COURSE INFORMATION

Course Code:	LIS 409
Course Title:	**Information System Analysis and Design**
Credit Unit:	2
Course Status:	Compulsory
Semester:	1st
Required Study Hour:	1 hour per day
Course Edition:	First

COURSE TEAM

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COURSE GUIDE

LIS 409: Information System Analysis and Design

INTRODUCTION

Welcome to **LIS 409: Information System Analysis and Design.** This is a two-credit (2-CR) unit course, a compulsory course for all the undergraduate students in the department. It is designed to enable you to explore and apply the strategies that relate to information systems analysis and design. The course examined the definition of concepts, types, and characteristics of information systems; system development life cycle; the role of system analyst; information organisation as a system; current trends in information system analysis and design; problems solving perspectives. This will facilitate an excellent successful academic journey and enhance your personal development and social status in the community.

The course guide tells you briefly what to expect from reading the accompanying study material. It provides you with information on how to make the best use of the materials so that you can achieve success. Make sure you read it carefully and pay attention to the instructions and suggestions.

What You Will Learn in this Course

This course, LIS 409, titled Information System Analysis and design has been specifically designed to help you understand everything you need to know about information systems, how they can be designed and developed, and their importance to library and information science. In this regard, the course will highlight the importance of information systems and design.

You will learn about the:

- definition of concepts;
- types and characteristics of information systems;
- system development life cycle;
- role of system analyst;
- information organisation as a system;
- evaluation of information systems and services;
- system software life cycle and development feasibility;
- data gathering;
- context diagram;
- data flow diagram;
- data dictionary;
- design of and modelling of Information System
- structured system modelling and object-oriented modelling etc.;
- strategic approaches to system implementation (installation and training, documentation and maintenance);
- current trends in information system analysis and design;

- problems-solving perspectives.

LEARNING OUTCOMES

By the end of this course, you should be able to discuss any topic in Information System Analysis and Design. Specifically, you will be able to:

i. define the concepts of the information system;
ii. describe the types and characteristics of information systems;
iii. Describe with illustration, the system development life cycle;
iv. Explain the role of the system analyst;
v. Explain information organisation as a system;
vi. Describe the evaluation of information systems and services;
vii. Explain the system software life cycle and development feasibility;
viii. Define data gathering;
ix. Describe and illustrate the context diagram;
x. Explain and illustrate the data flow diagram;
xi. Describe the data dictionary;
xii. Explain the Design of and modelling of the Information System (structured system modelling and object-oriented modelling etc.);
xiii. Identify and explain the strategic approaches to system implementation (installation and training, documentation and maintenance);
xiv. Describe the current trends in information system analysis and design; problems solving perspectives.

WORKING THROUGH THIS COURSE

To complete this course, you are required to participate in both the theoretical and practical parts of the course. You are also to read the study units, listen to the audio and videos, do all assessments, examine the links and read, participate in discussion forums, read the recommended books and other materials provided, prepare your portfolios, and participate in the online facilitation.

Each study unit has an introduction, intended learning outcomes, the main content, a summary conclusion, and references/further readings. The introduction opens the door to each unit and gives a glimpse of the expectations in the study unit. Read and note the learning outcomes, which outline what you should be able to do after each study unit. This will help you evaluate your learning at the end of each unit to ensure you have achieved the designed objectives (outcomes). To achieve the intended learning outcomes, the content of each section is presented in modules and units with videos and links to other sources to enhance your study. Click on the links as may be directed, but where you are reading the text offline, you may have to copy and paste the link address into a browser. You can download the audio and videos to view offline. You can also print or download the texts and save them on your computer or external drive. The unit summaries provide a recapitulation of the essential points in the unit. It's an indispensable brief that garnishes your journey through the unit. The conclusion brings you to the climax of the study and what you should be taking away from the unit.

There are two main forms of assessments – the formative and the summative. The formative assessments will help you monitor your learning. This is presented as in-text questions, discussion forums and Self-Assessment Exercises. The university would use summative assessments to evaluate your academic performance. This will be given as a Computer-Based Test (CBT) which serves as a continuous assessment and final examination. A minimum of three computer-based tests will be given, with only one final examination at the end of the semester. You are required to take all the computer base tests and the final examination.

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STUDY UNITS

There are 15 study units in this course divided into five modules. The modules and units are presented as follows:

Module 1: Definition of Concepts; Types and Characteristics of Information Systems

Unit 1: Concepts of Information Systems
Unit 2: Types of Information Systems
Unit 3: Characteristics of Information Systems

Module 2: System Development Life Cycle; System Analyst's Role and Information Organisation as a System

Unit 1: System Development Life Cycle Description
Unit 2: System Analyst and Roles
Unit 3: Information Organisation as a System

Module 3: Information Systems Evaluation; System Software life Development Feasibility and Data-Related Issues

Unit 1: Evaluation of Information Systems and Services
Unit 2: Data-Related Issues
Unit 3: Data Context Diagram and Data Flow Diagram

Module 4: Design and Modelling of Information System and Approach to System Implementation

Unit 1: Design and Modelling of Information System
Unit 2: Strategic Approaches to System Implementation
Unit 3: Challenges of System Implementation

Module 5: Current Trends in Information System Analysis and Design; Problems Solving Perspectives.

Unit 1: Information Systems Analysis and Design
Unit 2: Current Trends in Information System Analysis

Unit 3: Problem-Solving Perspectives in System Analysis

PRESENTATION SCHEDULE

The presentation schedule gives you the important dates for the completion of your computer-based tests, participation in forum discussions and facilitation. Remember, you are to submit all your assignments at the appropriate time. You should guide against delays and plagiarism in your work. Plagiarism is a criminal offence in academics and is liable to heavy penalties.

ASSESSMENT

Two main forms of assessment in this course will be scored. First is the set of Tutor-Marked Assignments (TMAs). You are advised to be sincere in attending the exercises. The second is TMAs. This is the continuous assessment component which is graded. It accounts for 30% of the total scores. You are advised to take this with all seriousness because it will assist you in passing the course. The TMAs will be given following the University calendar. Endeavour to strictly adhere to the slated calendar

FINAL EXAMINATION AND GRADING

At the end of the course, you are required to take an examination which will last for a 2-hour duration. It has a value of 70% of the total course grade. The examination will consist of questions that will carefully reflect the type of self-assessment and practice exercises.

Try to use the time between finishing the last unit and sitting for the examination to revise the entire course. You may find it useful to review your Tutor-Marked Assignment or activities before the examination.

COURSE MARKING SCHEME

The following table lays out how the actual course marking is done

Assessment	30% (Undergraduate) 40% (Postgraduate)
Final Examination	70% (Undergraduate) 60% (Postgraduate)
Total	100% of Course work

COURSE OVERVIEW

How to get the Most from the Course

The study units in Open and Distance Learning (ODL) replace the university lecture. This is one of the advantages of ODL. You can read and work through specially designed study materials at your own pace and at a time and place that is convenient for you. Just as a lecturer may give you classroom exercises, your study units provide exercises for you to do at a particular time.

Each of the study units follows a common format. The first item is an introduction to the subject matter of the study unit and how a specific study unit is integrated with the other study and the course as a whole. Following the introduction are the intended learning outcomes which help you to know what you should be able to do by the time you have completed the study unit. While studying the unit, you should go back and check if you have achieved the stated learning outcomes. If you consistently do this, you will improve your chances of passing the course. The main content of the study unit guides you through the required reading from recommended sources.

Tutor-Marked Assignments (TMAs) are found at the end of every study unit. Working through these SAEs will help you achieve the study units' objectives and prepare you for the examination.

You should do every SAE as you come to it in the study units. There will also be examples given in the study units. Work through these when you come to them too.The following are the practical strategies for working through the course. If you encounter any problem, telephone your tutor immediately. Remember that your tutor's job is to help you. When you need help, do not hesitate to call and ask your tutor to provide it.

1. The unit's main body guides you through the required reading and directs you to other sources, if any.
2. Your first assignment in this course is to read this course guide thoroughly.
3. Organise a study schedule: Refer to the course overview for more details. You should note that you are expected to devote at least 2 hours per week to studying this course. Note important information such as details of your tutorials, dates for submission of TMAs, exams etc., and writes it down in your diary.
4. Once you have created your study schedule, do everything to stay faithful. The major reason that students fail is that they get behind with their coursework. If you get into difficulties with your schedule, please let your tutor know before itis too late to help.
5. Turn to Unit 1, and read the introduction and the objectives for unit 1.
6. Assemble the study materials. You will need your references and the unit you were studying at any time.
7. As you work through the unit, you will know the sources to consult for further readings.

8. Visit your study centre whenever you need up-to-date information.

9. Before the relevant due dates (about 4 weeks before the due dates), visit your study centre for your next required assignment. Keep in mind that you will learn a lot by doing the assignment carefully. They have been designed to help you meet the objectives of the course and, therefore, will help you pass the examination. Submit all assignments no later than the due date.

10. Review the objectives for each study unit to confirm that you have achieved them. Review the study materials or consult your tutor if you feel unsure about any of the objectives. You can start on the next unit when you are confident that you have achieved a unit's objectives. Proceed unit by unit through the course and try to space your study so that you can keep yourself on schedule.

11. When you have submitted an assignment to your tutor for marking, do not wait for its return before starting on the next unit. Keep to your schedule. When the assignment is returned, pay particular attention to your tutor's comments on the tutor-marked assignment form and the written comments on the ordinary assignments.

12. After completing the last unit, review the course and prepare yourself for the final examination. Check that you have achieved the unit objectives (listed at the beginning of each unit) and the course objectives (listed in the Course Guide).

Facilitation

You will receive online facilitation. The facilitation is learner-centred. The mode of facilitation shall be asynchronous and synchronous. For asynchronous facilitation, your facilitator will:

- Present the theme for the week;
- Direct and summarise forum discussions;
- Coordinate activities in the platform;
- Score and grade activities when needed;
- Upload scores into the university-recommended platform;
- Support and help you to learn. In this regard, personal emails may be sent;
- Send videos, audio lectures and podcasts to you.

For the synchronous:

- There will be eight hours of online real-time contacts in the course. This will be through video conferencing in the Learning Management System. The eight hours shall be of one-hour contact eight times.
- At the end of each one-hour video conferencing, the video will be uploaded for viewing at your pace.
- The facilitator will concentrate on the main themes that are must-know in the course.
- The facilitator is to present the online real-time video facilitation timetable at the beginning of the course.

- The facilitator will take you through the course guide in the first lecture at the start date of the facilitation.

Do not hesitate to contact your facilitator. Contact your facilitator if you:

- do not understand any part of the study units or the assignments.
- have difficulty with the self-assessment exercises.
- have any questions or problems with an assignment or with your tutor's comments on an assignment.

Also, use the contact provided for technical support.

Read all the comments and notes of your facilitator, especially on your assignments, and participate in the forums and discussions. This allows you to socialise with others in the programme. You can discuss any problem encountered during your study. To gain the maximum benefit from course facilitation, prepare a list of questions before the discussion session. You will learn a lot from participating actively in the discussions.

Finally, respond to the questionnaire. This will help the university to know your areas of challenges and how to improve them for reviewing the course materials and lectures.

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Unit 2: Strategic approaches to System Implementation
Unit 3: Challenges of System Implementation

Module 5: Current Trends in Information System Analysis and Design; Problems Solving Perspectives.
Unit 1: Information Systems Analysis and Design
Unit 2: Current Trends in Information System Analysis
Unit 3: Problem-Solving Perspectives in System Analysis

Module 1: Definition of Concepts; Types and Characteristics of Information Systems

UNIT 1: CONCEPTS OF INFORMATION SYSTEMS

UNIT STRUCTURE

1.1 Introduction

In this unit, we will discuss several definitions of an information system. This will help you understand what it's all about. The history of information systems, the need for information systems, and the functions of information systems in libraries and information centres are also covered.

