.

MIS for Sales and Marketing

Management information systems for the **sales and marketing functions** of a company, also known as **database marketing**, compile and analyze information about customers and prospective customers. Often, the information is scanned or sourced from customer receipts, loyalty card transactions or credit card receipts. The information can be aggregated to highlight buying trends and patterns, identify repeat and **top-purchasing customers**, and target product marketing efforts to address relevant segments of the customer base. Gaining these types of insights can

help the company develop and fine-tune its marketing strategy, resulting in **lowered costs and increased sales** department effectiveness.

MIS for Human Resource Management

Human resource information systems handle employee data such as basic personnel information, attendance and hours, performance review ratings, and payroll tracking. Because the data can include **private information** – like names, addresses and Social Security numbers – protecting privacy and maintaining security are paramount. The **HRM** database can access information for any individual employee, reducing the cost of keeping paper records. When aggregated, the system can provide trending information for management feedback in such areas as improving recruiting efforts, administering benefits and managing schedules and workflow.

Fig 3.2.1 MIS for Human Resource Management

MIS for Accounting and Finances

Management information systems in accounting are designed to store and aggregate financial data. The resulting analyses are used both internally, by managers and **CFOs**, **for example**, and externally by consultants, regulators, tax agencies and others. Reports generated by the accounting **MIS** include profit-and-loss statements, accounts receivable tracking and other financial statements. Because these reports enable management and others to analyze the company's

financial health, it is imperative that the data input into to the system be complete, accurate and secure.

Management Information Systems and IT

Perhaps more than any other division, the **information technology** section of a company has a dual role with. First, the system can store and analyze data about the **IT** department, just as it can for any other department, which can lead to savings and greater efficiency in the company's use of IT. **For example**, the data might show that **IT technicians** spend an inordinate amount of time troubleshooting minor issues for other departments. One solution might be to train key staff to be database administrators for their departments, enabling them to do the **low-level troubleshooting**, thereby saving IT staff time for more serious issues.

2.2 Uses of Management Information System in Finance

Management Information Systems (MIS) in Finance have been widely adopted both by corporations as well as governments. They are information systems **with capacity to maintain large data bases** enabling organisations to store, organise and access financial information easily. These systems are primarily used for accounting operations and generation of **financial reports**. Increasingly they are also used to support budgetary, planning and decision making processes. These systems are credited with increasing financial transparency, efficiency and accountability.

General Ledger

The main use of a **Management Information System (MIS)** in finance is that it automatically updates all the transactions in the **General Ledger**. The General Ledger is the core component of all financial information systems. Financial transactions are simultaneously posted on the various accounts that comprise the organisation's **"Chart of Accounts"**. Simultaneous updating of accounts such as sales, inventory and accounts receivable, reduces errors. It also **provides an accurate and permanent record** of all historical transactions.

Cash Management

Cash flow management is an important use of **MIS in Finance**. Cash Management refers to the control, monitoring and forecasting of cash for financing needs. Use of **MIS in Finance** helps companies track the flow of cash through accounts receivable and accounts payable accurately. **Accurate records** also help in monitoring cost of goods sold. This can help pin point areas that eat up cash flow such as inventory costs, high raw material costs or unreliable sales.

Budget Planning

Financial budget planning uses **proforma or projected financial statements** that serve as formal documents of management's expectations regarding sales, expenses and other financial transactions. Thus **financial budgets** are tools used both for planning as well as control. **MIS** in finance helps organisations evaluate **"what if"** scenarios. By modifying the financial ratios, management can foresee the effects of various scenarios on the financial statements. **MIS** thus serves as a **decision making tool**, helping in choosing appropriate financial goals.

Financial Reporting

The use of **MIS systems in Finance** enables companies to generate multiple financial reports accurately and consistently. Generation of financial statements both for internal reports as well as for shareholder information takes less effort because of the automatic updating of the **General Ledger**. Compliance with Government regulations as well as auditing requirements is also easier because the records are accurate and provide a permanent historical map of transactions that can be verified.

Financial Modelling

A **financial model** is a system that **incorporates mathematics, logic and data in the form of a large database**. The model is used to manipulate the financial variables that affect earnings thus enabling planners to view the implications of their planning decisions. **MIS in Finance** enables organisations to **store a large amount of data**. This helps managers develop accurate models of the external environment and thus incorporate realistic **"what if"** scenarios into their long-range planning goals.

2.3 Information System in Business

Transaction processing systems (TPS)

Transaction processing systems (TPS) are systems for processing routine transactions, often in **large volumes**. They are used extensively in business and government and are an example of an **operational information system**.

Examples of TPS include:

Production and purchasing

- Production planning and control
- Inventory control
- Purchasing system
- Accounting system
- General ledger
- Receivables / payables systems
- Payroll

Sales

- Sales order system
- Delivery scheduling system
- Human resources
- Employee records
- Training records

The **advantages of transaction processing systems**, compared with manual systems for processing transactions, are:

- The ability to handle much larger volumes of transactions
- Cost-effectiveness
- Much faster processing
- Fewer errors in processing
- Efficiency in storing/filing data records.

Management Information Systems (MIS)

Management information systems (MIS) provide information to management, of a **routine or non-routine nature**, by analysing data and converting it into organised information.

MIS provide management information in regular or routine reports, which management can use for planning and controlling activities.

In many cases, **management information** is produced from systems that also process transactions. **For example**, sales reports can be produced from a sales order processing system, and financial reports can be produced from a general ledger system.

Some **management information systems** take data from other sources, and provide reports for management. **Examples** are:

- Budgeting systems, which are used to prepare budgets
- Budgetary control systems, that compare actual results with a budget and report the differences as variances
- Cost accounting and management accounting systems
- Sales analysis reporting systems.

Management information systems provide structured information, and can help **managers to make fairly routine or standard decisions**. They are not **well-suited** for assisting managers with more complex decisions.

MIS may also rely mainly on data obtained internally, from within the organisation, **rather than on external data obtained from outside sources**.

Office Automation Systems (OAS)

Office automation systems, as the name suggests, are systems that automate office processes. They include:

- Word processing systems
- Database systems for desk-top PCs
- Electronic filing systems
- Systems with **e-mail facilities** and a link to the internet groupware systems.

Decision support systems (DSS)

Decision support systems (DSS) are systems that provide support for managers in making decisions for **unstructured or semi-structured problems**. (**In comparison, MIS can help managers with reaching decisions for structured problems).**

A **DSS** consists of data analysis models, and may have access to a database to extract data for analysis. It should provide the user with information about a number of different alternatives or different possible outcomes.

Models in a **DSS** will therefore provide statistical analysis or the facility for scenario planning. For example:

- A **DSS** may include a forecasting model that allows the user to prepare forecasts from available data, and to consider possible variations in the forecast using **sensitivity analysis or statistical analysis**

- A **DSS** may provide a planning model that allows the user to prepare draft plans and then carry out sensitivity analysis on the data (**A spreadsheet model is a form of DSS**).

Executive Information Systems (EIS)

Executive information systems (EIS) are information systems for **senior executives**. They have access to data from sources **both inside and outside the organisation**. The system has the ability to analyse the data in a variety of ways, so that **senior executives** can obtain selected information on demand, analysed at a suitable level of detail. **EIS** are also called **executive support systems (ESS)**. A key feature of an **EIS** is that it provides information to executives in summarised form, **for example** information about performance in relation to critical success factors and key performance indicators, but which also allows the user to **'drill down'** to extract more detailed information. Although information can be presented to executives in the form of tables, or even narrative, **EIS** incorporate the facility to present information in a more user friendly form, **for example** in the form of graphs, bar charts or pie charts.

Expert Systems (ES)

Expert systems are a type of **artificial intelligence system**. The purpose of an expert system is to **provide expert information to the system user**. An **expert system** covers a specific area of expertise. It allows a user to interrogate the system to obtain information, advice or possible solutions to a problem. **Examples of expert systems** are legal advice systems, investment advice systems, medical

diagnosis systems and tax advice systems. An expert system has **several components**:

- A knowledge base, that holds all the facts and rules relating to the area of expertise
- A knowledge acquisition program, through which the knowledge base is kept up-to-date
- An **'inference engine'**, which is the software that responds to inputs from the user, and draws on the knowledge base and applies reasoning to provide a response
- An explanation program that provides an explanation of the reasoning that has been used by the system to reach its conclusion and produce its advice.

Expert systems can be used by experts to reinforce their opinion or give them suggestions. For example:

- Professional lawyers can use a legal expert system to obtain information about relevant legislation or court decisions.
- Similarly, doctors can use a medical expert system to obtain a diagnosis, or several possible diagnoses, of a patient's medial symptoms.
- An investment analyst can use a financial investment expert system to find suitable investments to recommend to a client.

Knowledge work systems (KWS)

Knowledge work systems are systems that are used to **create new knowledge or integrate new knowledge** into an organisation. They include **CAD systems** and virtual reality systems.

2.4 Information Needs of Management

We live in a **world of information**. Every day potential readers are presented with a multitude of books, journals and newspapers. However, **human capacity** is limited and we can absorb only a tiny amount of all this information. There are no clear procedures to help us to identify all information of interest quickly. **Information needs** refer to the information required to take decisions correctly and to carry out the tasks deriving from them.

Three (3) large sets of information needs are associated with the **three (3) stages** in the strategic management process:

1. A **strategic diagnosis** should be undertaken when a strategy is drawn up; in other words, an internal analysis and an environmental analysis – **both general and specific** – must be carried out. Information is an essential element in this strategic diagnosis stage. **Information is needed** on the main strategic environmental factors: cultural, financial, political, competition, technological. This information should attend to the evolution of these factors, as well as their present state. An internal analysis requires information generated by the company itself as a result of its activity. This information can be classified according to the ***company's functions, namely, marketing, production, finance, human resources, R&D and management***.

2. Each member of the company involved in **implementing the strategy** must be aware of his or her particular responsibility, and must receive information on the

tasks he or she has to perform – and how to perform them – in order for the strategy and its component plans to be effectuated. In other words, those responsible for accomplishing these actions need information about what they have to do and how to do it. This information is usually **passed down from higher to lower levels**.

3. Strategy control; efficient control requires knowledge on the outcomes of the actions undertaken to effectuate the plans, and how the different environmental components are evolving, in order to verify whether the strategy is developing appropriately and whether any changes are influencing its viability.

Some of the information used to draw up the strategy will also be required in the control stage in order to compare the **strategy targets** with the results being obtained. Information on the results of implementing the plans will also be needed at this stage. This information must be delivered at the right time so that when any **deviations are detected in the control**, opportune measures can be taken to correct them and achieve the target sets. We can therefore consider three sets of information needs in the management process, each one of which will require different information and will be obtained in different ways. It is extremely important to restrict the information to what is actually needed, as there is a risk of information excess, and everything that goes beyond the strictly necessity impoverishes rather than enriches the system, since it affects the cost of obtaining information. Information economics aims to determine the **optimum amount of information** for a specific problem, based on comparing the marginal cost of the information and the value of the sample or additional information. We know what

type of information we want to obtain; we now examine the sources of information that can be used to obtain it.