1.2 Intended Learning Outcomes

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

- ✓ Describe the information system,
- ✓ Describe the various perspectives regarding the overview of the information system.
- ✓ Discuss the background of the information system

- ✓ Describe the components of information systems
- ✓ Describe the role of information systems in libraries and information centres.

1.3 Concept of Information System

For quite some time, management circles have been aware of how information can improve an organisation's competitiveness. More than 20 years ago, some professionals commented on information systems and their importance to institutions like libraries and information centres. Timely information has always conferred power in political and commercial marketplaces, claiming the experts. However, some of the more conventional sources of power (such as natural resources) are dwindling as the accessibility and timeliness of information continue to rise.

Today, people who truly comprehend how technology affects business are flattening and drastically reducing organisational hierarchies. Layers of administration are becoming less necessary worldwide as information becomes more readily accessible to people at all levels faster. Designing databases that are essential to library operations and activities is one of the leadership responsibilities in libraries. Anything that increases the value of a library's data and makes it more accessible to patrons and staff who don't generally have computer literacy would undoubtedly boost the efficiency of the libraries. Libraries may need to have a formal financial strategy or an official information strategy. Timely access to information must be available and connected to the internal MIS system because all effective libraries are information-driven.

The ability of a company to communicate accurate, pertinent, and understandable information to its personnel is crucial to that organisation's effectiveness. When employees are uninformed of what other employees expect, an organisation's economies of scale, financial and technological resources, diversified abilities, and contacts are all practically useless.

Information systems have advanced significantly. Their relevance has grown over time; everyone now recognises and values their increasing role in the company, particularly in libraries and information centres. They have advanced and now provide a range of advantages to businesses. They add value by improving internal communication within the company, providing managers with pertinent information to aid in decision-making, supporting top-level management's decision-making by simulating various scenarios, assisting in routine office tasks by automating them, and capturing, storing, and mapping all transactions between the company and its internal and external customers. In an organisation, they all have a significant impact and add a lot of value. This is clear from the substantial sums that the majority of firms have invested in information technology. Now let's formally define information systems and the concepts that go along with them.

Information System is a unique class of systems with the primary goal of storing, retrieving, processing, communicating, and securing data is referred to as an information system (Fig. 1). Information systems are typically housed in a computerised environment or platform to give users access to quicker and more accurate information.

Information technology (IT) such as computers, software, databases, communication systems, the Internet, mobile devices, and much more are used by information systems (IS) to carry out certain activities, communicate with, and inform diverse players in various organisational or societal contexts. Therefore, all facets of the development, deployment, implementation, use, and effect of IS in companies and society are of general interest to the area of IS. The element that aids organisations in achieving their objectives, such as raising revenues or enhancing customer service, is also referred to as an information system.

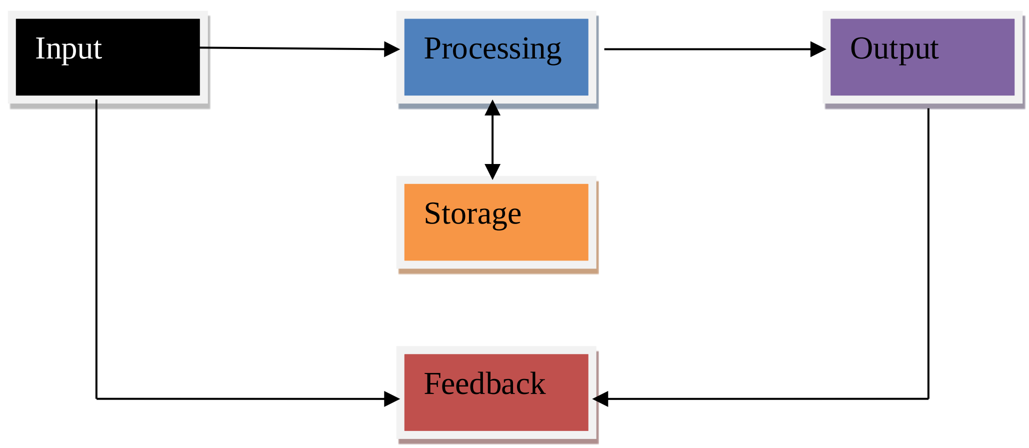

Figure 1-1: Example of Information System (Tella, 2022).

Some examples of information systems include the following:

Arrangements for flights (seat, booking, payment, schedules, boarding list, special needs, etc.).
Electronic bank transactions (deposits, transfers, and withdrawals) via a reputable payment gateway.
Streamlining the transportation system through departmental integration using modern tools like ERP
Logistics management application program for libraries. Apart from these general definitions, there are other definitions from experts. Some of these are provided in Table 1-1.

Table 1-1: Various Definitions of Information System

Source	IS Definitions
F. Land (1985, p. 215)	"An information system is a social system that has information technology built into it. The role played by information technology is expanding quickly. However, this does not change the fact that the system as a whole is a social system, and it is impossible to design a strong, efficient information system that uses a lot of technology without treating it as a social system".
Symons (1991, pp. 186-187),	A complex social object, an information system is "a result of the embedding of computer systems into an organisation... where it is not possible to separate the technical from the social factors given the variety of human judgments and actions, influenced by cultural values, political interests, and participants' specific definitions of their situations intervening in the implementation of such a system."

Paul (2007, pp. 194-195)	The use of the IT delivery system by users leads to the development of the IS (whose strengths are that they are human beings, not machines). There will be two components to this usage: 1. Let's start with the formal procedures, which are now believed to be pre-determinable in terms of choices on the usage of IT. 2. Second, the informal processes that people who employ formal processes and IT construct or design to make sure that productive work is completed.
Davis (2000, p. 67)	A system within an organisation that provides the information and communication services that are required by the organisation is known as an information system.
Lyytinen & Newman (2006, p. 4)	During ISD [information system development], technical, organisational, and semiotic elements are all reorganised and enlarged to fit an organisational objective.
Buckingham et al (1987, p. 18)	"A system that gathers, stores, processes, and provides information important to a company (or to society) in a way that makes it available and helpful to people who want to utilise it, including managers, employees, customers, and citizens. A human activity (social) system, such as an information system, may or may not include computer systems.
United Kingdom Academy for Information Systems (1997)	Information systems are the tools used by businesses and individuals to collect, process, store, use, and distribute information using information technology.

In contrast, the technical and computational parts of IT are not the primary focus of the IS field. Instead, how technology is adapted and implemented to enable the realisation of IS that satisfies different actors' information needs and requirements concerning particular goals and practices are important for IS.

The word "information system," which is fundamental to the discipline, is rarely clearly defined and evaluated and is often taken for granted, even though the IS community is aware of this. Recent requests to the IS community to deepen its engagement with fundamental concepts that are crucial to the discipline and its research were driven by this lack of conceptual engagement with "IS."

It is also important to note that this lack of involvement is problematic because it may result in a hazy and imprecise application of the notion of IS and may obstruct the development of a distinct identity for the IS area. "Instances where the word "information system" has been employed by IS academics and practitioners might be replaced with "information technology," “computer system," or just "the computer," with the substitution frequently having little to no impact. In hindsight, it is not an exaggeration to say that the majority of IS researchers have referred to just about anything involving electronic information technology as a "system" or "systems."

However, such employment of the phrase raises concerns since it obfuscates the line between IT, one of the defining notions of the IS area, and IS, another. Additionally, it downplays the significance of IS-relevant organisational, social, and human factors. Finally, the lack of conceptual clarity hinders conceptual progress regarding "IS" as a fundamental idea for the area. When discussing IS, it might be difficult for researchers to compare their findings and build on one another's efforts, which can prevent the development of a cumulative study tradition. When all of these issues are considered, defining an information system is one of the biggest challenges facing the IS community.

1.3.1 Overview of the Definition of Information System

The definition of Information System identifies four different conceptualisations of IS: a technology view, a social view, a socio-technical view, and a process view. These four points of view are based on the key feature that each definition emphasises:
(a) technological aspects, which include the handling, storing, and transformation of data;
(b) social aspects, which emphasise the fact that IS are fundamentally social systems;
(c) socio-technical aspects, which contend that IS contain both social and technological components that are interconnected; and (d) process aspects, which conceptualise IS in terms of handling and supporting tasks and processes. Each description was categorised based on the focus on these four factors the most frequently.

i. Definitions based on the technical perspective emphasise the value of IT in an organisational setting or the software utilised for data processing, storage, and delivery. Definitions linked with this perspective often do not downplay the significance of other IS-related factors but rather emphasise the superiority of technology, particularly IT, in the form of hardware, networks, and software. Organisations are viewed as a context for IT in this manner.

ii. Definitions that emphasise the social aspect of IS emphasise its significance. They frequently acknowledge the value of technology, although they typically place social factors ahead of technology. The social perspective attributes agency to people and social processes, in contrast to the technology view, which places agency in technology. Therefore, the social institutions and organisations that support and restrict human agency, as well as the methods through which human actors produce, distribute, and analyse information, and assign meaning to IS, are of utmost importance. This is accomplished by exchanging and storing signs useful for social actors and their behaviours.

iii. The socio-technical definitions of IS characterise it in terms of ongoing interactions between social and technical elements. Importantly, IS are seen to be made up of technological and social components and as phenomena that develop as a result of their interaction. Either technical or social factors do not determine IS. Instead, how technology and social systems interact allows for the creation of an IS that is greater than the sum of its parts. To continue the molecular analogy, an information system is more like a compound than a mixture. To address this, researchers studying information systems must concurrently examine the social and technical facets, concentrating on the phenomena resulting from their interaction. According to the socio-technical perspective, IS may take into account technology outside of IT, such as paper-based systems, and formal as well as informal features.

iv. The process view definitions of IS emphasise that IS are connected to the specific information processing activities they carry out and assist. The transformation of data into information or the dissemination and delivery of information are activities supported by IS. This relates IS to use and action. Thus, it is common for people to associate information systems (IS) with work-related activities, organisational goals, or problem-solving

1.3.2 **Background to Information System**

In the previous 40 years of their existence, information systems have seen significant development. Information systems were initially created to carry out a certain function. The goal of this kind of system was to do a task as rapidly as feasible with the fewest possible faults. It had not yet occurred to anyone to use information systems for decision-making. Organisations only employed information systems for data processing tasks. The emphasis at the time was on operational efficiency, whether it was processing bills or salaries. These systems were developed by knowledgeable individuals, and their user interfaces were quite simple. The output took the form of documents like pay stubs, loan and borrowing agreements, etc. The most effective data processing was the main goal of such systems. Most of these systems employed file-based data storage systems, allowing computer programs to work on them. This meant that the programs could access and organise the data but would store it in files. The issue with this kind of system was that it resulted in data replication and consistency loss. For most of these systems, COBOL was the preferred computer programming language. Important file management ideas like indexing were developed as a result of how data and records were managed in these types of files.

Information systems have evolved. More emphasis is now being placed on assisting management by giving data that will aid decision-making. Systems for processing data are no longer relevant. The current emphasis is on providing the appropriate information to the appropriate people at the appropriate time. Information systems have improved in speed, precision, and usability so that anyone may utilise them. These days, those who work on information systems don't necessarily know much about systems. They are typical consumers. The systems have evolved to the point where using them no longer requires users to be experts in information systems. In the field of information systems, fresher ideas have surfaced to aid organisations in getting more value for their money. Information systems have seen a radical transformation thanks to ideas like client-server architecture, networking, distributed computing, centralised databases, graphical user interfaces, and the internet. The time of large mainframe computers that cost a fortune to buy and maintain is over. Nowadays, purchasing software costs more than purchasing hardware.

1.3.3 **Components of Information System**

There are various components of information systems. These are discussed as follows:

a. People Resources: People are required for the operation of all information systems. People Resources are divided into two types:

i. End-Users: These are the individuals who make use of information systems or the data they generate. Examples include accounts, salespeople, clients, and managers.

ii. Information system experts: These are the individuals who design and manage information systems. Ex: Computer operation, programmers, and system managers.

b. Data Resources: Data resources of an Information system are typically organised in two parts:

i. Database: A database is a collection of organised and processed data.

ii. Knowledge Base: It contains knowledge in many different formats, including facts, regulations, and case studies.

c. Software Resources It includes all sets of information processing instructions. It is also two types:

i. Program: A collection of operational guidelines for computer hardware.

ii A set of instructions for processing information that humans need. For instance, operating systems, word processing programs, and spreadsheet programs

d. Hardware Resources: These include all physical devices and materials used in information processing. It has also two types

i. Devices such as a computer, video monitor, and scanner.

ii) Media hardware in information systems based on computers. For instance, optical disks, magnetic tape, and floppy disks. Microcomputers, midrange computers, large mainframe computers, and computer peripherals like a mouse and keyboard are examples of computer systems.

e. The basic resource elements of all information systems are network resources. It comes in two varieties: I Communication media, such as satellite systems, coaxial cables, twisted pairs of wire, fibre optic cables, and microwave systems. ii) Network Support: Usually required for a communication network to run and be used. Examples include modems, web browsers, and communication control software.

Self-Assessment Exercises 1

Attempt these exercises to measure what you have learnt so far. This should not take you more than 5 minutes.

1. Define information systems……………………………………………………..
2. Explain the four perspectives that differentiate the definition of an information system………………………………………………………………………………….

1.3.4 **Need for Information System**

The information system, the most recent stage in the company's ongoing growth, is crucial for both internet technology and traditional commercial issues. To react to client needs more quickly, all businesses must modernise their operations, infrastructure, and working methods. Assessing the information needs for management decision-making at various hierarchical levels is the first stage in creating and implementing an MIS, allowing the necessary information to be rendered timely and usable to the people who need it. Such an evaluation of information demands is frequently based on management personality, positions, levels, and functions.

1.3.5 Roles of Information Systems in Libraries and Information Centres

An Information system supports business Organisations in the following ways.

a) Support the business process by treating inputs as customer requests and outputs as services rendered to the client. Support present operations while using the system to shape future working practices.
b) Support Operation of a Business Organisation: An IS helps a business organisation's operations by providing timely information, maintaining and improving the system, and enhancing the organisation's operational flexibility.
c) Support Decision Making: An IS aids employees in making decisions regarding their daily tasks. Additionally, it aids managers in making choices that further the organisation's aims and objectives. IT tools and other mathematical models are employed to adapt strategies to satisfy market demands.
d) Organisational Strategies: In today's market, every organisation faces competition. An IS helps the organisation develop effective strategies for the firm to survive in a cutthroat market.

Self-Assessment Exercises 2

Attempt these exercises to measure what you have learnt so far. This should not take you more than 5 minutes.

3. Illustrate with the aid of a diagram, the distinction in the definition of information system……………………………………………………………………………..

4. Describe the role of information systems in libraries and information centres……………………………………………………………………………..

1.4 **Summary**

From the discussion in this unit, you learned the definitions of information systems; you have been introduced to an overview and various distinctions among the definitions, the background of information systems, the need for information systems and the role of information systems in libraries. In light of this, you can refresh the study through this recommended linkhttps://www.youtube.com/watch?v=Qujsd4vkqFI (Information systems by Charlie Love, 2022), https://www.youtube.com/watch?v=dLfpZtIacbc (Information system, what is it and what does it mean?) before answering the self-assessment exercise to evaluate your learning.

1.5 Glossary

Information System is a unique class of systems with the primary goal of storing, retrieving, processing, communicating, and securing data is referred to as an information system (Fig. 1). Information systems are typically housed in a computerised environment or platform to give users access to quicker and more accurate information.

Information technology (IT) such as computers, software, databases, communication systems, the Internet, mobile devices, and much more are used by information systems (IS) to carry out certain activities, communicate with, and inform diverse players in various organisational or societal contexts.

1.6 **References/Further Reading**

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Sebastian, K.B. & Dubravka, C. K.(2015). What is an information system? 48th Hawaii International Conference on System Sciences.

Symons, V.J. (1991). Impacts of information systems: Four perspectives. *Information and Software Technology*, 33(3),181–190.

UKAIS. (2012). Definition of IS. http://www.ukais.org.uk/about/DefinitionIS.aspx.

1.7. **Possible Answers to Self-Assessment Exercise(s) within the content**

Possible answers to SAES 1

1. Information System is a unique class of systems with the primary goal of storing, retrieving, processing, communicating, and securing data is referred to as an information system
2.
   i. Definitions based on the technical perspective emphasise the value of IT in an organisational setting or the software utilised for data processing, storage, and delivery.
   ii. Definitions that emphasise the social aspect of IS emphasise its significance.
   iii. The socio-technical definitions of IS characterise it in terms of ongoing interactions between social and technical elements.
   iv. The process view definitions of IS emphasise that IS are connected to the specific information processing activities they carry out and assist.

Possible answers to SAES 2

3. The answer is Figure 1.1.
4. a) Support the business process

   b) Support Operation of a Business Organisation:

   c) Support Decision Making:

   d) Organisational Strategies:

UNIT 2: TYPES OF INFORMATION SYSTEMS

UNIT STRUCTURE

2.0 INTRODUCTION

This unit will introduce you to various types of information systems. The unit will give you a better grasp of the information systems available and relevant to libraries and information centres. The unit will also expose you to Information System Security, Information System Assessment and the challenges confronting Information Systems.

2.2 Intended Learning Outcomes

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

- ✓ Identify the various types of information systems,
- ✓ Describe each of the various types of information systems.
- ✓ Discuss the relevance of information systems to libraries
- ✓ Explain formation systems security
- ✓ Describe information systems assessment.
- ✓ Explain the challenges confronting information systems.

2.3. MAIN CONTENT

2.3.1 Types of Information Systems

The uses of information systems put into practice in the business sector today can be categorised in many different ways. Several different information system types, for instance, can be categorised as either operation (support of business activity) or (Support of managerial decision-making). Support for company operations, including enterprise collaboration systems, process control systems, and transaction processing systems (office automation systems). Management information systems, decision support systems, and executive information systems all support managerial decision-making. Information systems can be divided into many categories, including executive information systems, management information systems, decision support systems, and data processing systems.

Systems for Processing Transactions

The fundamental business systems supporting an organisation's operational level are transaction processing systems (TPS). A computerised system known as a transaction processing system executes and records the daily transactions required for the operation of the firm. The systems used for transaction processing, which support the company's day-to-day operations, are found at the base of the organisational hierarchy.

Process Control Systems

Systems for process control observe and manage physical or industrial processes. Examples include systems for producing steel, electricity, and refining petroleum. As an illustration, a petroleum refinery uses computerised electronic sensors to continuously monitor chemical processes and make quick (real-time) adjustments that regulate the refinery process. A process control system includes the relevant tools, software, and operational protocols.

Enterprise Collaboration Systems (Office Automation Systems)

Office automation systems are one of the most popular forms of information systems that managers can employ to manage the information flow in their organisations. Office automation technologies that facilitate team and workgroup cooperation improve team and workgroup productivity. Office automation systems are an additional category of information systems that serve a wide range of users but are not specialised to any one level of the company. Information technology is used to support office tasks through office information systems. Office information systems can accomplish voice mail, multimedia systems, electronic mail, video conferencing, file transfers, and even group decisions.

Management Information Systems

Computer information systems known as "management information systems" can gather and process data from various sources for management-level decision-making in an organisation [9]. Informational management systems To aid in business decision-making, provide information in the form of pre-specified reports and displays. Low-level managers and supervisors are found at the next level of the organisational hierarchy. Computer solutions at this level are designed to help operational management monitor and regulate the transaction processing operations at the clerical level. The data gathered by the TPS is used by management information systems (MIS) to give supervisors the required control reports. An information system known as a management information system uses internal data from the system. It summarises it to create management reports that can support management activities and decision-making.

Decision Support Systems

A decision support system is a computer-based tool designed to assist managers at any organisational level in selecting the best method for solving a semi-structured problem. Computerisedorganisational information systems known as "decision support systems" assist managers in making decisions that require modelling, formulation, calculation, comparison, choosing the best option, or scenario prediction. Decision-support systems are made expressly to assist managers in making choices when there is ambiguity surrounding the potential implications of those choices. A computer-based information system known as a decision support system helps managers make a variety of complex decisions, such as the choices necessary to address vague or unstructured challenges.

Executive Information Systems

Executive information systems have been developed that offer quick access to both internal and external information, frequently presented in a graphical fashion, but with the capacity to present more in-depth underlying data if needed. Executive information systems give executives and managers quick access to vital information from a wide range of internal and external sources (including MIS, DSS, and other sources catered to their information needs). Senior managers can use an EIS to help them make strategic and tactical decisions. An executive information system is made to produce abstract data to display the entire business function in a condensed manner to senior management's satisfaction.

Expert Systems Expert

Systems are the branch of AI that has been used most successfully in creating business applications. Expert systems are knowledge-based systems that serve as advisors to users and offer them expert counsel. A computer program called an expert system attempts to mimic human reasoning. A group of computer programs known as an expert system can carry out a task at the same level as a human expert.

Knowledge Management Systems

Knowledge-based information systems called knowledge management systems, enable the production, structuring, and distribution of business knowledge to staff members and managers across an organisation. Knowledge management is the implementation of a comprehensive system that facilitates the expansion of knowledge within an organisation.

Strategic Information Systems

Strategic information systems use information technology in a company's goods, services, or operational procedures to give it a competitive edge over rivals. The strategic information system is an essential special type of organisational information system used to gain or maintain a competitive advantage in the marketplace.

Functional Business Systems (Information Systems From Functional Perspective)

Information systems that concentrate on managerial and operational applications to support core business operations are referred to as functional business systems. Applications in accounting, finance, marketing, operations management, and human resource management are a few examples of information systems. The specific organisational functions of sales and marketing systems, manufacturing and production systems, finance and accounting systems, and human resource systems can be used to categorise information systems.

Sales and Marketing Information Systems

The task of selling the company's goods or services falls within the purview of the sales and marketing department. Marketing focuses on identifying the consumers of a company's goods or services, figuring out what they need or desire, planning and creating goods and services to satisfy those needs, and then marketing, promoting and advertising those goods and services. Contacting customers, offering goods and services, receiving orders, and tracking sales are all aspects of sales. Information systems for sales and marketing assist in these efforts. A marketing MIS assists managers in making decisions regarding product development, the marketing mix, distribution, pricing, the success of promotions, and sales forecasting.

Manufacturing and Production Information Systems

Producing the company's products and services is the responsibility of the manufacturing and production function. The planning, development, and maintenance of production facilities, the definition of production goals, the purchase, storage, and accessibility of production materials, and the scheduling of the machinery, facilities, resources, and labour needed to create finished goods are all covered by manufacturing and production systems. Information systems for manufacturing and production assist in these tasks. A database of production-related information is managed by the production information system, a computer application. A manufacturing information system's goal is to use computer technology to enhance a manufacturing system's workflow and efficiency, which will raise product quality and cut down on production costs. To put it another way, a manufacturing system is a system that uses management, information systems technology, data, materials, equipment, and manufacturing processes as inputs and produces better final products as an output.