Information Needs and Business Processes

- Types of information needed for decisions:
  - Some is financial
  - Some is nonfinancial
  - Some comes from internal sources
  - Some comes from external sources

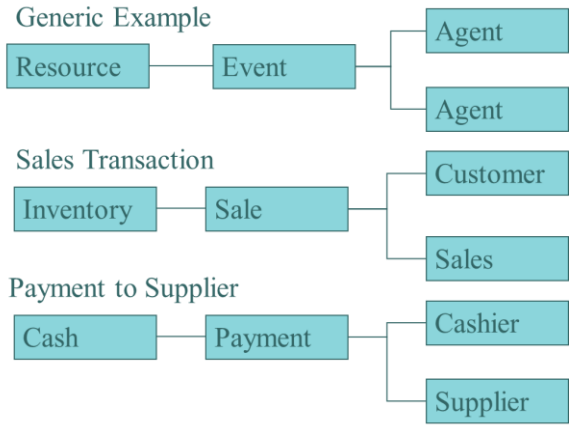

Fig 3.2.2: Information Needs and Business Processes

2.5 The Design of MIS

Strategies for Determining MIS Design

MIS design should be specific to an organisation, respecting its age, structure, and operations.

Six (6) strategies for determining **MIS design** have been suggested by **Blumenthal (1969)**:

- ***Organisation-chart approach:*** Using this approach, the **MIS** is designed based on the traditional functional areas, such as finance, administration, production, **R&D** and extension. These functional areas define current organisational boundaries and structure.
- ***Integrate-later approach:*** Largely **a *laissez faire* approach**, it does not conform to any specified formats as part of an overall design. There is no notion of how the **MIS** will evolve in the organisation. Such an **MIS**

becomes difficult to integrate. In **today's environment**, where managers demand quick and repeated access to information from across sub-systems, **the integrate-later approach** is becoming **less and less popular**.

- ***Data-collection approach***: This approach involves collection of all data which might be relevant to **MIS design**. The collected data are then classified. This classification influences the way the data can be exploited usefully at a later stage. The classification therefore needs to be done extremely carefully.
- ***Database approach:*** A large and detailed database is amassed, stored and maintained. The **database approach is more and more accepted for two main reasons: first**, because of data independence it allows for easier system development, even without attempting a complete **MIS**; and, **second**, it provides management with immediate access to information required.
- ***Top-down approach:*** The **top-down approach** involves defining the information needs for successive layers of management. If information required at the top remains relatively stable in terms of level of detail, content and frequency, the system could fulfil **MIS** requirements (**Zani, 1970**). The usefulness of this approach **depends on the nature of the organisation**. It can be suitable for those organisations where there is a difference in the type of information required at the various levels.
- ***Total-system approach:*** In this approach the interrelationships of the basic information are defined prior to implementation. Data collection, storage and processing are designed and done within the framework of the total system. This approach can be successfully **implemented in organisations which are developing**.

Factors affecting the Design of MIS

Many factors come to mind when designing **MIS**. Some of these factors include:

- **Behavioural Factor:** Consists of the norms, attitudes, motivations, aspirations and capabilities of the people involved. **For instance**, in Nigeria **MIS** on compulsory levy in primary institutions might be jeopardised in some parts of the country because of their beliefs and attitudes.
- **Communication Channels:** In order to make information available where and when needed, seminars, meetings, retreats etc have to be organised.
- **Computer Facilities:** Computer and other data transmission should be made available to help in data processing.
- **Internet Facilities:** If possible, it is ideal to be on network so as to have access to important information when designing yours.
- **Personnel:** For effective data processing, competent personnel with qualitative computer knowledge might be needed to help in data processing.
- **Database:** Simple database might be maintained to help in analyzing information.

So far, you have learnt about the brain and the nervous system. Let us test what you have learnt so far.

In-text Question
Highlight the advantages of transaction processing systems.
In-text Answer
The ability to handle much larger volumes of transactions; Cost-effectiveness; Much faster processing; Fewer errors in processing; Efficiency in storing/filing data records.

3.0 Conclusion/Summary

In this session you have been introduced to the fundamental concepts of Information Systems and different types of information systems with these areas of application.

You have also learnt the strategies for determining MIS design.

4.0 Self-Assessment Questions

1. List and briefly explain the different types of Information Systems in business.
2. List 5 Factors affecting the Design of MIS

Self-Assessment Answers

1. Information Systems in business are of different types, some of which are:

- Transaction processing systems (TPS): They are systems for processing routine transactions, often in large volumes. They are used extensively in business and government and are an example of an operational information system.
- Management Information Systems (MIS): They provide information to management, of a routine or non-routine nature, by analysing data and converting it into organised information. MIS provide management information in regular or routine reports, which management can use for planning and controlling activities.
- Office Automation Systems (OAS): They are systems that automate office processes. They include; Word processing systems; Database systems for

desk-top PCs; Electronic filing systems; and Systems with e-mail facilities and a link to the internet groupware systems.

- Decision support systems (DSS): They are systems that provide support for managers in making decisions for unstructured or semi-structured problems. A DSS consists of data analysis models, and may have access to a database to extract data for analysis. It should provide the user with information about a number of different alternatives or different possible outcomes.
- Executive Information Systems (EIS): They are information systems for senior executives. They have access to data from sources both inside and outside the organisation. The system has the ability to analyse the data in a variety of ways, so that senior executives can obtain selected information on demand, analysed at a suitable level of detail. EIS are also called executive support systems (ESS).
- Expert Systems (ES): They are a type of artificial intelligence system. The purpose of an expert system is to provide expert information to the system user. An expert system covers a specific area of expertise. It allows a user to interrogate the system to obtain information, advice or possible solutions to a problem. Examples of expert systems are legal advice systems, investment advice systems, medical diagnosis systems and tax advice systems.
- Knowledge work systems (KWS): They are systems that are used to create new knowledge or integrate new knowledge into an organisation. They include CAD systems and virtual reality systems.

2. Some of the factors affecting the Design of MIS include:

- Behavioural Factor
- Communication Channels

- Computer Facilities
- Internet Facilities
- Personnel

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add https://bit.ly/2EeCiNf & https://bit.ly/2Zd1HN1 https://bit.ly/2SzYpAO. Watch the video & summarise in 1 paragraph

b. View the animation on add/site https://bit.ly/2za9NeT and critique it in the discussion forum

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STUDY SESSION 3

Business System Hierarchy

Section and Subsection Headings:

Introduction

In this session, we explain the members in the business system hierarchy and the various level of business hierarchy.

1.0 Learning Outcomes

After studying this session, I expect you to be able to:

1. Explain the Business System Hierarchy
2. List the levels in business hierarchy

2.0 Main Content

2.1 Business System Hierarchy

Member of each position in a **business system hierarchy** supervises the juniors and reports to the seniors. This continues till it reaches the **CEO or the Managing director**, who is the top level officer in the business system hierarchy. This hierarchy makes it easy to understand the roles of various employees in the business system. Read below to know in detail about each level of business system hierarchy:

Fig 3.3.1: Business System Hierarchy

- **CEO:** The **Chief Executive Officers** are responsible for **planning and overseeing the business activities and performance**. The final decisions related to the functioning of the company are mostly taken by **CEOs**.
- **Managing Directors:** The **Managing Directors** have the function of **managing the entire business operations management and overviewing the working of each and every department**. Managing

directors need a huge amount of **experience and qualifications** in order to carry out the responsibility of such a big position.

- **General Managers:** The General Managers are **junior to the Directors** who look after all the divisions of the company. They make sure that the decisions taken by the **Managing Directors and the CEOs** are being executed in the right way.
- **Senior manager:** Senior managers usually look after particular **fields or departments**. **For example**, Accounts, Human Resources, Marketing, Communications, Operations etc. all the teams have a dedicated senior manager who looks after the progress of his team and reports it to his seniors. In short, he has to look after the entire functioning of his department.
- **Assistant Manager:** He is **junior to the senior manager**. They are required to analyze important statistics and report about it to the seniors. They are needed to **focus of profitability and major developments** on the daily basis. They need to instruct the executives with respect to what is to be done and what their daily targets are.
- **Operational level Employees:** Operation level employees deal with **machines and resources**. They are more inclined towards **field work and deal with actual execution of physical tasks**. They have workers who work under them as per their instructions.
- **Executives:** Executives are the **lowest level permanent employees**. They take care of performing the **day to day activities of the company** at the basic level so that the progress can be monitored by their seniors. They

have to follow the orders and complete the work targets given by the **Assistant managers**.

- **Interns:** Interns or trainees are the **lowest levels in a business system hierarchy**. They are **temporary employees** who are trained in their field of specialization by the company and are permanently hired if their work ifs found productive and satisfactory by the employer business organisation.

2.2 Levels in Business Hierarchy

The **levels in business hierarchy** refer to the levels of chain of command, employee designations and designation categories which take a **pyramidal form** with the largest segment of employees situated at the base of the pyramid. These employees who constitute the base of the - are supervised by a relatively smaller group of supervisors or immediate managers who in return are supervised and managed by the officers placed above them in the hierarchy, and this way these levels in **business hierarchy** continue till they reach the highest level comprised by the **CEO or the board of directors**.

Hence it can be concluded that the levels in any **business hierarchy** are the predefined steps represented by designations and which keep on narrowing **from bottom to top**. These hierarchies are quite useful in developing an understanding of the roles of various employees in the organisation.

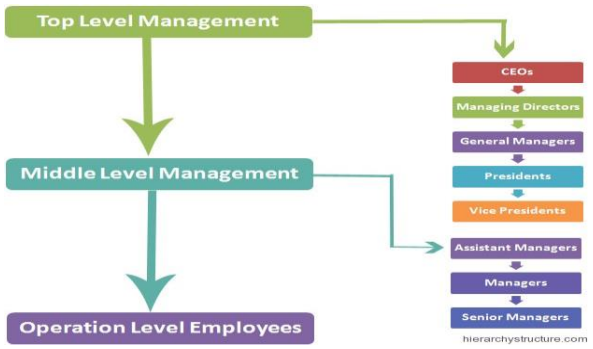

Fig 3.3.2: Levels in Business Hierarchy

The following are the major levels in business hierarchy ranging from top to bottom.

Top Level Management

The **top level management** consists of people like **CEOs, Managing Directors, General Managers, Presidents, and Vice Presidents etc**. These are the personnel who are involved in the planning of the business as well as overseeing its performance. They deal with totality of business system and overlook both **business & administration activities** from top levels. These are majorly engaged in scanning **external and internal environments**. These professionals are meant to make business a success in the long term perspective. Hence they need great conceptual decision making, reasoning and extra ordinary skills. These personnel are required to navigate the business activities all the time and take right decisions for the success of the business.

Middle Level Management

The **second level in business hierarchy is middle management level**. At this level are the **managerial professionals** like **assistant managers, managers, senior managers etc**. These professionals are required to manage the activities pertaining to the actual usage of all the resources and leading the employees in the right direction. These are responsible for **planning activities** in order to achieve the organisational objectives framed by the **top management**. These **professionals** are also required to achieve the **operational and financial objectives** on yearly

basis. Their major focus is on striving profitability, liquidity, efficiency and effectiveness. The jobs performed by these professionals are knowledge & leadership oriented jobs.

Operation Level Employees

The **last level in business hierarchy is operation level** which is constituted by the front line **employees who perform the day to day activities** of structured nature and deal with the units of operation. These employees are majorly related with **machines and resource utilization**. Since employees at this level and their supervisors are engaged in actual implementation of technology or in the production of the organisation's products, hence these are regarded as operational level employees. These employees majorly strive for **effective and efficient implementation** and are guided for work by their immediate supervisors or managers.

2.3 Sub-Optimization

Sub-optimization is a fairly well known concept in business management. **Sub-optimization** occurs when different **sub-units** each attempt to reach a solution that is optimal for that unit, but that may not be optimum for the organisation as a whole. **Sub-optimization** is a term that has been adopted in the business world for a **policy mistake**. It refers to the practice of focusing on one component of a total and making changes intended to improve that one component and ignoring the effects on the other components. We expand on these definitions and descriptions to include other professions including the world of engineers–their solutions and decisions. A **sub-optimal solution is quasi solution** that either does not solve the

problem or ends up creating worse problems. The nature of the sub-optimization problem is most easily understood from examples. These examples exist not as a result of **unethical behaviour and incompetence** but rather because of such things as professional preferences, past practice, unintended and unanticipated consequences, focus only on economic goals, tunnel vision, lack of awareness of **environmental-social** impacts, etc.