Finance and Accounting Information Systems

The firm's financial assets, such as cash, stocks, bonds, and other investments, are managed by the finance function. The accounting department keeps track of and manages the company's financial documents, including payroll, depreciation, and receipts. Accounting software's primary function is to automate the tedious process of recording and posting accounting transactions. This data is arranged in an electronic format to create financial statements and is available right away to support business management. All financial managers within an organisation have access to financial information through a financial management information system. Typically, accounting system data is used to inform financial decisions.

Human Resource Information Systems

Systems for organising, storing, and disseminating human resource information are known as human resources information systems (HRIS). HRIS helps managers at all levels of an organisation make informed decisions. Human resource information systems assist the daily operations of human resources in the majority of today's successful businesses. The human resources department must attract, develop, and maintain the company's staff. Information systems for human resources assist with tasks like finding potential employees, keeping thorough records on current workers, and developing initiatives to boost workers' abilities.

2.3.2 Information systems Security

Information is not always lost when it is stolen, unlike tangible goods. An unauthorised person may upload private information that an organisation owns and keep it accessible to the organisation, such as a new manufacturing technique. Information confidentiality is violated when it is disclosed to unapproved parties. When information integrity is no longer assured, a different sort of system failure occurs. In other words, unauthorised modifications to information occur rather than unauthorised exposure of information. If a hacker changed the instructions, causing customers to incorrectly configure or even ruin the purchased product, the corporate website that provided documentation on how to configure or repair its products could sustain severe financial harm.

Another sort of information failure is the refusal of access to information or the absence of information. For instance, if a doctor cannot access a patient's test results, the patient may endure needless suffering or possibly pass away. Significant sales could be lost if a business website's website was down for an extended period. It is possible to prevent system failure by taking the necessary action after understanding the likely causes. The information systems of an organisation are susceptible to many different types of threats. The most challenging dangers to control are those posed by people since they exhibit a wide range of behaviours.

Although, there may be variation in the level of detail, however, some relevant categories are:

- Inadvertent actions taken by consumers, technical support workers, and members of the company Intentional actions taken by someone inside or outside the business
- Other hazard categories include: Natural occurrences, such as floods, fires, tornadoes, ice storms, earthquakes, and pandemic flu.
- Environmental factors include a chemical spill and a gas pipeline explosion.
- Threat: Hardware or software malfunction
- Operational Threat: a flawed procedure that unintentionally jeopardises information availability, confidentiality, or integrity. For instance, allowing application programmers to upgrade software without testing it or notifying system operators might lead to extended disruptions. The many checks used to prevent a failure can be divided into categories, such as:

1. Management processes that define system needs, such as confidentiality, integrity, and information availability, and offer a variety of management controls to guarantee that these requirements are met.
2. Operational controls: these comprise the regular procedures involved in the delivery of information services.
3. Technical controls relate to the IT infrastructure's technical capabilities built in to enable the greater confidentiality, integrity, and availability of information services.

2.3.3 Information systems assessment

It is possible to quantify and value perceptible benefits. Although imperceptible advantages, like better customer service or better decision-making, cannot be measured right away, they can result in quantifiable long-term gains. Different metrics can be used to assess system performance.

2.3 3.1 **Efficiency**

Efficiency is frequently associated with "doing things well" or "doing things." The ratio of output to input can be used to determine efficiency. In other words, a business is more efficient if it generates more output from a given number of resources, generates the same amount of product from a given amount of resources invested, or, even better, generates more output from a given amount of input. In other words, the business increases productivity while minimising resource waste to increase efficiency. The manager updates the quantity of the sold item in the inventory system each time an item is sold or requested. The manager must review the sales to find out which products have been restocked and sold the most frequently. This considerably reduces the manager's time to manage his stock (limit input to achieve the same output). So efficiency is a measure of what is produced divided by what is consumed.

2.3.3.2 **Effectiveness**

The degree to which system objectives are met is used to gauge effectiveness. It can be calculated by dividing the goals attained by the number of goals established. Being effective is defined as "doing the right thing," "doing what is necessary," or "doing what is right." The capacity of an organisation to meet its stated goals and objectives can be used to define effectiveness. Usually, the most important business is the one that can make and execute the best decisions. An organisation might, for instance, develop new products or enhance existing ones based on feedback from its various customers and knowledge gathered from sales activities. In other words, information systems assist businesses in better comprehending their clients and providing the goods and services they need.

Customers will receive more individualised service from the company if individual customer data is collected. To anticipate their needs, the manager can also ask customers what goods and services they would like to purchase. The manager will order the products that the customers want and stop ordering unpopular products once the information has been gathered. The formulas we present below were developed to gauge the effectiveness and efficiency of information systems. Financial metrics can gauge how an information system affects a company.

2.3.3.3 **Financial measures of managerial performance**

Management will undoubtedly want to evaluate whether the information system has accomplished its goals after it is put into place. This assessment is frequently difficult to complete. The company can make use of financial indicators like ROI, net present value, productivity, and other performance indicators as described below:

- Return on capital invested: Return on investment, also known as return rate, is a financial ratio that assesses how much has been made or lost concerning the initial amount invested. A successful return on investment for an information system suggests that the system can become more effective. The benefit of employing return on investment is that the expenses and benefits of implementing an information system can be quantified. As a result, this statistic can be used to compare various systems and determine which ones will help the organisation be more successful and/or efficient.

- Productivity for the majority of firms, creating information systems that track productivity and control is essential. The ratio of produced output to necessary input is a measure of productivity. Higher output levels show Greater Productivity for a given entry level; lower output levels for a given entry-level indicate lower Productivity. Productivity ratings are not usually based on the number of hours worked. The number of raw materials used, the quality attained, or the turnaround time for the items or services can all be used as productivity measures. The value of Productivity must only be evaluated in comparison to previous periods of Productivity, both with other firms in the same industry and according to other characteristics.
- Growth in profits: The rise in profit or the growth in realised earnings serves as another gauge of the SI value. As an illustration, a mail-order business might build an order processing system that results in a 7% increase in profits over the prior year.
- Market Share: Market share is the proportion of sales that a good or service generates in comparison to the total market. Installing a new online catalogue could help the business gain, say, 20% more market share if it boosts sales.
- Client satisfaction: Although measuring customer happiness is challenging, many businesses use internal and external feedback to gauge the performance of their information systems. Some businesses employ questionnaires and surveys to find out whether their investments have improved consumer satisfaction.
- Cost of ownership overall: The Total Cost of Ownership is a different metric that the Gartner Group has created to assess the value of information systems (TCO). With this method, the whole cost is divided between buying the technology, paying for technical assistance, and paying for overhead. The total cost of ownership (TCO) also includes fees for retooling and training. TCO can be used to create a more precise total cost estimate for systems ranging from compact computers to massive mainframe systems.

Self-Assessment Exercises 1

Attempt this exercise to measure what you have learnt so far. This should not take you more than 3 minutes.

1. Identify NINE types of information systems…………………………..

2. Describe each of the NINE types of information systems……………………….

3. Discuss the relevance of information systems to libraries………………………….

2.4 Information System Challenges

This section focuses on the five most significant information systems difficulties, even though there are many more as well:

Security: Today, safety or cybersecurity is one of the biggest issues that IT must deal with. Given the enormous value of these assets and the potential harm from getting them wrong, keeping the data, identities, and personal information we exchange and interact with regularly secure has become difficult.

Accessibility: Particularly for senior roles within an organisation, data accessibility and availability are critical. With interoperability, making data accessible for all parties would be relatively simple. Although the advantages it can provide are well known, IT still needs to complete several tasks before it can empower users.

Strong networks: Internal networks need to be secure, robust, resilient, and scalable, which is both important and extremely difficult. To reduce obsolescence in the business, solutions must not only address current needs but also be future-oriented and take into consideration anticipated technology improvements.

System Integration

An important IT difficulty in many firms is ensuring that the various services, created in various technologies or languages, interact correctly. Even though system and service integration has many more benefits.

Cost reduction: IT executives are under constant pressure to save expenses while still delivering innovation and efficiency increases. Competitive organisations might concentrate their investment on innovation when they can give the same functionality for less money. Organisations must ensure they are ahead of the curve on this issue as IT continues to advance and evolve rapidly, creating new opportunities to deliver more for less.

Self-Assessment Exercises 2

Attempt this exercise to measure what you have learnt so far. This should not take you more than 3 minutes.

4. Explain information systems security……………………………………….

5. Describe information systems assessment…………………………………

6. Explain the challenges confronting information systems.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,

2.5 **Summary**

This unit has discussed the various types of information systems. The unit has given you a better grasp of the types of information systems available and which are relevant to libraries and information centres. The unit also described Information System Security, Information System Assessment and the challenges confronting Information Systems.

2.6 Glossary

Management Information Systems: Computer information systems known as "management information systems" can gather and process data from various sources for management-level decision-making in an organisation.

Decision Support Systems: A decision support system is a computer-based tool designed to assist managers at any organisational level in selecting the best method for solving a semi-structured problem.

Executive Information Systems: Executive information systems give executives and managers quick access to vital information from a wide range of internal and external sources (including MIS, DSS, and other sources catered to their information needs).

Expert Systems Expert: These are systems are the branch of AI that has been used most successfully in creating business applications. Expert systems are knowledge-based systems that serve as advisors to users and offer them expert counsel. It is computer program called an expert system attempts to mimic human reasoning. A group of computer programs known as an expert system can carry out a task at the same level as a human expert.

Knowledge Management: Knowledge management is the implementation of a comprehensive system that facilitates the expansion of knowledge within an organisation.

Knowledge Management Systems: Knowledge-based information systems called knowledge management systems enable the production, structuring, and distribution of business knowledge to staff members and managers across an organisation.

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2.8 Possible Answers to Self-Assessment Exercises

1. i. Systems for Processing Transactions
ii. Process Control Systems
iii. Enterprise Collaboration Systems (Office Automation Systems)
iv. Management Information Systems
v. Decision Support Systems
vi. Executive Information Systems
vii. Expert Systems Expert
viii. Knowledge Management Systems
ix. Strategic Information System

2. Systems for Processing Transactions

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Strategic Information Systems

Strategic information systems use information technology in a company's goods, services, or operational procedures to give it a competitive edge over rivals. The strategic information system is an essential special type of organisational information system used to gain or maintain a competitive advantage in the marketplace.

UNIT 3: CHARACTERISTICS OF INFORMATION SYSTEMS

UNIT STRUCTURE

3.0 INTRODUCTION

This unit will introduce you to various characteristics of information systems. This will be to enable you to have a good idea about how information systems can be identified. You'll also learn about the elements of information systems as well as the classification of information systems.

3.2. INTENDED LEARNING OUTCOMES

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

- ✓ Identify the characteristics of information systems,
- ✓ Describe each of the characteristics of information systems.
- ✓ Discuss the element of information systems.
- ✓ Explain the classification of information systems.
- ✓ Describe the role of information systems in libraries and information centres.

3. 3.MAIN CONTENT

3. 3.1 Characteristics of a System

According to the definition, a system is an ordered relationship between several subsystems or components to accomplish particular goals. An example of a subsystem is the keyboard, monitor, CPU, mouse, etc. of a computer system. An ordered relationship between these subsystems in a planned manner is all that a computer system is. To meet predetermined goals, these subsystems are also dependent on one another. As a result, the following traits, which are found in all systems, are suggested by the definition of a system.

1. Organisation: This describes a systematic arrangement of elements that cooperate to accomplish a centralised goal. The placement of subsystems in a certain structure and sequence aids in the achievement of goals.

2. Interaction: This refers to how each subsystem performs, engages in communication with, or interacts with, other system components. Subcomponents can transfer data and information using special interfaces.
3. Interdependence: This refers to the idea that a system's components depend on one another to achieve its goals. This is comparable to a scenario in which a large task is broken up into several simple ones (i.e. subsystems). Every straightforward task completes itself and generates results. A task's output could become its input in another task. In this way, a complex issue is ultimately resolved. Similarly, a system's output from one subsystem could become its input from another. According to a plan, these subsystems are coordinated and connected.
4. Integration: This is a holistic view of the system that describes how various subsystems are connected to the main goal. A bottom-up strategy is used to integrate the subsystem.
5. Planned approach: A system should operate following a planned strategy to accomplish consolidated goals. The planned method consists of several previously established policies, rules, budgets, timelines, and tactics.
6. Central goal: Each system is created to accomplish particular centralised goals. All subsystems are developed and merged to accomplish centralised goals while preserving their identities. Each subsystem functions independently and communicates with the others. Each subsystem contributes directly or indirectly to the system's goals.

3.3.2 Elements of a System

An information system typically accepts input data, processes it, and outputs information for decision-making. System performance is assessed based on the generated output, and suggestions are made to improve the system. These essential components make up a system:
i. Output: One of a system's main goals is to generate an output that is valuable to the user. The output type could be products, services, information, etc. The output of a system is the product of processing and the final consequence.
ii. Inputs: Materials, labour, data, information, and other factors that are entered into the system for processing are considered inputs.
iii. Processor(s): A processor is a system component that transforms the input into output. It is a part of a system's functioning.
iii. Control: A system is guided by the control element. It is a decision-making subsystem that regulates a system's input, processing, and output among other operations. Control is attained by adjusting the output's divergence from the standard.
iv. Feedback: Feedback is how control is achieved in a dynamic system. Feedback measures a system's output against performance benchmarks and communicates the information as needed for the system to take the appropriate action. This could lead to changes in the input or processing, which would affect the result.
v. Environment: An organisation operates within a larger system known as the environment. It is the origin of outside factors that have an impact on a system. It frequently decides how a system ought to operate. Vendors, rivals, government regulations, the tax department, and other factors, among others, may impose restrictions and thus affect the system's actual performance.
vi. Boundaries and interface: A system's boundaries, or the limits that characterise its constituent parts, operational procedures, and interrelationships, distinguish it from other systems with which it interfaces. Where one system stops and another begins is marked by a system boundary. In general, distinctions between systems are not always obvious. There may be numerous interfaces between complex systems and other systems. For instance, the market and sale section deals with the sale of milk and milk-related products, gathering sales data, and forecasting product demand. This section does not address manufacturing processes, production losses due to manufacturing, etc..

3.3.3 Classification of System

Systems have been classified in different ways. Common classifications are:

I. Physical and Abstract System
II. Deterministic and Probabilistic System
III. Open and Closed System
IV. Information System

Physical and abstract system

Physical and abstract systems can both be characterised as systems. The term "physical system" refers to actual operational systems that are composed of tangible (i.e., physically accessible items) elements like people, materials, machinery, and other actual objects that may be static or dynamic. The physical systems exhibit some behaviour or activity. Such a system's components work together to accomplish a common goal. For instance, the physical components of a dairy factory are the tools, personnel, workplace, furnishings, and structure that make the business run smoothly. These components are static since they are essentially the same and are visible and countable. In contrast, daily milk receipt, daily product production, daily product sales, etc. continue.

Conceptual or non-physical things are abstract systems. These are a carefully arranged set of interrelated concepts or constructs that may or may not have physical counterparts. They could be as simple as formulas for the interactions between groups of variables or models for the conception of abstract physical phenomena. A model is a picture of an actual system or a proposed one. An example of an abstract system is a set of instructions or processes for producing dairy products (such as paneer, cheese, ice cream, etc.). The steps in a procedure are an organised arrangement of concepts that ultimately result in the production of milk products.

3.3.4 Deterministic and probabilistic system

A deterministic system is one in which every event's occurrence can be predicted with absolute certainty. In such systems, the upcoming state may be precisely anticipated and described the system's state at a certain point in its operation. Deterministic systems include, for instance, machinery controlled numerically.

A probabilistic system is one in which it is impossible to forecast the future with absolute certainty. Although the behaviour of such a system can be expressed in terms of probability, the behaviour prediction of the system is always subject to some degree of mistake. The status of items in inventory, phone calls made during a specific time frame, the average demand for milk products at a specific moment, etc. are examples of such a system.

3.3.5 Open and closed system

Open systems communicate with their surroundings and have numerous interfaces to the outside world. As a result, these systems communicate with their surroundings, including unpredictable and ill-defined inputs. Open systems allow communication across borders, accept inputs from outside sources, and provide results. These systems typically interact with the environment in a way that allows them to adjust themselves in response to circumstances that allow them to persist for a longer period. For instance, to survive, information systems must adjust to the shifting needs of their users. Another example of an open system is a person. Since no organisation can function in isolation, all organisations are open systems.

Closed systems do not interact with their surroundings or adapt to changes since they are separated from environmental effects. While moderately closed systems are frequent, such ones are uncommon. Closed systems are largely sealed off from their surroundings but not entirely. A relatively closed system is shielded from external disturbances since it controls its input. A computer program is an example of a relatively closed system that handles inputs in a prescribed manner. Since they do not interact with changing environments, closed or largely closed systems find it difficult to endure for an extended period and finally fail.

3.4 Summary

You have learned about many information system properties in this unit. You have been made aware of how the unit can identify information systems. Additionally, you have learned about the components of information systems and their categorisation.

The many characteristics of information systems have been covered in this unit. The identification of information systems has been made clear by this unit. Additionally, the unit covered the taxonomy of information systems and the components of information systems.

3.5 Glossary

Physical system: This refers to actual operational systems that are composed of tangible (i.e., physically accessible items) elements like people, materials, machinery, and other actual objects that may be static or dynamic. The physical systems exhibit some behaviour or activity.

Conceptual or non-physical things are abstract systems: These are a carefully arranged set of interrelated concepts or constructs that may or may not have physical counterparts. They could be as simple as formulas for the interactions between groups of variables or models for the conception of abstract physical phenomena.

Model: A model is a picture of an actual system or a proposed one. An example of an abstract system is a set of instructions or processes for producing dairy products (such as paneer, cheese, ice cream, etc.). The steps in a procedure are an organised arrangement of concepts that ultimately result in the production of milk products.

3.6 Self-Assessment Exercises 1 **(SAEs)**

- ✓ Identify the characteristics of information systems,
- ✓ Explain each of the characteristics of information systems.
- ✓ Identify the element of information systems.
- ✓ What are the classifications of information systems?

3.7 Possible Answers to Self –Assessment Exercise

1

a) Organisation:

b) Interaction:

c) Interdependence:
d) Integration:
e) Planned approach:
f) Central goal:

2. Systems have been classified in different ways. Common classifications are:

I. Physical and Abstract System
II. Deterministic and Probabilistic System
III. Open and Closed System
IV. Information System

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Module 2: System Development Life Cycle; System Analyst's Role and Information

Organisation as a System

Unit 1: System Development Life Cycle Description
Unit 2: System Analyst and Roles
Unit 3: Information Organisation as a System

UNIT 1: System Development Life Cycle Description

UNIT STRUCTURE

1.1.Introduction
1.2.Intended Learning Outcomes
1.3.Main Content
1.3.1 Concept of System Development Life Cycle
1.3.2 Process of System Development Life Cycle
1. 3.3 System Development Life Cycle Methods
1.4 Summary
1.5 Glossary
1.6. Self Assessment Exercise (SAEs)
1.7. References/Further Reading
1.8 Possible Answer to Self Assessment Exercise

1.0 INTRODUCTION

You will learn several definitions of an information system in this section. You'll have a better understanding of it after doing this. Additionally, you'll discover the history of information systems, a summary of the numerous definitions, the necessity of information systems, and the functions of information systems in libraries and information centres.

1.2 INTENDED LEARNING OUTCOMES

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

- ✓ Describe the information system,
- ✓ Describe the various perspectives regarding the overview of the information system.
- ✓ Discuss the background of the information system
- ✓ Identify the need for an information centre
- ✓ Describe the role of information systems in libraries and information centres.

1.3 MAIN CONTENT

2.3.1 Concept of System Development Life Cycle

Systems engineering, information systems, and software engineering use the phrase "systems development life cycle" (SDLC), often known as the "application development life cycle," to describe a method for organising, developing, testing, and deploying an information system. As a system can be made up of solely hardware, only software, or a combination of both, the systems development life-cycle idea applies to various hardware and software combinations.

Overview

Systems engineers and developers employ a systems development life cycle, which comprises numerous clearly defined and separate work phases, to plan, design, build, test, and deliver information systems. Like anything produced on an assembly line, an SDLC seeks to create systems that go through each clearly defined phase within scheduled time frames and cost estimates andhigh-quality systems that meet or exceed customer expectations, depending on customer needs. Computer systems are intricate and frequently connect numerous conventional systems that might be provided by various software providers (particularly with the recent advent of service-oriented architecture).
Many SDLC models or approaches, including "waterfall," spiral," Agile software development," rapid prototyping," incremental," and "synchronise and stabilise," have been developed to handle this level of complexity.

Agile, iterative, and sequential development life cycles are all possible SDLC descriptions. Agile techniques, like XP and Scrum, emphasise simple procedures that enable quick modifications throughout the development cycle (without necessarily adhering to the SDLC approach's structure). Iterative project scope and product expansion or improvement over several iterations is the main goals of iterative techniques like the Rational Unified Process and dynamic systems development approach. Sequential or big design-up-front (BDUF) methods, like a waterfall, emphasise accurate and thorough planning to steer risky and huge projects toward successful and predictable outcomes.
Other models, like anamorphic development, prefer to concentrate on a style of development determined by the project's scale and adaptive feature development iterations. A project can be characterised in project management using an SDLC and a project life cycle (PLC), during which somewhat different activities occur. According to Taylor (2004), "includes all project operations, whereas the systems development life cycle concentrates on achieving the product requirements." When an IT project is being developed, the SDLC is used to define the various steps that are involved from the project's conception through its completion.

Phases of System Development Life Cycle (SDLC)

System designers and developers can follow a set of steps provided by the system development life cycle framework. The SDLC is made up of many processes or phases, each of which draws on the outcomes of the preceding one. The section below explains the SDLC's planning, analysis, design, and implementation phases, which are critical phases that developers must follow. It entails assessing the current system, obtaining data, conducting a feasibility study, and requesting approval. Waterfall, fountain, spiral, build-and-fix, rapid prototyping, incremental, and synchronise-and-stabilise are a few examples of SDLC models that have been developed. The waterfall model, a series of stages where the output of each stage determines the next, is the oldest and most well-known of these.

Preliminary analysis: Phase 1's goals include conducting an initial study, putting forth potential solutions, outlining costs and advantages, and submitting an initial plan with suggestions. Perform the preliminary analysis. In this step, you must ascertain the goals of the organisation and the nature and dimensions of the problem being researched. Even if a problem only affects a small portion of the business, you still need to learn the organisation's goals. The next step is determining how the problem under study fits into these categories. Offer substitute solutions: You may have already discussed some solutions when you delved deeper into the organisation's goals and specific issues. Interviewing employees, clients, vendors, and/or consultants may yield alternative proposals. Additionally, you can research what rivals are doing. You will have three options with this information: leave the system as-is, enhance it, or create a new system.

Maintenance: The system is evaluated at the SDLC's maintenance phase to ensure it doesn't become outdated. Additionally, this is where the original software gets modified. It involves performing ongoing performance evaluations of the system.