Sub-optimization refers to the analysis to assist a lower level decision as a step toward the attainment of a higher level objective to which the lower level decision is to contribute. **Systems are hierarchical in structure**, i.e. a system is made up of subsystems and each subsystem is made up of further **sub-systems**. **Sub-systems** need to work towards the goals of the system to which they belong and not pursue their own goals independently. Where this latter situation does occur, **a condition of sub-optimization occurs**. This is to be avoided if possible, but it must be recognised that in most organisations, conflicting objectives across departments is inevitable. The systems approach is commonly operationalised through learning organisations

Principle of Sub-optimization

Optimizing each subsystem independently will not in general lead to a system optimum, or more strongly, improvement of a particular subsystem may actually worsen the overall system. The **principle of sub-optimization** provides the basis for a link between organisational structure and the policies adopted. (**Machol, 1965, pp. l-8**) See also sub-optimization._The well-being of an element is dependent on the well-being of the system of which it is a part. It is sometimes

necessary for an element to limit its goals and actions in order to preserve the **well-being of the system**. In acting to achieve its goals one element may come to constrain the actions of another element to the point of serious injury to the other element.

The **principle of sub optimization** states that sub optimization in general does not lead to global optimization. Indeed, the optimization for each of the wolves separately is to let the others do the hunting, and then come to eat from their captures. Yet if all wolves would act like that, no prey would ever be captured and all wolves would starve. Similarly, the **sub-optimization** for each of the prisoners separately is to betray the other one, but this leads to both of them being punished rather severely, whereas they might have escaped with a mild punishment if they had stayed silent.

Examples of Sub optimization:

- If a firm focus on **minimization cost**, a desirable aim if all other factors remain equal, and takes measures which not only reduce cost but also reduce revenues even more the profit of the firm is adversely affected.
- A government agency that promotes a program for its benefits but ignores its costs may make society worse off rather than better off. **Maximization of benefits** without taking into account costs is not rational.
- An educational institution concerned about thefts of equipment might take steps to **minimise theft** which result in students not being able to use the equipment at all. This is clearly not optimal because it results in the same

effect as if all the equipment were stolen. The proper policy has to consider the tradeoffs between **security and access** for legitimate use.

- **Minimization of air pollution** may be a valid goal if all other variables, such as economic production, are held constant. But **minimization of air pollution** without regard to what happens to production is not valid. The proper goal is **maximization of net social benefit** which means that the tradeoffs between **air pollution and economic production** must be taken into account.

Management should make effort in directing employee work performance towards desired organisational objectives so as to **reduce sub-optimization** within the departmental units.

To avoid **sub-optimization**, the system of management ought to have a leadership infrastructure which is the entire management infrastructure.

In-text Question
1. Explain the Business System Hierarchy
2. List the levels in business hierarchy
In-text Answer
1. Member of each position in a business system hierarchy supervises the juniors and reports to the seniors. This continues till it reaches the CEO or the Managing director, who is the top level officer in the business system hierarchy.
2. Top Level Management; Middle Level Management; Operation Level Employees.

3.0 Conclusion/Summary

Business System hierarchy makes it easy to understand the roles of various employees in the business system. In your study of the Business System Hierarchy, you must understand Levels in Business Hierarchy.

4.0 Self-Assessment Questions

1. What do you understand by the word levels in Business Hierarchy?
2. Explain the principle of sub-optimization

Self-Assessment Answers

1. The levels in business hierarchy refer to the levels of chain of command, employee designations and designation categories which take a pyramidal form with the largest segment of employees situated at the base of the pyramid.

2. Optimizing each subsystem independently will not in general lead to a system optimum, or more strongly, improvement of a particular subsystem may actually worsen the overall system. The principle of sub-optimization provides the basis for a link between organisational structure and the policies adopted. The well-being of an element is dependent on the well-being of the system of which it is a part. It is sometimes necessary for an element to limit its goals and actions in order to preserve the well-being of the system. In acting to achieve its goals one element may come to constrain the actions of another element to the point of serious injury to the other element. The principle of sub optimization states that sub optimization in general does not lead to global optimization. Indeed, the optimization for each of the wolves separately is to let the others do the hunting, and then come to eat from their captures. Yet if all wolves would act like that, no prey would ever be captured and all wolves would starve. Similarly, the sub-optimization for each of the prisoners separately is to betray the other one, but this leads to both of them being punished rather severely, whereas they might have escaped with a mild punishment if they had stayed silent.

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add https://bit.ly/2KJe934. Watch the video & summarise in 1 paragraph

b. View the animation on add/site https://bit.ly/2Nk7w9l and critique it in the discussion forum

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MODULE 4

Understanding Management Information Systems

Contents:

STUDY SESSION 1

The Evolution Of Computers

Section and Subsection Headings:

Introduction

Introduction

This session introduces you to the history of computer, exploring the changes over time (**eras**) from in generation to generation.

1.0 Learning Outcomes

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

1. Discuss the history of Computers

2.0 Main Content

2.1 The Evolution of Computers

The term **Computer**, originally meant a person capable of **performing numerical calculations** with the help of a mechanical computing device. The **foundation stone of the development of computers** was laid way back in the **era before Christ**. **Binary arithmetic** is at the core of computer systems. The **history of computers** dates back to the invention of a **mechanical adding machine in 1642**. **ABACUS,** an early computing tool, the **invention of logarithm** by **John Napier**

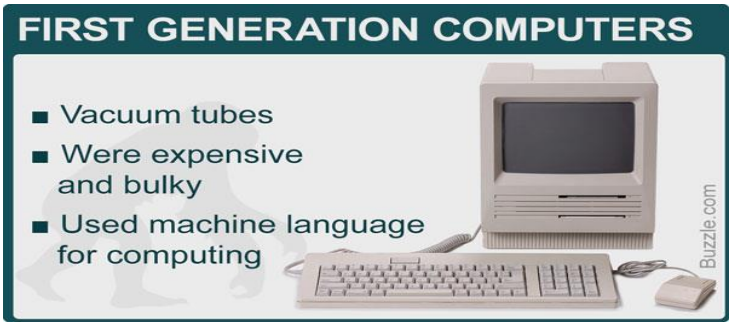
and the invention of slide rules by **William Oughtred** were significant events in the evolution of computers from these early computing devices. Here's introducing you to the ancestors of **modern computers**.

- **Abacus** was invented in **2400 BC**.
- **Pingala** introduced the **binary number system**, which would later form the core of computing systems.
- Later in **60 AD**, **Heron of Alexandria** invented machines that could follow instructions. Who knew back then that this idea would evolve into **intelligent machines**!
- The **1600s** witnessed the **invention of slide rules**, the system of movable rods based on logarithms used to perform **basic mathematical calculations**, and a **mechanical adding machine**, which in some way, laid the foundation of modern-day calculating machines or computers.
- **1800s** saw some remarkable feats in the history of computers. They included:
- A **punching card system** was devised by **Joseph Marie Jacquard in 1801**.
- **Charles Babbage** designed the **first computer in 1822** and the **Analytical Engine in 1834**.
- **Morse code** was invented in **1835 by Samuel Morse**.
- **George Boole** invented the **Boolean algebra in 1848**, which would later be at the heart of programming
- **Computers** in the form of personal desktop computers, laptops and tablets have become such an important part of everyday living that it can be difficult to remember a time when they did not exist. In reality, computers as they are known and used today are still relatively new. Although computers

have technically been in use since the abacus approximately **5000 years ago**, it is modern computers that have had the greatest and most profound effect on society. The first **full-sized digital computer** in history was developed in **1944** called **the Mark I**, this computer was used only for calculations and weighed five tons. Despite its size and limited ability, it was the first of many that would start off **generations of computer development and growth**.

2.1.1 First Generation Computers

First generation computers bore little resemblance to computers of today, either in appearance or performance. The first generation of computers took place from **1940 to 1956** and was extremely large in size. The inner workings of the computers at that time were unsophisticated. These early machines required magnetic drums for memory and vacuum tubes that worked as switches and amplifiers. It was the vacuum tubes that were mainly responsible for the large size of the machines and the massive amounts of heat that they released. These computers produced so much heat that they regularly overheated despite large cooling units. **First generation computers** also used a very basic programming language that is referred to as **machine language**. If you look at how computers evolved, you will notice that first generation computers made use of vacuum tubes.



These computers were expensive and bulky. They

used machine language for computing and could solve just one problem at a time. They did not support multitasking.

Fig 4.1.1: First Generation Computers

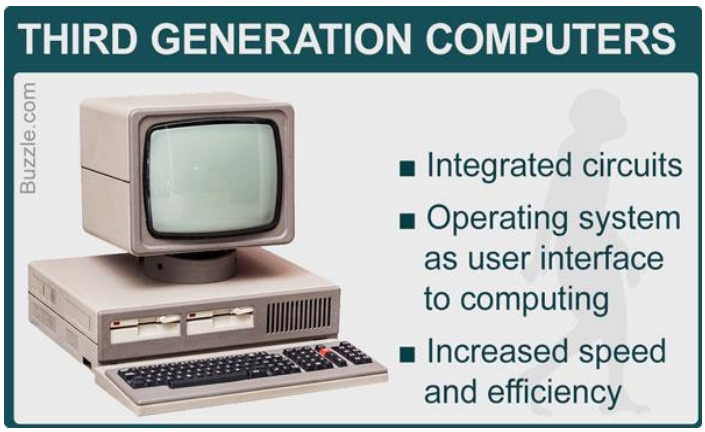
2.1.2 Second Generation Computers

The second generation (**from 1956 to 1963**) of computers managed to do away with **vacuum tubes in lieu of transistors**. This allowed them to use less electricity and generate less heat. **Second generation computers** were also significantly faster than their predecessors. Another significant change was in the size of the computers, which were smaller. Transistor computers also developed core memory which they used alongside magnetic storage. They made computers energy-efficient. But transistors led to emission of large amounts of heat from the computer, which could damage them. The use of transistors marked the second generation of computers. Computers of this generation used punched cards for input. They used assembly language.

Fig 4.1.2: Second Generation Computers

2.1.3 Third Generation Computers

From **1964 to 1971** computers went through a significant change in terms of speed, courtesy of integrated circuits. **Integrated circuits**, or semiconductor chips, were large numbers of miniature transistors packed on silicon chips. This not only increased the speed of computers but also made them smaller, more powerful, and less expensive. In addition, instead of the punch cards and the printouts of previous



systems, keyboards and monitors were now allowing people to interact with computing machines Their use increased the speed and efficiency of computers. **Operating systems** were the human interface to computing operations and keyboards and monitors became the **input-output devices**. **COBOL**, one of the earliest computer languages, was developed in **1959-60**. **BASIC** came out in **1964**. It was designed by **John George Kemeny and Thomas Eugene Kurtz**. **Douglas Engelbart** invented **the first mouse prototype in 1963**. Computers used a **video display terminal (VDT)** in the early days. The invention of **Color Graphics Adapter in 1981** and that of **Enhanced Graphics Adapter in 1984**, both by **IBM** added **'color'** to computer displays. All through the **1990s**, computer monitors used the **CRT technology**. **LCD** replaced it in the **2000s**. Computer keyboards evolved from the early typewriters. The development of computer storage devices started with the invention of **Floppy disks, by IBM** again.

Fig 4.1.3: Third Generation Computers

2.1.4 Fourth Generation Computers

The changes with the greatest impact occurred in the years **from 1971 to 2010**. During this time technology developed to a point where manufacturers could place millions of transistors on a single circuit chip. This was called **monolithic integrated circuit technology**. It also heralded the invention of the **Intel 4004 chip** which was the first microprocessor to become commercially available in

1971. This invention led to the dawn of the personal computer industry. By the **late 70s and early 80s** assembled personal computers for home use, such as the **Commodore Pet, Apple II** and the first **IBM computer**, were making their way onto the market. Personal computers and their ability to create networks eventually would lead to the Internet in the early **1990s**. The fourth generation of computers also saw the creation of even smaller computers including laptops and hand-held devices. **Graphical user interface, or GUI,** was also invented during this time. Computer memory and storage also went through major improvements, with an increase in storage capacity and speed. Thousands of integrated circuits placed onto a silicon chip made up a **microprocessor**. Introduction of **microprocessors** was the hallmark of **fourth generation computers**.

- Intel produced large-scale integration circuits in **1971**.
- In **1972**, Intel introduced the **8080 microprocessors**.
- In **1974**, **Xerox** came up with **Alto workstation at PARC**. It consisted of a monitor, a graphical interface, a mouse, and an Ethernet card for networking.
- **Apple Computers** brought out the **Macintosh personal computer on January 24 1984**.
- By **1988**, more than **45 million computers** were in use in the **United States**. The number went up to a billion by **2002**.

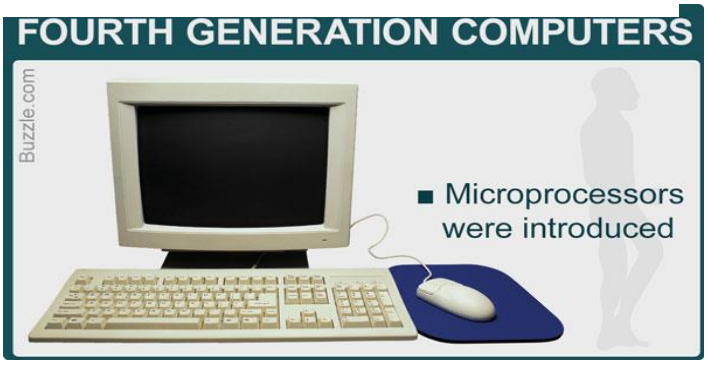


Fig 4.1.4: Fourth Generation Computers

2.1.5 The Fifth Generation of Computers

In the future, computer users can expect even **faster and more advanced computer technology**. Computers continue to develop into advanced forms of technology. **Fifth generation computing** has yet to be truly defined, as there are numerous paths that technology is taking toward the future of computer development. **For instance**, research is ongoing in the fields of **nanotechnology**, **artificial intelligence**, as well as quantum computation. **The fifth generation computers** are in their development phase. They would be capable of massive parallel processing, support voice recognition and understand **natural language**. The current advancements in computer technology are likely to transform computing machines into intelligent ones that possess **self organising skills**. The evolution of computers will continue, perhaps till the day their processing powers equal **human intelligence**.

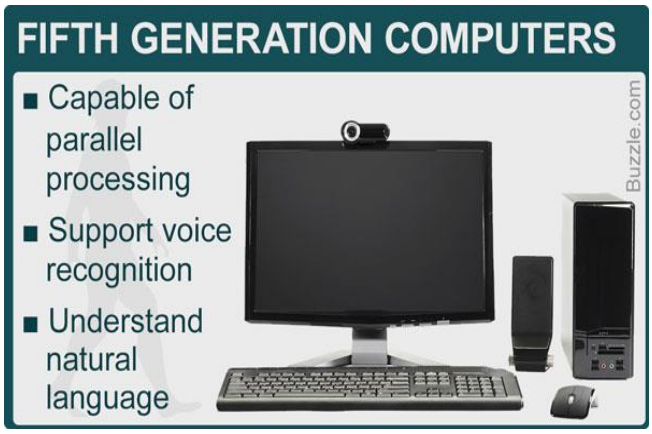


Fig 4.1.5: The Fifth Generation of Computers

In-text Question
Outline the generation of compulsory
In-text Answer
First Generation Computers; Second Generation Computers; Third Generation Computers; Fourth Generation Computers; and Fifth Generation Computers.

3.0 Conclusion/Summary

The foundation stone of the development of computers was laid way back in the era before Christ. Binary arithmetic is at the core of computer systems. Since them it has evolve over time from one generation to other.

4.0 Self-Assessment Questions

1. Explain the evolution of computer.
2. Briefly explain the Second Generation Computer.

Self-Assessment Answers

1. The foundation stone of the development of computers was laid way back in the era before Christ. Binary arithmetic is at the core of computer systems. The history of computers dates back to the invention of a mechanical adding machine in 1642. ABACUS, an early computing tool, the invention of logarithm by John Napier and the invention of slide rules by William Oughtred were significant events in the evolution of computers from these early computing devices. Here's introducing you to the ancestors of modern computers.

- Abacus was invented in 2400 BC.
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2. The second generation (from 1956 to 1963) of computers managed to do away with vacuum tubes in lieu of transistors. This allowed them to use less electricity and generate less heat. Second generation computers were also significantly faster than their predecessors. Another significant change was in the size of the computers, which were smaller. Transistor computers also developed core memory which they used alongside magnetic storage. They made computers energy-efficient. But transistors led to emission of large amounts of heat from the computer, which could damage them. The use of transistors marked the second generation of computers. Computers of this generation used punched cards for input. They used assembly language.

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b. View the animation on add/site https://bit.ly/2TNfOaV and critique it in the discussion forum

6.0 References/Further Readings

An excellent brief treatment of the history of computers is found in Wikipedia.

Internet resources relating to the history of computing include http://ei.cs.vt.edu/~history/

https://techspirited.com/evolution-of-computers

https://www.nortonsecurityonline.com/security-center/evolution-of-computers.html

STUDY SESSION 2

The Computer System

Section and Subsection Headings:

Introduction

1.0 Learning outcomes

2.0 Main Content

- 2.1- Computer Systems
- 2.1.1- Input Devices
- 2.1.2- The Central Processing Unit (CPU)
- 2.1.3- Output Devices
- 2.1.4- Storage Devices
- 2.2- Computer Hardware
- 2.3- Computer Software
- 2.4 Classification of Software
- 2.4.1 Systems Software
- 2.4.1.1 Operating System Software
- 2.4.1.2 Utility software
- 2.4.1.3 Communications Software
- 2.4.2 Application Software

3.0 Summary and Conclusion

4.0 Self-Assessment Questions

5.0 Additional Activities (Videos, Animations & Out of Class activities)

6.0 References/Further Readings

Introduction

This session introduces you to the history of computer to the computer system and its component. In this Session, we will go further to explore both computer software and hardware and this forms the basis for discussion in this unit.

1.0 Learning Outcomes

After studying this session, I expect you to be able to:

1. Explain with examples the component of a computer system
2. Describe the concepts of hardware and software
3. Distinguish between application software and system software
4. Functions and types of Operating system

2.0 Main Content

2.1 The Computer System

A **computer system** comprises of **four (4)** key components:

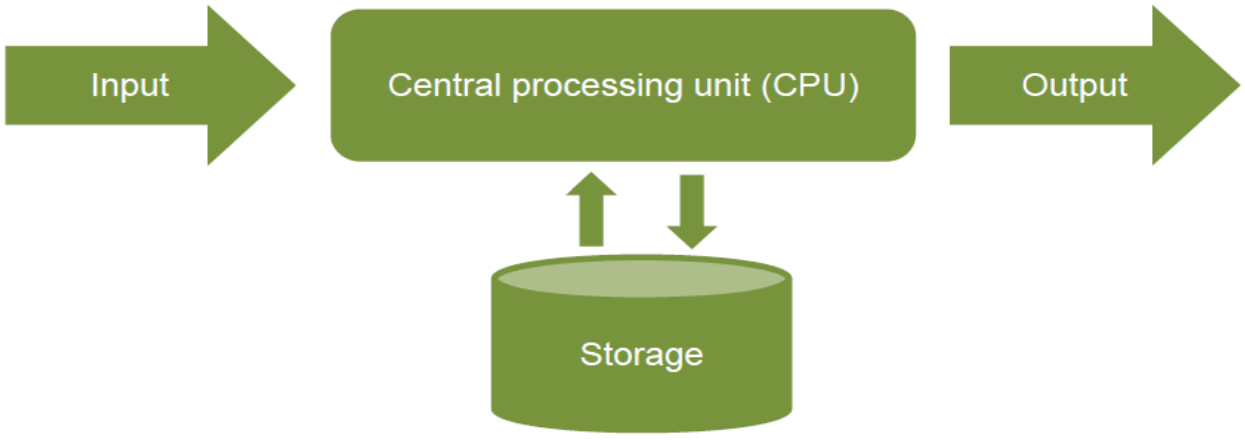


Fig 4.2.1: The computer system

17th century French philosopher, psychologist and Mathematician, Descartes, who in the early 1600s was the first to think about the brain functioning as a machine. He applied the Machines principles of physics, math and astronomy to human behaviour for the first time.

2.1.1 Input Devices

As you saw in **section 2.1** above computer systems have **four (4) key components – input, CPU, storage and output**. In this section we take a brief look at some of the many input devices commonly used in computer systems. These components help users enter data and commands into a computer system. **Data** can be in the form of numbers, words, actions, commands, etc. The main function of **input devices** is to direct commands and data into computers. Computers then use their **CPU** to process this data and produce output.

The following are some of the important input devices which are used in a computer

Keyboard:- Keyboard is the most common and very popular input device which helps to **input data** to the computer. The layout of the **keyboard** is like that of traditional typewriter, although there are some additional keys provided for performing additional functions.

Fig 4.2.2: Keyboard

Mouse:- Mouse is the most popular **pointing device**. It is a very famous **cursor-**

control device having a small palm size box with a round ball at its base, which senses the movement of the mouse and sends corresponding signals to the **CPU** when the mouse buttons are pressed. Generally, it has two buttons called **the left and the right button** and a wheel is present between the buttons. A mouse can be used to control the position of the **cursor on the screen**, but it cannot be used to enter text into the computer.

Fig 4.2.3: Mouse

Joystick: - Joystick is also a **pointing device**, which is **used to move the cursor position on a monitor screen**. It is a stick having a **spherical ball at its both lower and upper ends**. The lower spherical ball moves in a socket. The joystick can be moved in all four directions.

Fig 4.2.4: Joystick

The function of the **joystick is similar to that of a mouse**. It is mainly used in **Computer Aided Designing (CAD)** and **playing computer games**.

Light Pen:- Light pen is a pointing device similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a **photocell** and an optical system placed in a small tube.

Fig 4.2.5: Light Pen

When the tip of a light pen is moved over the **monitor screen** and the **pen button** is pressed, its **photocell** sensing element detects the screen location and sends the corresponding signal to the **CPU**.

Track Ball:- Track ball is an input device that is mostly used in **notebook or laptop computer**, instead of a mouse. This is a ball which is **half inserted and by moving fingers** on the ball, the pointer can be moved.

Fig 4.2.6: Track Ball

Since the whole device is not moved, a track ball requires less space than a mouse. A **track ball** comes in various shapes like a ball, a button, or a square.

Scanner:- Scanner is an input device, which works more like a **photocopy machine**. It is used when some information is available on paper and it is to be transferred to the hard disk of the computer for further manipulation.