Evaluation: Although some businesses do not consider this to be an official phase of the SDLC, it is an essential aspect of the life cycle. The evaluation stage, which is a continuation of the maintenance stage, is sometimes referred to as the post-implementation review. Here is where the developed system and the entire procedure are assessed. Does the newly implemented system meet the initial business requirements and objectives? is one of the queries that need to be addressed. Is the system stable and resilient to errors? Does the system work following the functional requirements that have been approved? It's critical to analyze the efficiency of the development process in addition to the product that was released. This is the moment to enhance if there are any elements of the overall process or specific steps that the management is not happy with. The subject of evaluation and assessment is challenging. However, the business needs to evaluate the procedure and deal with flaws.

Disposal: Plans are created during this stage to get rid of system data, hardware, and software to switch to a new system. Here, the goal is to relocate, archive, trash, or destroy information, hardware, and software that are being replaced in a way that avoids any chance of sensitive data being disclosed without authorization. The disposal procedures guarantee a smooth transition to a new system. Proper archiving and preservation of the data processed by the previous system are given particular emphasis. According to the organisation's security requirements, all of this should be done.

The stages of the systems development life cycle are grouped into 10 steps in the example below, starting with definition and ending with the creation and modification of IT work products: The system is abolished in the eleventh phase, and the task it was performing is either done away with or moved to other systems. The ensuing chapters detail the duties and outputs for each phase. Not every project will call for carrying out the phases in order. The phases do, however, depend on one another. The number and complexity of the project will determine whether or not the phases are merged or overlap.

System investigation: The IT suggestion is investigated by the system. All current priorities that would be impacted and how they should be handled must be considered at this step. A feasibility study should be performed to ascertain whether developing a new or upgraded system is a workable answer before any system planning is done. This will make it easier to calculate the completion-related costs, advantages, resource needs, and particular user requirements. Only when management has given its approval to the feasibility study's recommendations can the development process move further.
The following are different components of the feasibility study:
Operational feasibility
Economic feasibility
Technical feasibility
Human factors feasibility
Legal/Political feasibility

System analysis: Finding the source of the issue and trying to fix the system are the objectives of system analysis. To identify clear requirements, this step entails disassembling the system into its parts to examine the scenario, project goals, and what needs to be built. It also involves seeking to engage users.

Design: In systems design, the design procedures and functions, including screen layouts, business rules, process diagrams, and other documentation, are thoroughly documented. This stage's output will list the new system's components as modules or subsystems. The document's requirements that have been authorised serve as the design stage's initial contribution. A set of one or more design elements will be created for each requirement as a result of interviews, workshops, and/or prototype work. Design elements often contain functional hierarchy diagrams, screen layout diagrams, tables of business rules, business process diagrams, pseudo-code, and a complete entity-relationship diagram with a full data dictionary. These elements explain the desired system characteristics in detail. These design elements are meant to sufficiently describe the system so that competent programmers and engineers can create and deliver the system with little additional input design.

Environments: Systems developers can create, distribute, install, configure, test, and run systems that go through the SDLC in controlled environments. Each environment is designed to serve a certain function and is in line with various SDLC phases. Examples of such settings include the following:

- a setting for development where programmers can first individually complete their work before attempting to combine it with that of others,

- Common build environment, which enables the construction of combined tasks as a single system, A system's integration points with other upstream or downstream systems can be tested thoroughly in a systems integration testing environment.
- An environment for user acceptability testing where business stakeholders can evaluate their original business needs,
- Systems are ultimately deployed to a production environment where their intended end users will use them.
- The practice of IT environment management is the planning, provisioning, and operation of such environments.

Testing: In software testing, the code is tested on multiple levels. User acceptance, system, and unit testing are frequently carried out. This is a murky subject because there are many conflicting views on the various testing stages and the extent, if any, of iteration. Although iteration is not often a component of the waterfall model, it frequently happens at this point. The following types of testing are conducted, one by one, on the entire system:

Defect testing of the failed scenarios, including defect tracking
Path testing
Data set testing
Unit testing
System testing
Integration testing
Black-box testing
White-box testing
Regression testing
Automation testing
User acceptance testing
Software performance testing

Training and transition: The SDLC makes ensuring that suitable system training is carried out or documented once a system has been stabilised through adequate testing before transferring the system to its support staff and end users. Training often includes operational training for individuals who will be utilising the system after it is delivered to a production operating environment and operational training for those end users responsible for supporting the system. When training is finished, the system is moved to its ultimate production environment by systems engineers and developers. From there, it is meant to be utilised by end users and supported by operations and support employees.

Operations and maintenance: Before the system is decommissioned or sunsets, updates and improvements are made during deployment. The SDLC includes an important component called system maintenance. New adjustments will be made as important persons in the organisation shift jobs. The classical technique (structured) and the object-oriented approach are the two methods used in system development. The traditional system approach, often known as the structured analysis and design technique, is a component of information engineering. According to the object-oriented methodology, an information system is made up of several interconnected objects.

Evaluation: Measuring the application's effectiveness and considering improvements is the last stage of the SDLC.

1. 3.2 Process of System Development Life Cycle

It's difficult to create an effective information system for business applications. Developing a system comprises understanding, planning, designing, implementing, and maintaining systems. As a result of advancements in software development technologies, system development methodologies have changed. Modular software was replaced by structured software, and now object-oriented technology is the norm. The primary objective of system development is to create high-quality information systems for handling business applications. It offers a structure for organising, planning, and managing the process of creating a system. Over time, numerous techniques have developed and are used. A few prevalent techniques are:

I. System Development Life Cycle method (or traditional method))
II. Structured Analysis Development method
III. Waterfall method
IV. Prototype method
V. Spiral method
VI. Object-oriented Development method

Each of these approaches has advantages and disadvantages of its own. A single approach might not be appropriate for all kinds of systems. It relies on the system's technological makeup, the needs of the company, the developers' skill level, etc. In essence, these strategies use either an iterative, linear, or hybrid of these approaches to design systems. In a linear method, the aforementioned actions are carried out in order, with or without certain processes overlapping, to construct a system. Following user feedback, the activities in an iterative approach may or may not be repeated for improvement.

1.3.3 System Development Life Cycle Methods

The System Development Life Cycle (SDLC) method is the most common and significant approach to system development. Although it is a classic technique, system development is a general phrase for it. Therefore, it applies to any methodology or approach. Like a living organism, the system development process has a life cycle. Systems are envisioned, created, improved upon, and maintained. Numerous adjustments have been made to the current computer system to fit new user requirements and technology advancements, giving the system a completely different appearance than it did when it was first designed and constructed.

This ongoing process demonstrates how information systems are like life systems in that they were created and eventually perish (i.e., replaced with new one). The system development life cycle includes crucial elements like system analysis and design. For computer experts, the SDLC is a methodical approach to creating a computer-based system to address a company's or a customer's demands by resolving business or scientific problems. While an application is being

developed, the SDLC approach aids in tracking progress. Through a continuous process of fact-gathering, developing, implementing, and maintenance, this method continuously monitors and regulates system development.
This strategy has received a great deal of criticism. However, as opposed to replacing the SDLC process, alternative approaches just support it. The various SDLC phases are as follows:

- ✓ Study and analysis phase
- ✓ Systems design
- ✓ System development
- ✓ System implementation
- ✓ System maintenance

As long as the system is in place, system development and maintenance must be ongoing due to the yearly changes in organisational requirements. In today's age of intense global competition, business processes evolve quickly, necessitating the replacement or considerable updating of most systems after only a few years of use. The revised system appears to be a brand-new, unique system. This ends the life cycle of a system that functions like living things (from origin to death). All of the SDLC method's steps are depicted in Fig. 2.1.

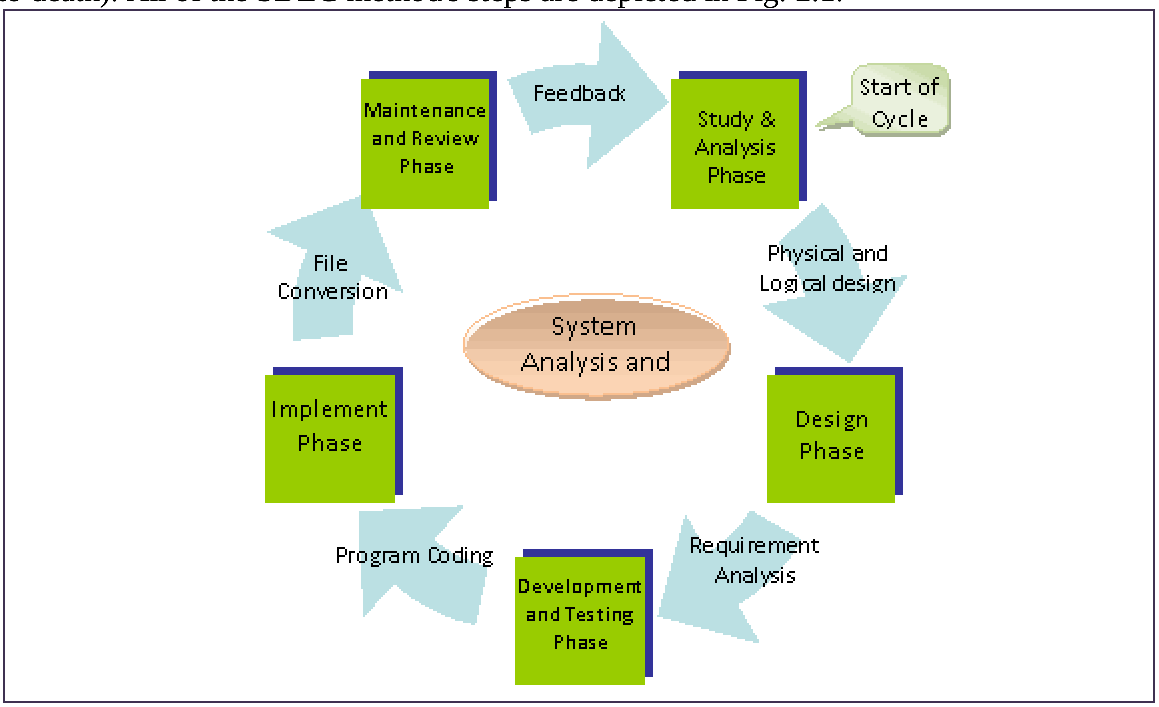

Fig. 2-1: System development life cycle method

1. 3.3.1 Structured analysis method

Traditional system development techniques like structured analysis are tried-and-true and simple to comprehend. This technique/methodology, often known as the "process-centric method," defines the system through a collection of process models. The system is seen from the standpoint of data passing through several operations. A system's functionality is defined by the procedures used to convert input into information useful for attaining the system's goals. The system is broken down into sub-processes, which are then broken down into even more sub-processes, and so forth. This enables focusing exclusively on the important information while putting extraneous aspects to the side.

Process modelling identifies the data entering a process and the business rules that change the input data into the output data. The structured analysis also covers data organisation, database architecture, user interface design, and process modelling. A collection of related graphical diagrams, process descriptions, and data definitions are the output of the structured analysis. Many structured tools are utilised to describe the data items, data flow, logical complexity, etc., including data flow diagrams, decision tables, decision trees, data dictionaries, and structured English. To develop a system using this method, all SDLC steps are considered.

1.3.3.2 Waterfall method

This technique adheres to the system development life cycle (SDLC). The system is organised into linear stages that follow one another, with the output of one phase becoming the input of the next. Between phases, there might be some overlap and splashback. Planning, timetables, goal dates, budgets, and the execution of an entire system at once, finishing the system's development and implementation, are all stressed. When creating a system, a strict schedule is upheld in the form of a timetable, documentation, and manager and user approval after each phase and before moving on to the next. All of the steps in the waterfall approach are shown in Fig. 2.2.