Fig 4.2.7: Scanner

Scanner captures images from the source which are then **converted into a digital form** that can be **stored on the disk**. These images can be **edited** before they are **printed**.

Digitizer:- Digitizer is an input device which converts analog information into digital form. **Digitizer** can **convert a signal from the television or camera** into a series of numbers that could be **stored in a computer**. They can be used by the computer to create a picture of whatever the **camera** had been pointed at.

Fig 4.2.8: Digitizer

Digitizer is also known as **Tablet or Graphics Tablet** as it **converts graphics and pictorial data into binary inputs**. A **graphic tablet** as digitizer is used for fine **works of drawing and image** manipulation applications.

Microphone:- Microphone is an input device to **input sound** that is then stored in a digital form.

The **microphone** is used for various applications such as adding sound to a multimedia presentation or for **mixing music**.

Fig 4.2.9: Microphone

Magnetic Ink Card Reader (MICR):- MICR input device is generally used in **banks** as there are large number of cheques to be processed every day. The **bank's code number and cheque number are printed** on the cheques with a special type of ink that contains particles of magnetic material that are machine readable.

Fig 4.2.1o: Magnetic Ink Card Reader (MICR)

Optical Character Reader (OCR):- OCR is an input device used to read a printed text.

OCR scans the text optically, character by character, **converts them into a machine readable code**, and stores the text on the system memory.

Fig 4.2.11: Optical Character Reader (OCR)

Bar Code Readers:- Bar Code Reader is a device used for **reading bar coded data** (**data in the form of light and dark lines**).

Bar coded data is generally used in labelling goods, numbering the books, etc. It may be a

handheld scanner or may be embedded in a **stationary scanner**.

Fig 4.2.12: Bar Code Readers

Bar Code Reader scans a bar code image, converts it into an **alphanumeric value**, which is then fed to the computer that the bar code reader is connected to.

Optical Mark Reader (OMR):- OMR is a special type of optical scanner used to recognise the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be **selected and marked**.

It is specially **used for checking the answer sheets of examinations having multiple choice questions**.

Fig 4.2.13: Optical Mark Reader (OMR)

2.1.2 Central Processing Unit (CPU)

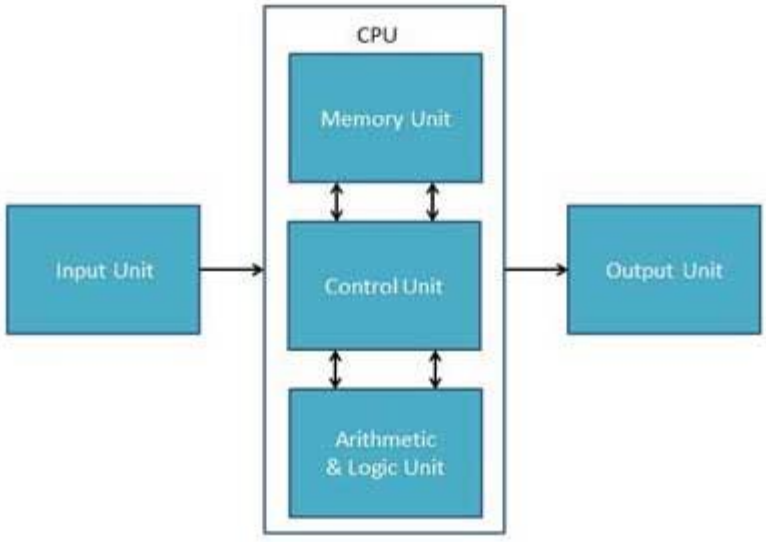


Fig 4.214: Central Processing Unit (CPU)

After receiving data and commands from users, a **computer system** now has to **process** it according to the instructions provided. Here, it has to rely on a component called **the central processing unit**. The **CPU** further uses these three elements:

a) Memory Unit

Once a user enters data using input devices, the computer system stores this data in its **memory unit**. This data will now remain here until other **components of CPU** process it. The memory unit uses a set of pre-programmed instructions to further transmit this data to other parts of the **CPU**.

b) Arithmetic and Logic Unit

This part of the **CPU performs arithmetic operations**. It does basic mathematical calculations like addition, subtraction, division, multiplication, etc. Further, it can even perform **logical functions** like the comparison of data.

c) Control Unit

This unit is the **backbone of computers**. It is responsible for coordinating tasks between all **components of a computer system**. The control unit **collects data from input units and sends it to processing units depending on its nature**. Finally, it also further transmits processed data to output units for users.

2.1.3 Output Devices

An **output device** is the part of a computer system that receives the processed data from the computer and presents it in some way. **Output devices** are distinct from input devices which are the parts of the computer that provide data and instructions. However, **technology has advanced** to the stage where some devices are a combination of both **input and output** such as a **touch-sensitive screen**. The third and final component of a computer system is the output unit. After processing of data, it is converted into a format which humans can understand. After conversion, the output units displays this data to users. **Examples** of output devices include monitors,

screens, printers and speakers. Thus, output units basically reproduce the data formatted by the computer for users' benefit.

Following are some of the important output devices used in a computer.

Monitors:- Monitors, commonly called as **Visual Display Unit (VDU)**, are the main output device of a computer. It forms images from tiny dots, called **pixels** that are arranged in a rectangular form. The **sharpness of the image depends upon the number of pixels**.

Fig 4.2.15: Monitors

Printers:- Printer is an output device, which is used to **print information on paper**. A printer is a device that prints output to a page (**on paper**). Printing can be in **colour or 'black and white'** depending on the printer type.

Fig 4.2.16: Printers

Speakers and headsets:- Speakers are attached to computers for the output of sound. The sound output is produced by a sound card. Speakers range from simple, **single-speaker** output devices **offering low-quality audio to surround-sound multi-channel units** sending different output to multiple speakers in different locations. Headsets are a combination of speakers and microphones and are commonly used by gamers. They are also growing in popularity as an increasingly

cost-effective method of communicating with friends and family over the internet using software such as **Skype**.

Projector:- A projector can be thought of as a variation of monitor in that it translates the digital output into a **visual display** directed onto a screen. Think of some of the lectures you attended and how common it is for a computer to be connected to a **projector** to output the presentation slides.

2.1.4 Storage Devices

You have already seen how the **CPU** is the **brain of the computer** taking inputs from various devices such as **keyboards, mice and scanners then outputting to devices such as speakers, printers and monitors**. However, computers need somewhere to store all the data such as music, videos, pictures, documents, spreadsheets, presentations, emails and so on.

Primary storage (internal memory)

Internal temporary store directly accessible by the **CPU** that allows it to process data. Volatile by nature as it is erased when power is turned off. Much smaller than **secondary or tertiary storage** but much quicker to access (**as it has no mechanical parts**). **Examples** include **RAM and ROM (see 1.2 above)** plus the **CPU's cache memory** (**temporary store of instructions repeatedly required to run programs – typically up to 2MB (megabytes) in size**).

Secondary storage (external memory)

Secondary storage differs from primary storage in that it is not directly accessible by the **CPU**. **Secondary storage** is used for data not currently being

processed but which may need to be accessed at a later stage, **for example** the operating system, documents, music files and emails.

Non-volatile as data remains intact even when powered off. Located further from the **CPU** than primary storage (**and not directly accessible by the CPU**), therefore takes longer to access. However, is much larger than primary storage. A computer's largest **secondary storage** location is typically its hard disk drive (**also called hard drive**), the capacity of which would typically fall between **40GB (gigabytes) to 2 TB (terabytes)**. **Other examples include**:

- Flash memory (**USB flash drives or keys**)
- Floppy disks
- CD
- DVD
- Blu-ray drive
- Magnetic tape
- Cloud drive

Tertiary storage

Tertiary storage is not as commonly recognisable as **primary or secondary storage** by most computer consumers as they may never encounter it.

Tertiary storage typically involves a **robotic mechanism** that mounts (**inserts**) and dismounts removable mass storage media into a storage device. Often used for archiving rarely accessed information as it is much slower than **secondary storage**.

Primarily useful for extremely large data stores accessed without human operators.

In-text Question
1. _____ is the backbone of a computer system.
2. What are the key components of a computer system?
In-text Answer
1. Control Unit
2. input, CPU, storage and output

2.2 Computer Hardware

Computer hardware refers to the **physical devices** such as servers, desktop computers, laptops, portable devices, networking devices, storage devices and printers, etc. Let's now look at each of these **elements** separately. **Examples** of peripherals include printers and stand-alone disc drives.

The computer systems used in **IT systems** range from the very large supercomputers to the very small **hand-held computer systems**. In many organisations, different computers are connected to each other to form a network.

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

Desktop computers – these are workstation clients that usually connect to the server to post, process, and retrieve information. **For example**, a point of sale system installed on a desktop computer to connect to the **POS database** on the server to post and retrieve data.

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

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

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

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

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

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

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

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

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

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

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

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

The peripheral unit: This can be **subdivided into 3 units**

- Input Devices
- Output Devices
- Auxiliary Devices

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

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

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

2.3 Computer Software

Software is the generic term for all sorts of program that runs on the **hardware** system. The **hardware system** on its own is just a **bunch of electrical gadgets** which at best could deliver a fatal electric shock when powered. It is the **software** that drive the **hardware**. The **software** is designed to exploit and provide the potential capabilities of the **hardware** to the intending user.

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

2.4 Classification of Software

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

i. Systems software/program

ii. Application software/program

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

2.4.1 Systems Software

This is the collection of programs that directs the basic functions of the computer in such a way that they are for the most part transparent to the user. **System software** helps run the computer hardware and computer system itself. **System software** includes operating systems, device drivers, diagnostic tools and more. **System software** is almost always **pre-installed on your computer**. They refer to the sets of programs that facilitate the optimal use of the hardware systems and provide suitable environment for the writing, testing, editing, debugging and running of user programs. Usually, every **computer systems** come with a collection of these suites of programs which are provided by the hardware manufacturer.

They permit the **programmer** to concentrate on writing efficient program to solve problems, without being concerned with such things as the **internal memory**, selection of memory addresses, control of **input and output devices**, or error detection.

There are **three categories of system software**:

- Operating system software
- Utility software
- Communications software

2.4.1.1 Operating System Software

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

It is an organised collection of programs that acts as **an interface between machine hardware and users**. An **operating system (OS)** is the software that controls the operation of the computer. **Examples** of operating systems include **DOS (short for disk operating system)**, Windows and Linux.

Key features of OS include:

- The **OS** controls all operations within the **computer itself**
- The **OS** controls the operation of all **other software**, such as the application software
- The **OS** controls the operation of all the **other hardware** connected to the

2.4.1.2 Utility software

Utility software performs a variety of general functions on the computer, such as copying files, sorting data on files and checking for viruses.

Utilities are either:

- Provided with the operating system by its developer (**e.g. a file copying utility**); or
- Purchased in the form of utility packages (**e.g. Norton Utilities anti-virus software**)

Utility programs provide many of the background operations essential for the **efficient operation of any computer system** such as continuous protection against viruses.

2.4.1.3 Communications Software

Definition: Communications software controls the transmission of data within a **computer network** making it possible to **send and receive data over media** such as telephone lines and fibre optic cables.

2.4.2 Application Software

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

A. Ready-made Programs (Application Packages)

Application packages are ready-made programs or suite of programs with **associated documentation**, used for a **particular type of problems or variety of similar problems**. The **documentation** should include specifications of **input and output formats** and file layouts. This will include user instruction manuals, **hardware** requirements and details of how the package may be varied to suit the user‘s individual needs.

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

Application packages may be classified into **two (2)** : **Special or Specific purpose and General Purpose Application Packages**.

1. **Special or Specific purpose**: These consist of programs designed carry out just one specific task **Example includes:**

- Software used in wide variety of business such as **Payroll and Stock Control**.
- Software used only in specialised businesses such as Transaction processing in banks and building societies.
- Packages are also available in education, scientific, engineering and mathematical areas. They address problems such as: Economic analysis.

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

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

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

Reasons for application packages are:

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

Advantages of Application Packages

1. The main advantages are the saving of programming effort and expense on the part of the user. Development costs are effectively shared between the users.
2. There is reduction in systems and programming effort and cost.
3. Implementation of an application is quicker and possibly cheaper.
4. System testing is minimised since the packages should have been well tested.

Disadvantages of Application Packages

1. The package is not tailored for a particular user needs.
2. The company providing the package may cease business and leaves the user without a system.
3. Inefficiency may result from the inclusion of features not relevant to every application.

B. User written Programs

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

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

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

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

2. **Developing software** using Contract programming.

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

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

Relationship between hardware and software

Software and Hardware work together to process the input. The **CPU (Central Processing Unit)** processes input into output through the fetch-execute cycle.

The **CPU** is made up of several different parts including: Arithmetic and Logic Unit (**ALU**), Control Unit (**CU**) and various registers. Its performance is measured in **GHz or Petaflops(speed)** and word size (**power**), **for example Pentium4 2.4 GHz 32 bit Quad Core.**

- The Arithmetic and Logic Unit performs calculations
- The Control Unit loads and executes instructions
- The current instruction is stored in the Instruction Register
- The other Registers store the results of calculations (**Accumulator**) and where the next instruction is to come from (**Program Counter**)
- Communications between the **CPU** and memory occur using Buses - Address Bus, Data Bus, and the Control Bus

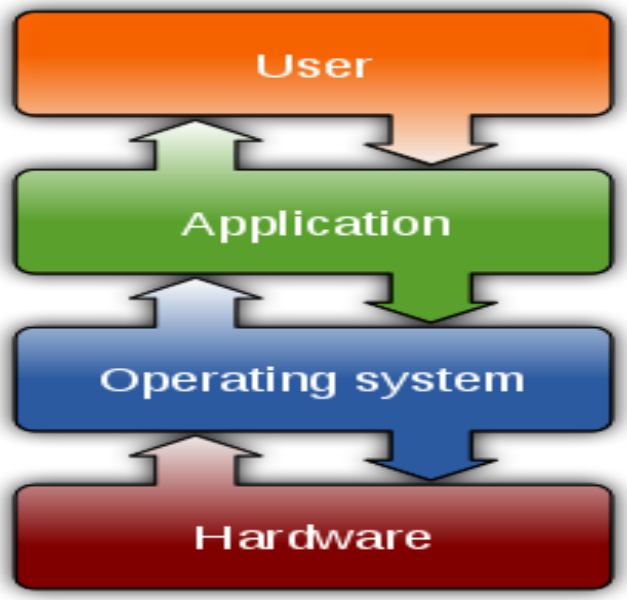


Fig 4.2.17: Relationship between hardware and software

In-text Question
1. Define Hardware
2. List out the units of computer hardware you know.
In-text Answer
1. Computer hardware refers to the physical units or machine, which makes up the computer configuration. The software refers to the programs, which are processed by the hardware.
2. *The Central processing Unit (CPU) and The Peripheral unit or Electrical gadgets.*

3.0 Conclusion/Summary

The understanding of the basic and detailed knowledge of computer system including the software and hardware is good for development of an information system. Hardware refers to the physical devices such as servers, workstations, printers, etc. The software most used included database servers, email servers, spread sheet applications, word processors, etc. Local area networks and sometimes wide area networks are used to share resources among users.

4.0 Self-Assessment Questions

1. Explain the component of a computer system
2. Highlight the types of system software.

Self-Assessment Answers

1. The component of a computer system are as follows:

- Input Devices: The main function of input devices is to direct commands and data into computers. Computers then use their CPU to process this data and produce output. The following are some of the important input devices which are used in a computer: Keyboard; Mouse; Joystick; Light Pen; Track Ball; Scanner; Digitizer; Microphone; Magnetic Ink Card Reader (MICR); Optical Character Reader (OCR); Bar Code Readers; and Optical Mark Reader (OMR).
- Central Processing Unit (CPU): After receiving data and commands from users, a computer system now has to process it according to the instructions provided. Here, it has to rely on a component called the central processing unit. The CPU further uses these three elements: Memory Unit; Arithmetic and Logic Unit; and Control Unit.
- Output Devices: This is the part of a computer system that receives the processed data from the computer and presents it in some way. Output devices are distinct from input devices which are the parts of the computer that provide data and instructions. However, technology has advanced to the stage where some devices are a combination of both input and output such as a touch-sensitive screen. The third and final component of a computer system is the output unit. After processing of data, it is converted into a format which humans can understand. After conversion, the output units display this data to

users. Examples of output devices include monitors, screens, printers and speakers. Thus, output units basically reproduce the data formatted by the computer for users' benefit.

- Storage: computers need somewhere to store all the data such as music, videos, pictures, documents, spreadsheets, presentations, emails and so on.

2. The types of system software are as follows:

- Operating system software
- Utility software
- Communications software

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add https://bit.ly/33WiMP8. Watch the video & summarise in 1 paragraph

b. View the animation on add/site https://bit.ly/33MW0sQ and critique it in the discussion forum

6.0 References/Further Readings

https://www.toppr.com/guides/accountancy/application-of-computers-in-accounting/components-computer-system/

STUDY SESSION 3

Introduction to Computer Programming Languages

Section and Subsection Headings:

Introduction

1.0Learning outcomes

2.0 Main Content

2.1- What is computer programming

2.2- Computer programming languages

3.0 Summary and Conclusion

4.0 Self-Assessment Questions

5.0 Additional Activities (Videos, Animations & Out of Class activities)

6.0 References/Further Readings

Introduction

In this unit we review computer programming languages in general but with special focus on high level programming languages.

1.0 Learning Outcomes

After studying this session, I expect you to be able to:

1. Explain computer programming
2. Describe computer programming languages

2.0 Main Content

2.1 What is Computer Programming

Computer programming is the act of writing a program which the **computer can execute to produce the desired result**. A **computer program** is the **sequence of simple instructions** or statements into which a given problem is reduced and that which is in a form the computer can understand. Embedded in a program is the logic of the **problem to be solved** and in fact, this logic that is expressed in simple computer executable statement. In effect the computer does not produce the logic rather; it follows the logic supplied by programmer. Programming demand a great deal of planning, creativity and logical reasoning. Depending on the complexity of the problem to be solve, **programming can be quite challenging**.

Fig 4.3.1 What is computer programming

2.2 Computer Programming Languages

A **set of notations** used for communication is called **a language**. **Spoken languages** are said to be **ambiguous** while **computer languages** are said to be **unambiguous** because **each statement has a unique meaning**. The two main classes of computer languages are called **low level language and high level language**.

Low Level Language: A low level language is **either a machine language or as assembly language.**

Machine language: In Theory we could write our programs using **machine code** but this would be quite a **laborious exercise**. Remember that **machine code** is made up of **ones and zeroes**; getting them all right is not easy.

It is a **programming language** composed primarily of **numeric instructions**, i.e. it is defined by the **operation codes and format** of the machine instructions of the computer. It is a language made up of strings of binary digits specific to a particular make and model of computer. A machine instruction contains two basic parts:

- An operation to be performed, e.g. add, subtract, multiply, etc.
- One or more operands and the memory address where the data to be operated upon is located.

The **operation** is identified by a **numeric code** called **the operation or operands e.g**. an instruction to add the contents of a memory address to a register. The **operation code** is the **numeric code** for the addition operation and the **operands** are simply, **numbers indicating the memory**, address and the address of a register.
Since the **computer deals with only binary numbers**, machine language instructions must be **expressed numerically**, **using the digits 0 and 1**.

Machine language cannot be changed by the programs. The interpretation of a **machine language** program is a **direct function of the computer hardware**, the circuitry of the computer determines the rules of the language.

Disadvantages of Machine Language

- Programming in machine language is a difficult and tedious task.
- It is subject to much human error
- It is machine dependent

Assembly Language

Slightly less difficult to use is **assembly language**. This is written by using mnemonic codes, each of which corresponds directly to a machine language instruction**. Assembly language instructions** are **translated into machine language by a program called an assembler**. Writing in assembly language does have some advantages over using most of the other languages that we will be discussing below. It gives us very detailed control over precisely what the computer does. We can therefore **write efficient programs which will run quickly** and which occupy relatively small amounts of space in the computer's memory. However, assembly language programs have some disadvantages:

- They are quite difficult to write and harder to learn (**although not as difficult as machine code**).
- They cannot easily be moved from one computer to another as different microprocessor use different assembly languages, thus the entire program must be **re-written** if it is to be used in another computer.
- An assembly language program is more difficult to modify, because it is written in a language that is hard to interpret.
- The logical steps to solve the problem are buried in mass of machine instructions.

For these reasons it is often **more convenient** to write programs in a **high-level language**.

High-level Languages

In general, **high-level languages** use **words and symbols** in ways which are similar to those in which they are normally used by **human beings**, rather than using the somewhat **cryptic mnemonic codes** used by **assembly languages**.

Advantages of High-level Languages

- The programmer is **free to concentrate on problem solution** instead of the internal operations of the computer.
- **Less time is required** for writing the program.
- Program **logic is easier to trace**.
- Program **revision is easier**
- High-level languages are much **easier to learn, to understand, and to use**.
- Major high-level languages are **available on most computers** and so it is relatively easy to move a program from one kind of machine to another.
- Because they are **machine-independent**, a program written on one computer can easily be run on another computer.

We now turn to a discussion of **individual high-level languages**. We will not attempt to describe the details of how to use them (**except for FORTRAN**); these can be found in the manufacturer‘s manuals or in other books on particular languages. Instead, we will simply attempt to give an idea of the purposes for which the languages are used and of their general nature.

The languages we will discuss are:

- BASIC	**PASCAL**	**FORTRAN**
- ALGOL	**COBOL**	**LISP**
- LOGO	**FORTH**	**PROLOG**
- APL	**JAVA**	**ADA**
- C++	**PHP**	**C_Sharp(C#)**
- C		

There are, of course, many others, some of which are designed for specialised applications. However, those listed above should give some idea of the variety of languages available.

BASIC: (**an acronym for Beginner's All-purpose Symbolic Instruction Code**) is a family of general-purpose, **high-level programming languages** whose design philosophy emphasises ease of use. In **1964**, **John G. Kemeny and Thomas E. Kurtz** designed the **original BASIC language at Dartmouth College in New Hampshire, United States**. They wanted to enable students in fields other than science and mathematics to use computers. At the time, nearly all use of computers required writing custom software, which was something **only scientists and mathematicians tended to learn**.

PASCAL: is an imperative and procedural programming language, which **Niklaus Wirth** designed in **1968–69** and published in **1970**, as a small, efficient language

intended to encourage good programming practices using structured programming and data structuring.

A derivative known as **Object Pascal designed for object-oriented programming** was developed in **1985**, later developed into **Delphi**. **PASCAL** is the main rival to **BASIC** as a language for those starting to learn computer programming. For once, the letters in the name do not stand for anything, the language is **named after Blaise Pascal, the 17th century French Mathematician** whose achievements included the **invention of a calculating machine**. **PASCAL** is intended to avoid the potential untidiness of **BASIC programs**, and to bring out the logical structure of a program much more clearly.