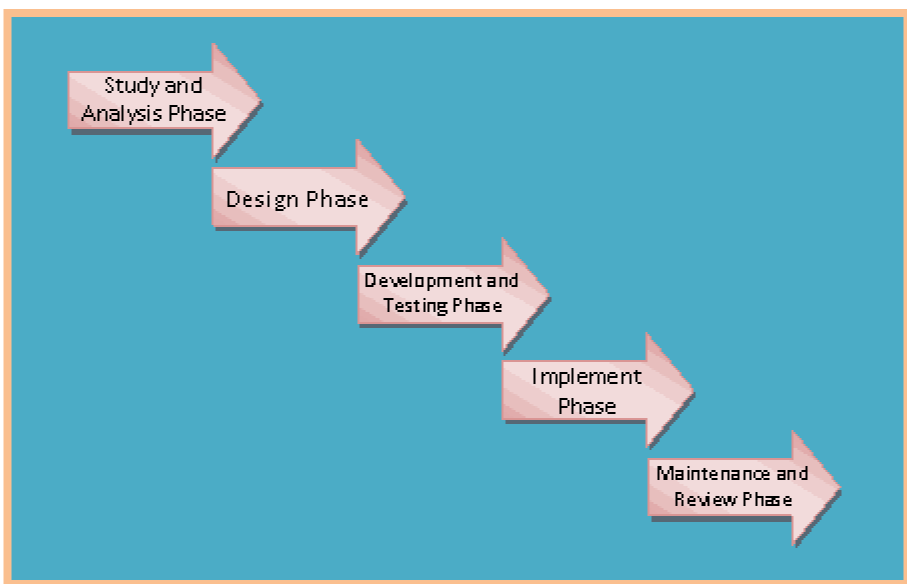

Fig. 2.2: Waterfall method for system development (linear approach)

1. 3.3.3 Prototyping method

This strategy is based on a system development iterative approach. With this approach, a system prototype—a scaled-down functional replica of the system—rather than an entire system is created. Despite being a sophisticated system, it does not satisfy all user needs. Before creating a comprehensive system, this model is made available to users at an early stage for testing and understanding their needs. Wherever users are, this strategy is helpful. Initial requirements are challenging to identify, and requirements can change as the system development process progresses. Final system development is based on user suggestions and feedback.

This method is focused on involving users in the analysis and design phases to produce a suitable system that lowers the likelihood of product rejection. This strategy similarly addresses the SDLC's associated operations, but here the emphasis is on user participation. As seen in fig. 2.4, the prototype model is based on the evolutionary method of system development.

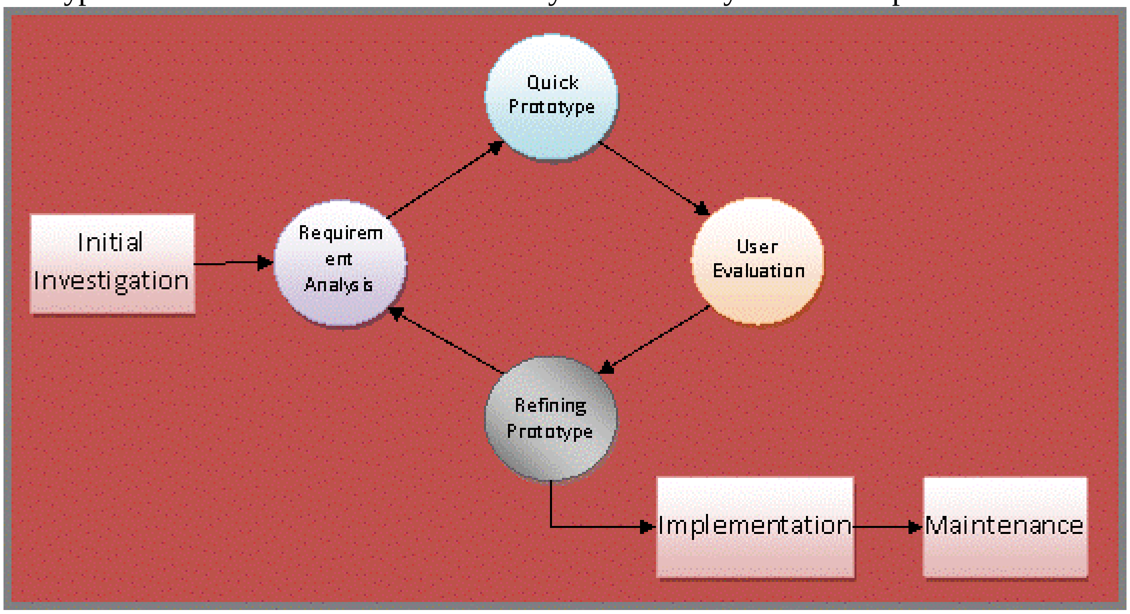

Fig. 2.3: Prototype model (iterative approach)

Reasons for developing a prototype system

- High cost: Systems with high costs or high-risk circumstances will be best suited to the prototyping technique since it gives users a chance to participate directly in the system analysis and design process. reduces the price of system development as a result.
- Insufficiently defined information requirements: When user interaction in interactive mode leads to the identification and streamlining of poorly defined information requirements, prototyping offers a good opportunity to define system requirements.
- Unknown information requirements: When one has neither knowledge nor experience of information requirements, a very unusual situation may arise. Prototyping is a good method for allowing time to gain experience and determine information needs.

Advantages

- Consumers' participation in the system development process reduces the likelihood of product rejection and gives users the ability to express what they like and dislike about the prototype model.
- Following an iterative adjustment process, till the users are happy, requirements are discovered in a better method.

1. 3. 3.4 Spiral method

This strategy for system development combines a linear and iterative approach. With this strategy, risk analysis gains a new component. The emphasis is on risk assessment and limiting system risk by segmenting a system into smaller pieces and making changes easier throughout the development phase as well as giving opportunities to analyse risks and weigh the pros and cons of maintaining the system across its entire life cycle. According to this approach, various system development activities ought to be arranged spiral style. The four stages of a spiral cycle are planning, risk analysis, engineering, and user evaluation. According to fig. 2.5, these stages are shown on four quadrants. Progress in the development process is represented by an angular dimension.

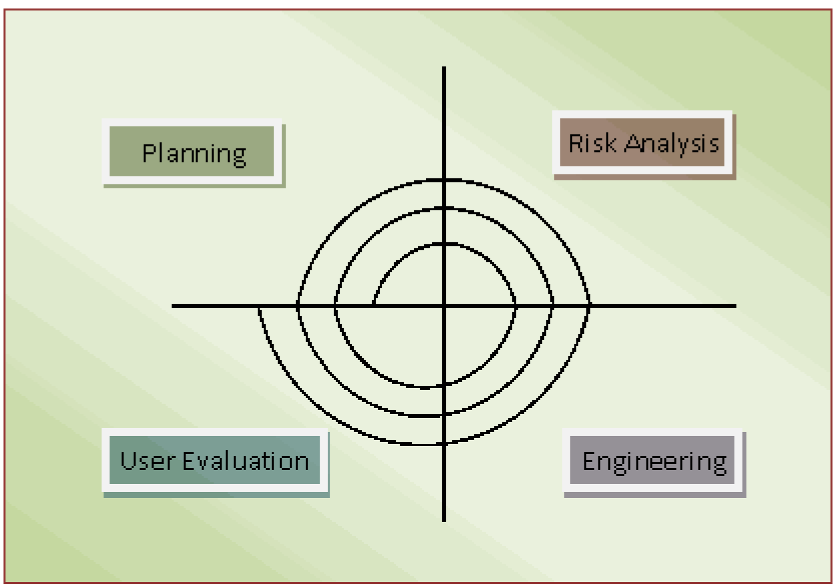

Fig. 2.4 Spiral method (combination of linear and iterative approach)

1. 3.3.5 Object oriented analysis

While Object Oriented Analysis (OOA) mixes data and the processes that operate on the data into something called objects, Structured Analysis regards processes and data as separate components. The OOA approach is used to simulate actual company activities and processes. This approach examines and comprehends user requirements in light of the classes and objects present in the problem domain. A collection of software objects that represent individuals, things, transactions, and events constitute the end product. The objects are converted into reusable code and components by a programmer using object-oriented programming language.

An object belongs to a class, which is a group of related items. Objects have what are referred to as properties, which they either inherit from their class or independently possess. This strategy has the following phases:

- Object Oriented Analysis
- Object Oriented Design
- Object Oriented Testing
- Implementation

1.4. Summary

You have learnt about the system development life cycle idea, the system development life cycle process, and the system development life cycle methods from the discussion in this unit, where several system development life cycle approaches were covered.

1.5 Glossary

Maintenance: this is where the original software gets modified. It involves performing ongoing performance evaluations of the system.

Evaluation: Here is where the developed system and the entire procedure are assessed.

Disposal: Here, the goal is to relocate, archive, trash, or destroy information, hardware, and software that are being replaced in a way that avoids any chance of sensitive data being disclosed without authorization. The disposal procedures guarantee a smooth transition to a new system. Proper archiving and preservation of the data processed by the previous system are given particular emphasis.

System investigation: This have to do with the performance of feasibility study to ascertain whether developing a new or upgraded system is a workable answer before any system planning is done.

1.6 Self-Assessment Exercises 1

- ✓ Describe the system development life cycle,
- ✓ Explain the process and procedure in the system development life cycle.
- ✓ Identify and explain the methods of the system development life cycle.

1.7 Possible Answers to Assessment Exercise

1.

The various SDLC phases are as follows:

- ✓ Study and analysis phase
- ✓ Systems design
- ✓ System development
- ✓ System implementation
- ✓ System maintenance

2.

A few prevalent techniques are:

I. System Development Life Cycle method (or traditional method))
II. Structured Analysis Development method
III. Waterfall method
IV. Prototype method
V. Spiral method
VI. Object-oriented Development method

3. Structured analysis method. Waterfall method, Prototyping method, spiral method.

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UNIT 2: SYSTEM ANALYST AND ROLES

UNIT STRUCTURE

2. 0 NTRODUCTION

You will learn about many definitions of information systems in this unit. You'll have a better understanding of it after doing this. Additionally, you'll learn about the history of information systems, a summary of the several definitions, the necessity of information systems, and the functions of information systems in libraries and information centres.

2. 2. INTENDED LEARNING OUTCOMES

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

- ✓ Describe the information system,
- ✓ Describe the various perspectives regarding the overview of the information system.
- ✓ Discuss the background of the information system
- ✓ Identify the need for an information centre
- ✓ Describe the role of information systems in libraries and information centres.

2. 3. MAIN CONTENT

2.3.1 Systems Analyst

Researching, organising, and recommending software and system options to satisfy the business needs of an organisation are the responsibilities of a systems analyst. A systems analyst's job is to pinpoint needs and resource limitations and turn them into workable operations. A system analyst looks into, analyses, develops, installs, tests, and manages an organisation's information system. System analysts work closely with users and managers both inside and outside of the company to complete these tasks. Systems analysts are essential to the analysis and design of any business or scientific environment's systems or applications. Typically, a team from the company's IT department supports the system analyst.

A systems analyst is a person who employs design and analysis methods to leverage information technology to address business challenges. Systems analysts can act as change agents by identifying the organisational adjustments that are required, designing the systems to carry out those adjustments, and motivating others to use the systems.

Even though they could be knowledgeable on a range of programming languages, operating systems, and computer hardware platforms, they typically stay out of the actual hardware or software development process. They might be in charge of creating cost analyses, design considerations, and implementation schedules.