FORTRAN: (/ˈfɔːrtræn/; formerly FORTRAN, derived from "Formula Translation") is a **general-purpose**, imperative programming language that is especially suited to numeric computation and scientific computing. Originally developed by IBM in the **1950s** for scientific and engineering applications, Fortran came to dominate this area of programming early on and has been in continuous use for over half a century in computationally intensive areas such as numerical weather prediction, finite element analysis, computational fluid dynamics, computational physics, crystallography and computational chemistry. It is a popular language for **high-performance** computing and is used for programs that benchmark and rank the world's fastest supercomputers.

ALGOL: (**short for Algorithmic Language**) is a family of imperative **computer programming languages**, originally developed in the **mid-1950s**, which greatly influenced many other languages and was the standard method for algorithm

description used by the **ACM** in textbooks and academic sources for **more than thirty years**.

In the sense that the syntax of most modern languages is **"Algol-like"**, it was arguably the most influential of the four high-level programming languages with which it was roughly contemporary: **FORTRAN, Lisp, and COBOL**. It was designed to avoid some of the perceived problems with **FORTRAN** and eventually gave rise to many other programming languages, including **PL/I, Simula, BCPL, B, Pascal, and C**.

ALGOL introduced code blocks and the begin…end pairs for delimiting them. It was also the **first language implementing nested function definitions with lexical scope**. Moreover, it was the first programming language which gave detailed attention to formal language definition and through the **Algol 60 Report introduced Backus–Naur form**, a principal formal grammar notation for language design.

There were three major specifications, named after the year they were first published:

- **ALGOL 58** – originally proposed to be called **IAL**, for **International Algebraic Language**.
- **ALGOL 60** – first implemented as **X1 ALGOL 60 in mid-1960**. Revised **1963.[5][6]**
- **ALGOL 68** – introduced new elements including flexible arrays, slices, parallelism, operator identification. Revised **1973.[7]**

COBOL: (/ˈ**koʊbɒl/, an acronym for common business-oriented language**) is a compiled **English-like computer programming language** designed for business use. It is imperative, procedural and, since **2002**, object-oriented. **COBOL** is primarily used in business, finance, and administrative systems for companies and governments. **COBOL** is still widely used in legacy applications deployed on mainframe computers, such as large-scale batch and transaction processing jobs. But due to its declining popularity and the retirement of experienced **COBOL** programmers, programs are being migrated to new platforms, rewritten in modern languages or replaced with software packages. Most programming in **COBOL** is now purely to maintain existing applications. It was standardised in **1968** and has since been revised four times. Expansions include support for structured and object-oriented programming.

Academic computer scientists were generally uninterested in business applications when **COBOL** was created and were not involved in its design; it was (**effectively**) designed from the ground up as a **computer language** for business, with an emphasis on inputs and outputs, whose only data types were numbers and strings of text. **COBOL** has been criticised throughout its life, however, for its verbosity, design process and poor support for structured programming, which resulted in monolithic and incomprehensible programs.

LISP: (**historically, LISP**) is a family of computer programming languages with a long history and a distinctive, fully parenthesised prefix notation. Originally specified in **1958, Lisp** is the **second-oldest high-level programming language** in widespread use today. Only **Fortran is older**, by one year. **Lisp** has changed since

its early days, and many dialects have existed over its history. Today, the best known **general-purpose Lisp dialects** are Common Lisp and Scheme.

Lisp was originally created as a practical mathematical notation for computer programs, influenced by the notation of **Alonzo Church's lambda calculus**. It quickly became the favoured programming language for **artificial intelligence (AI)** research. As one of the earliest programming languages, **Lisp pioneered** many ideas in computer science, including tree data structures, automatic storage management, dynamic typing, conditionals, higher-order functions, recursion, the self-hosting compiler, and the **read–eval–print loop**. **Lisp programs** can manipulate source code as a data structure, giving rise to the macro systems that allow programmers to create new syntax or new domain-specific languages embedded in **Lisp**.

LOGO: is an educational programming language, designed in **1967 by Wally Feurzeig, Seymour Papert and Cynthia Solomon**. **"Logo"** is not an acronym. It was derived from the **Greek logos** meaning word or **"thought"** by **Feurzeig**, to distinguish itself from other programming languages that were primarily numbers, not graphics or logic, oriented.

A **general-purpose language**, Logo is widely known for its use of turtle graphics, in which commands for movement and drawing produced line graphics either on screen or with a **small robot** called **a turtle**. The language was conceived to teach concepts of programming related to Lisp and only later to enable what **Papert** called **"body-syntonic reasoning"**, where students could understand, predict and

reason about the turtle's motion by imagining what they would do if they were the turtle. There are substantial differences among the many dialects of **Logo**, and the situation is confused by the regular appearance of **turtle-graphics programs** that call themselves.

FORTH: Forth is an imperative **stack-based** computer programming language and environment originally designed by **Charles "Chuck" Moore**. Language features include structured programming, reflection (**the ability to modify the program structure during program execution**), concatenative programming (**functions are composed with juxtaposition**) and extensibility (**the programmer can create new commands**). Although not an acronym, the language's name is sometimes spelled with all capital letters as **FORTH,** following the customary usage during its earlier years. A procedural programming language without type checking, Forth features both interactive execution of commands (**making it suitable as a shell for systems that lack a more formal operating system**) and the ability to compile sequences of commands for later execution. Some Forth implementations (**usually early versions or those written to be extremely portable**) compile threaded code, but many implementations today generate optimised machine code like other language compilers.

PROLOG: is a **general-purpose logic programming language** associated with **artificial intelligence and computational linguistics**.

Prolog has its roots in first-order logic, a formal logic, and unlike many other programming languages, Prolog is declarative: the program logic is expressed in

terms of relations, represented as facts and rules. A computation is initiated by running a query over these relations.
The language was first conceived by a group around **Alain Colmerauer in Marseille, France, in the early 1970s**.

Prolog was one of the **first logic programming languages**, and remains the most popular among such languages today, with several free and commercial implementations available. The language has been used for theorem proving, expert systems, term rewriting, type inference, and automated planning, as well as its original intended field of use, natural language processing. **Modern Prolog environments** support the creation of graphical user interfaces, as well as administrative and networked applications. **Prolog** is well-suited for specific tasks that benefit from **rule-based logical queries** such as searching databases, voice control systems, and filling templates.

APL: (**named after the book A Programming Language**) is a programming language developed in the **1960s by Kenneth E. Iverson**. Its central datatype is the **multidimensional array**. It uses a large range of special graphic symbols to represent most functions and operators, leading to very concise code. It has been an important influence on the development of concept modeling, spreadsheets, functional programming, and computer math packages. It has also inspired several other **programming languages**. It is still used today for certain applications.

ADA: is a structured, statically typed, imperative, wide-spectrum, and object-oriented **high-level computer programming language**, extended from **Pascal**

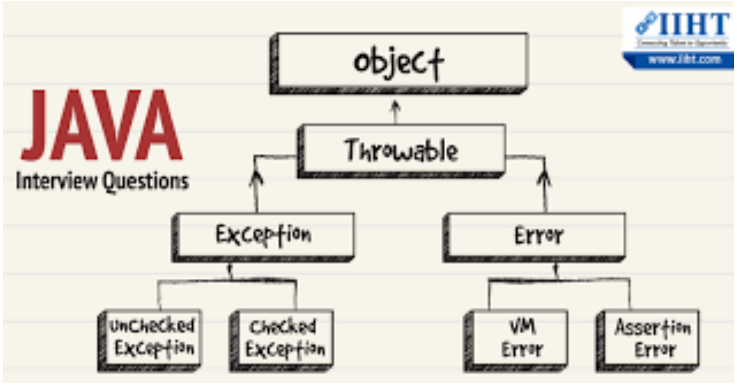
and other languages. It has built-in language support for design-by-contract, extremely strong typing, explicit concurrency, offering tasks, synchronous message passing, protected objects, and non-determinism. **Ada improves code safety** and maintainability by using the compiler to find errors in favour of runtime errors. **Ada** is an international standard; the current version (**known as Ada 2012**) is defined by **ISO/IEC 8652:2012**.

C: (/ˈ**si**:/**, as in the letter c**) is a general-purpose, imperative computer programming language, supporting structured programming, lexical variable scope and recursion, while a static type system prevents many unintended operations. By design, **C** provides constructs that map efficiently to typical machine instructions, and therefore it has found lasting use in applications that had formerly been **coded in assembly language**, including operating systems, as well as various application software for computers ranging from supercomputers to embedded systems.

C is an imperative procedural language. It was designed to be compiled using a relatively **straightforward compiler**, to provide **low-level access to memory**, to provide language constructs that map efficiently to machine instructions, and to require minimal run-time support. Despite its **low-level capabilities**, the language was designed to encourage **cross-platform programming**. A standards-compliant and portably written **C program** can be compiled for a very wide variety of computer platforms and operating systems with few changes to its source code. The language has become available on a very wide range of platforms, from embedded microcontrollers to supercomputers.

(C-Sharp) C#: (**pronounced as see sharp**) is a **multi-paradigm programming language** encompassing strong typing, imperative, declarative, functional, generic, object-oriented (**class-based**), and component-oriented programming disciplines. It was developed by **Microsoft** within its NET initiative and later approved as a standard by **Ecma** (**ECMA-334**) and **ISO (ISO/IEC 23270:2006)**. **C#** is one of the programming languages designed for the **Common Language Infrastructure**. **C#** is a general-purpose, object-oriented programming language. Its development team is led by **Anders Hejlsberg**. The most recent **version is C# 7.0**, which was released in **2017** along with **Visual Studio 2017**.

JAVA: is a general-purpose computer programming language that is concurrent, class-based, object-oriented, and specifically designed to have as few implementation dependencies as possible. It is intended to let application developers **"write once, run anywhere"** (**WORA**), meaning that compiled **Java code** can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any **Java virtual machine (JVM)** regardless of computer architecture. As of **2016**, Java is one of the most popular programming languages in use, particularly for client-server web applications, with a reported **9 million developers**. Java was originally developed by **James Gosling at Sun Microsystems** (**which has since been acquired by Oracle Corporation**) and released in **1995** as a core component of Sun **Microsystems' Java platform**. The language derives



much of its syntax from **C and C++**, but it has fewer **low-level facilities** than either of them.

Fig 4.3.2 JAVA

The **latest version is Java 9**, released on **September 21, 2017**, and is one of the **two versions** currently **supported for free** by **Oracle**. Versions earlier than **Java 8** are supported both by **Oracle and other companies on a commercial basis**.

PHP: is a **server-side** scripting language designed primarily for web development but also used as a general-purpose programming language. Originally created by **Rasmus Lerdorf in 1994**, the **PHP** reference implementation is now produced by the **PHP Development Team**. PHP originally stood for Personal Home Page, but it now stands for the recursive acronym PHP: Hypertext Preprocessor. PHP code may be embedded into **HTML or HTML5** markup, or it can be used in combination with various web template systems, web content management systems and web frameworks. **PHP code** is usually processed by a **PHP interpreter** implemented as a module in the web server or as a **Common Gateway Interface (CGI)** executable. The web server software combines the results of the interpreted and executed **PHP code**, which may be any type of data, including images, with the generated web page**. PHP code** may also be executed with a **command-line interface (CLI)** and can be used to implement standalone graphical applications.

PL/1: (**Programming Language One, pronounced /pi**: **ɛl wʌn/**) is a procedural, imperative computer **programming language** designed for scientific, engineering, business and system programming uses. It has been used by various academic, commercial and industrial organisations since it was introduced in the **1960s**, and continues to be actively used.

PL/I's main domains are **data processing, numerical computation, scientific computing, and system programming; it supports recursion, structured programming, linked data structure handling, fixed-point, floating-point, complex, character string handling, and bit string handling**. The language syntax is English-like and suited for describing complex data formats, with a wide set of functions available to verify and manipulate them.

(C-plus plus) C++: (**pronounced cee plus plus /ˈsi: plʌs plʌs/**) is a general-purpose programming language. It has imperative, object-oriented and generic programming features, while also providing facilities for low-level memory manipulation.

It was designed with a bias toward system programming and embedded, resource-constrained and large systems, with performance, efficiency and flexibility of use as its design highlights. **C++** has also been found useful in many other contexts, with key strengths being software infrastructure and resource-constrained applications, including desktop applications, servers (**e.g. e-commerce, web search or SQL servers**), and performance-critical applications (**e.g. telephone switches or space probes**). **C++** is a compiled language, with implementations of it available on many platforms. Many vendors provide **C++** compilers, including the Free Software Foundation, Microsoft, Intel, and IBM.

In-text Question
Briefly explain computer programming
In-text Answer

Computer programming is the act of writing a program which the computer can execute to produce the desired result. A computer program is the sequence of simple instructions or statements into which a given problem is reduced and that which is in a form the computer can understand.

3.0 Conclusion/Summary

Here, we carry out a brief review of sixteen popular computer high level programming languages that are used for developing information system. This unit is a review of computer programming languages

4.0 Self-Assessment Questions

Discuss on the following computer programming language by highlighting their strengths and weaknesses.

1. COBOL
2. FORTRAN
3. PHP

Self-Assessment Answers

1. COBOL: (/ˈkoʊbɒl/, an acronym for common business-oriented language) is a compiled English-like computer programming language designed for business use. It is imperative, procedural and, since 2002, object-oriented. COBOL is primarily used in business, finance, and administrative systems for companies and governments. COBOL is still widely used in legacy applications deployed on mainframe computers, such as large-scale batch and transaction processing jobs. But due to its declining popularity and the retirement of experienced COBOL programmers, programs are being migrated to new platforms, rewritten in modern languages or replaced with software packages. Most programming in COBOL is now purely to maintain existing applications. It was standardised in 1968 and has

since been revised four times. Expansions include support for structured and object-oriented programming. Academic computer scientists were generally uninterested in business applications when COBOL was created and were not involved in its design; it was (effectively) designed from the ground up as a computer language for business, with an emphasis on inputs and outputs, whose only data types were numbers and strings of text. COBOL has been criticised throughout its life, however, for its verbosity, design process and poor support for structured programming, which resulted in monolithic and incomprehensible programs.

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combination with various web template systems, web content management systems and web frameworks. PHP code is usually processed by a PHP interpreter implemented as a module in the web server or as a Common Gateway Interface (CGI) executable. The web server software combines the results of the interpreted and executed PHP code, which may be any type of data, including images, with the generated web page. PHP code may also be executed with a command-line interface (CLI) and can be used to implement standalone graphical applications.

5.0 Additional Activities (Videos, Animations & Out of Class activities) e.g.

a. Visit U-tube add https://bit.ly/2EZ3oYC. Watch the video & summarise in 1 paragraph

b. View the animation on add/site https://bit.ly/30lB0Hr and critique it in the discussion forum

6.0 References/Further Readings

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http://en.wikipedia.org/wiki/Java_(programming_language)

http://en.wikipedia.org/wiki/C_sharp_(programming_language).

Glossary

- Application software package: A set of prewritten, precoded application software programs that are commercially available for sale or lease.
- Application software: Programs written for a specific application to perform functions specified by end users.
- Artificial intelligence (AI): The effort to develop computer-based systems that can behave like humans, with the ability to learn languages, accomplish physical tasks, use a perceptual apparatus, and emulate human expertise and decision making.
- Automation: Using the computer to speed up the performance of existing tasks.
- Batch processing: A method of collecting and processing data in which transactions are accumulated and stored until a specified time when it is convenient or necessary to process them as a group.
- Bit: A binary digit representing the smallest unit of data in a computer system. It can only have one of two states, representing 0 or 1.
- Bluetooth: Standard for wireless personal area networks that can transmit up to 722 Kbps within a 10-meter area.
- Byte: A string of bits, usually eight, used to store one number or character in a computer system.
- C: A powerful programming language with tight control and efficiency of execution; is portable across different microprocessors and is used primarily with PCs.
- Case-based reasoning (CBR): Artificial intelligence technology that represents knowledge as a database of cases and solutions.

- CD-ROM (compact disk read-only memory): Read-only optical disk storage used for imaging, reference, and database applications with massive amounts of unchanging data and for multimedia.
- CD-RW (CD-ReWritable): Optical disk storage that can be rewritten many times by users.
- Central processing unit (CPU): Area of the computer system that manipulates symbols, numbers, and letters, and controls the other parts of the computer system.
- Centralized processing: Processing that is accomplished by one large central computer.
- Client/server computing: A model for computing that splits processing between clients and servers on a network, assigning functions to the machine most able to perform the function.
- Client: The user point-of-entry for the required function in client/server computing. Normally a desktop computer, workstation, or laptop computer.
- COBOL (Common Business Oriented Language): Major programming language for business applications because it can process large data files with alphanumeric characters.
- Communications technology: Physical devices and software that link various computer hardware components and transfer data from one physical location to another.
- Computer hardware: Physical equipment used for input, processing, and output activities in an information system.
- Computer literacy: Knowledge about information technology, focusing on understanding of how computer-based technologies work.

- Computer software: Detailed, preprogrammed instructions that control and coordinate the work of computer hardware components in an information system.
- Computer virus: Rogue software programs that are difficult to detect which spread rapidly through computer systems, destroying data or disrupting processing and memory systems.
- Computer vision syndrome (CVS): Eyestrain condition related to computer display screen use; symptoms include headaches, blurred vision, and dry and irritated eyes.
- Computer: Physical device that takes data as an input, transforms the data by executing stored instructions, and outputs information to a number of devices.
- Computer-aided design (CAD): Information system that automates the creation and revision of designs using sophisticated graphics software.
- Connectivity: The ability of computers and computer-based devices to communicate with each other and share information in a meaningful way without human intervention.
- Control unit: Component of the CPU that controls and coordinates the other parts of the computer system.
- Controls: All of the methods, policies, and procedures that ensure protection of the organization's assets, accuracy and reliability of its records, and operational adherence to management standards.
- Conversion: The process of changing from the old system to the new system.

- Cookies: Tiny file deposited on a computer hard drive when an individual visits certain Web sites. Used to identify the visitor and track visits to the Web site.
- Copyright: A statutory grant that protects creators of intellectual property against copying by others for any purpose for a minimum of 70 years.
- Data administration: A special organizational function for managing the organization's data resources, concerned with information policy, data planning, maintenance of data dictionaries, and data quality standards.
- Data definition language: The component of a database management system that defines each data element as it appears in the database.
- Data management software: Software used for creating and manipulating lists, creating files and databases to store data, and combining information for reports.
- Data: Streams of raw facts representing events occurring in organizations or the physical environment before they have been organized and arranged into a form that people can understand and use.
- Database (rigorous definition): A collection of data organized to service many applications at the same time by storing and managing data so that they appear to be in one location.
- Database management system (DBMS): Special software to create and maintain a database and enable individual business applications to extract the data they need without having to create separate files or data definitions in their computer programs.
- Database: A group of related files.

- Design: Simon's second stage of decision making, when the individual conceives of possible alternative solutions to a problem.
- Distance learning: Education or training delivered over a distance to individuals in one or more locations.
- Electronic mail (e-mail): The computer-to-computer exchange of messages.
- Electronic payment system: The use of digital technologies, such as credit cards, smart cards and Internet-based payment systems, to pay for products and services electronically.
- Encryption: The coding and scrambling of messages to prevent their being read or accessed without authorization.
- Feedback: Output that is returned to the appropriate members of the organization to help them evaluate or correct input.
- File: A group of records of the same type.
- Floppy disk: Removable magnetic disk storage primarily used with PCs.
- Geographic information system (GIS): System with software that can analyze and display data using digitized maps to enhance planning and decision-making.
- Hard disk: Magnetic disk resembling a thin steel platter with a metallic coating; used in large computer systems and in most PCs.
- Home page: A World Wide Web text and graphical screen display that welcomes the user and explains the organization that has established the page.
- Hybrid AI systems: Integration of multiple AI technologies into a single application to take advantage of the best features of these technologies.

- Information system: Interrelated components working together to collect, process, store, and disseminate information to support decision making, coordination, control, analysis, and visualization in an organization.
- Information: Data that have been shaped into a form that is meaningful and useful to human beings.
- Input: The capture or collection of raw data from within the organization or from its external environment for processing in an information system.
- Integrated software package: A software package that provides two or more applications, such as word processing and spreadsheets, providing for easy transfer of data between them.
- Internet: International network of networks that is a collection of hundreds of thousands of private and public networks.
- Internet2: Research network with new protocols and transmission speeds that provides an infrastructure for supporting high-bandwidth Internet applications.
- Java: Programming language that can deliver only the software functionality needed for a particular task, such as a small applet downloaded from a network; can run on any computer and operating system.
- Just-in-time: Scheduling system for minimizing inventory by having components arrive exactly at the moment they are needed and finished goods shipped as soon as they leave the assembly line.
- Learning management system (LMS): Tools for the management, delivery, tracking, and assessment of various types of employee learning.

- Local area network (LAN): A telecommunications network that requires its own dedicated channels and that encompasses a limited distance, usually one building or several buildings in close proximity.
- Logistics: Planning and control of all factors that will have an impact on transporting a product or service.
- Management information systems (MIS): The study of information systems focusing on their use in business and management.
- Microbrowser: Web browser software with a small file size that can work with low-memory constraints, tiny screens of handheld wireless devices, and low bandwidth of wireless networks.
- Minicomputer: Middle-range computer used in systems for universities, factories, or research laboratories.
- Model: An abstract representation that illustrates the components or relationships of a phenomenon.
- Modem: A device for translating a computer's digital signals into analog form for transmission over ordinary telephone lines, or for translating analog signals back into digital form for reception by a computer.
- Module: A logical unit of a program that performs one or several functions.
- MP3 (MPEG3): Compression standard that can compress audio files for transfer over the Internet with virtually no loss in quality.
- Multimedia: The integration of two or more types of media such as text, graphics, sound, voice, full-motion video, or animation into a computer-based application.
- Network: The linking of two or more computers to share data or resources, such as a printer.

- Operating system: The system software that manages and controls the activities of the computer.
- Operating system: The system software that manages and controls the activities of the computer.
- Operational control: Deciding how to carry out specific tasks specified by upper and middle management and establishing criteria for completion and resource allocation.
- Operational control: Deciding how to carry out specific tasks specified by upper and middle management and establishing criteria for completion and resource allocation.
- Output: The distribution of processed information to the people who will use it or to the activities for which it will be used.
- Processing controls: The routines for establishing that data are complete and accurate during updating.
- Processing: The conversion, manipulation, and analysis of raw input into a form that is more meaningful to humans.
- RAM (Random Access Memory): Primary storage of data or program instructions that can directly access any randomly chosen location in the same amount of time.
- Rapid Application Development (RAD): Process for developing systems in a very short time period by using prototyping, fourth-generation tools, and close teamwork among users and systems specialists.
- ROM (Read-Only Memory): Semiconductor memory chips that contain program instructions. These chips can only be read from; they cannot be written to.

- Router: Specialized communications processor that forwards packets of data from one network to another network.
- Software package: A prewritten, precoded, commercially available set of programs that eliminates the need to write software programs for certain functions.