2. 3.2 Roles/Functions of a System Analyst

To determine how a business system and computer system can be utilized together to solve problems and increase revenues, a systems analyst investigates the needs and problems of a business system.

An analyst must carry out the following duties to research and determine a system's demands or to create a new system:

Planning

To plan a solution that meets the user's needs, a system analyst gathers information, facts, and user perspectives.

They also interact with other users, managers, and data specialists.

The individual compiles and researches the organisation's historical background.

Analysis

The system analyst analyses the data after gathering the information needed to define a problem. He may seek assistance from others and listen to their ideas before modifying them until a practical solution is found. He or she specifies system and business goals.

Design

The system analyst must work on developing the system so that management objectives may be met after selecting the best alternative and outlining all the requirements. System analysts determine system requirements and their specifications while taking into account potential expansion and additional business needs. This specialist develops several plausible alternatives that fit an organisation's resources; they identify the hardware and software needs and choose them following the suggested designs. He creates databases, data integrity policies, input and output protocols, etc. He creates a whole system and testing protocol.

Implementation

The system must be tested and put into operation after it has been designed, according to the analyst. Implementation is what it is. It also aids in understanding how the system ought to work. Following the system and business objectives, he implements, updates, and maintains the system until it is a practical solution.

Maintenance

It concentrates on the management and personnel issues related to the system installation. A system analyst must devise tactics to get past change resistance because the future is unpredictable, and the system will inevitably change.

Other roles and functions performed by a system analyst include but are not limited to:

Defining user requirements: A systems analyst must observe users and their expectations of a system. This can be achieved by conducting conversational user interviews and anticipating users' future system demands. Looking at current systems and updating configurations for new systems, this aids in determining the requirements of new systems.

Prioritizing requirements: Prioritizing system specifications require both social and analytical abilities from systems analysts. Although the majority of enterprise systems have several requirements, these are typically limited by a shortage of resources. Although different users within an organisation will have different needs from a system, a systems analyst can assist in prioritizing those needs in light of the available resources. This ensures that a functional system yields its maximum productivity

Analysis of the issue: Systems analysts frequently pay attention to data and information about a business in operation. They employ technological methods for locating issues and eliminating superfluous information to permit a system's fulfilment of real needs.

Creating specifications: Systems analysts also designate the appropriate persons and team members to handle managing system requirements. They assign managerial tasks to managers and programming tasks to programmers. They use specification documents to thoroughly document these system tasks as well as check the output to make sure it adheres to the required specifications.

System design and Evaluation: The development of every system in an organisation, from the specification of requirements to the designing of the system itself, is guided by systems analysts. They carry out system evaluations to make sure the built systems adhere to the system specifications. To make sure the system is operating at the required level of performance, they test its performance as well.

Keeping up to date with technological advancements: Systems analysts are effective change agents in an organisation's usage of technology. They frequently pay attention to how technology is used throughout a business and strive to stay up with changing technological demands by replacing outmoded technology with the newest models. They frequently struggle to get the consumers to accept the modifications; therefore they include them in the development process. To integrate the most recent technology for users, they do this by interviewing the system's users and determining potential user wants and requirements. Systems analysts periodically verify that a company is using the most up-to-date technical systems, resulting in excellent output and productivity.

2.3.2 Skills of a systems analyst

A system analyst needs the following traits and abilities to do the aforementioned tasks: investigator, change agent, system designer, IT specialist, trainer, motivator, etc.

A systems analyst interacts with many people in numerous organisational departments. Therefore, they need effective communication skills to assign duties and explain issues they identify.

System analysts are required to perform numerous analytical activities. Therefore, they need strong critical thinking skills to assist them in problem analyses, system development, and implementation.

Business analytics: A systems analyst typically leverages their understanding of information technology to address business issues. Understanding business analysis is crucial for a systems analyst because it improves one's problem-solving skills.

Technical analysis: A systems analyst should have solid technical expertise in programming languages, IT infrastructure, and database management.

Management: A systems analyst collaborates with many people from various organisational areas. They must have strong managerial skills to manage resources effectively, including human resources.

The skills can be summarised as follows:

- Communication Skill
- Quick assimilation and sharpness in understanding skills
- Farsightedness and vision
- Adaptability and Flexibility skills
- Sound temperament, patience and rationality
- Management skills
- Leadership Quality
- Training and Documentation capabilities

Technical skills

- Application domain and IT Knowledge
- Creativity
- Project Management
- Interdisciplinary interfaces
- Technical Capability of questioning

2.4 SUMMARY

You have encountered many information systems definitions in this lesson, which has improved your comprehension of the idea. In addition, the study covered the history of information systems, a summary of the many definitions, the need for information systems, and the functions of information systems in libraries and information hubs. From the discussion in this unit, you've learned about the concept of the system development life cycle, the system development life cycle process and the system development life cycle methods where various methods of the system development life cycle were discussed.

2.5. GLOSSARY

System analyst: A system analyst looks into, analyses, develops, installs, tests, and manages an organisation's information system. System analysts work closely with users and managers both inside and outside of the company to complete these tasks.

Business analytics: A systems analyst typically leverages their understanding of information technology to address business issues. Understanding business analysis is crucial for a systems analyst because it improves one's problem-solving skills.

Technical analysis: A systems analyst should have solid technical expertise in programming languages, IT infrastructure, and database management.

Management: A systems analyst collaborates with many people from various organisational areas. They must have strong managerial skills to manage resources effectively, including human resources.

2.6. Self Assessment Exercise (SAEs)

- ✓ Define system analyst,
- ✓ Explain the roles and functions of a system analyst.
- ✓ Describe the skills of a system analyst.

2.7 Possible Answers to the Assessment Questions

1. A system analyst looks into, analyses, develops, installs, tests, and manages an organisation's information system.

2.

- ➢ To determine how a business system and computer system can be utilized together to solve problems and increase revenues, a systems analyst investigates the needs and problems of a business system.
- ➢ An analyst must carry out the following duties to research and determine a system's demands or to create a new system:
- ➢ Planning
- ➢ To plan a solution that meets the user's needs, a system analyst gathers information, facts, and user perspectives.
- ➢ They also interact with other users, managers, and data specialists.
- ➢ The individual compiles and researches the organisation's historical background.

3.

The skills can be summarised as follows:

Communication Skill
Quick assimilation and sharpness in understanding skills
Farsightedness and vision
Adaptability and Flexibility skills
Sound temperament, patience and rationality
Management skills
Leadership Quality
Training and Documentation capabilities

Technical skills

Application domain and IT Knowledge

Creativity
Project Management
Interdisciplinary interfaces
Technical Capability of questioning

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UNIT 3: INFORMATION ORGANISATION AS A SYSTEM

UNIT STRUCTURE

3.0 INTRODUCTION

In this unit, you will learn about information organisation as a framework or system. You'll have a clearer understanding after reading this. You'll also discover social tagging and bibliographic control, information organisation frameworks and systems, their goals and assumptions, their purposes, contexts, and evaluation criteria.

3. 2. INTENDED LEARNING OUTCOMES

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

- ✓ Describe information organisation as a system or framework.
- ✓ Explain social tagging and bibliographic control.
- ✓ Discuss purpose and predication.
- ✓ Identify functions and context functions
- ✓ Describe the rubric for evaluating the information organisation system or framework.

3.3 MAIN CONTENT

3. 3.1 Information Organisation as a System or Framework

There are many different frameworks for organizing information due to the diversity of technology and behaviours. In other words, information workers have created information organisation frameworks to meet specific needs. In many cases, they have used various technologies and components to achieve various goals, built on various hypotheses, and perform multiple functions in a particular context. For instance, according to ideas of bibliographic control, users can seek, group, identify, choose, and obtain materials in a library by using the catalogue (Svenonius, 2001). In other words, there are five different functions for bibliographic control in a library catalogue: find, collocate, identify, choose, and retrieve items. These tasks are incorporated into the catalogue system, and the setting is a library.

Information organisation systems (classification schemes, taxonomies, ontologies, bibliographic descriptions, etc.), methods for conceptualising and designing the systems, and the work processes involved in maintaining the systems comprise an information organisation framework. Bibliographic control, information retrieval, resource discovery, resource description, open access academic indexing, personal information management protocols, and social tagging are all parts of information organisation frameworks. Each of these emerged from the desire to control how people and information interacted. But every one of these frameworks for organizing information does it differently to meet these needs. They have different goals, assumptions, roles, and contexts.

According to Patrick Wilson (1968), bibliographic control aims to provide the best textual means to a goal, which necessitates the creation of tools (which Wilson refers to as bibliographical instruments) that provide control over a body of works. In the context of libraries and bibliographic tools like the WorldCat, database, bibliographic control, as it appears in catalogues, is present. On the other hand, social tagging developed out of the need to share objects within a social group. A social tagging system called flickr.com describes itself as wanting to "allow new methods of organizing images" and "help people make their photos visible to the people that matter to them" (Flickr, 2005).

3. 3.2 Social Tagging Versus Bibliographic Control

According to Patrick Wilson (1968), bibliographic control aims to provide the best textual means to a goal, which necessitates the creation of tools (which Wilson refers to as bibliographical instruments) that provide control over a body of works. In the context of libraries and bibliographic tools like the WorldCat database, bibliographic control, as it appears in catalogues, is present. On the other hand, social tagging developed out of the need to share objects within a social group. A social tagging system called flickr.com describes itself as wanting to "allow new methods of organizing images" and "help people make their photos visible to the people that matter to them" (Flickr, 2005).

1. The system's components are not designed to do the same tasks or have the same purposes. For instance, unlike many of the terms in bibliographic control, the terms in Flickr have no regulated vocabulary terms. Furthermore, no specific capability is sought that is similar to the catalogue's discover, collocate, identify, select, and get functions (Svenonius, 2001). 2 This method of dissecting a function, sharing, would highlight the distinctions between these two frameworks.

2. These frameworks for organizing information do not operate in the same context. The context in which photos are shared online, or how a shareable photo album is replicated in a web environment, differs from the context in which the catalogue is built and maintained.
These frameworks for information arrangement are comparable in that they are all designed for retrieval. However, retrieval occurs in various circumstances and for various reasons using a wide range of systems and system components. For instance, Svenonius disagrees with Wilson's (1989) emphasis on the collocation function of the catalogue, claiming that the inventory purpose of the catalogue is important (Svenonius, 2001, 204 n24). To determine the optimal course of action for developing and implementing information organisation frameworks in information systems, more analysis of this complex argument and examples of disagreement on aim, prediction, function, and context are necessary. For example, how much of the inventory function should be considered when evaluating modern catalogues that do not point to only those items they own? An explication of purpose in line with predication, function, and context would help us answer this question.

To develop more effective evaluation criteria for the design requirements, work processes, and consequential representations in information systems across the global learning society, it is crucial to recognise the diversity of purposes, predictions, functions, and contexts of information organisation frameworks. Suppose we have a more in-depth grasp of the variety of information organisation frameworks, their goal, prediction, function, and context. In that case, we can improve the evaluation rubrics (checklists, comparative models, fieldwork analysis codebooks, etc.).

3.3.3 Information Organisation Systems (Frameworks)

Purposes, predictions, functions, and context make up information organisation systems and frameworks. We introduce these ideas in this section.

3. 3.3.1 Purpose and Predication

This lesson defines purpose as the reason anything is made. Frameworks for organizing information provide three functions: retrieval, attestation, and inference. Retrieval is the first.

A. Retrieval can be accomplished in many different ways, and it is reasonable to suppose that it is not defined the same way for any information organisation scheme. That is, we cannot assume that each information organisation scheme operates in the same manner and context, regardless of how the retrieval goal is operationalised. We must first describe the explicit predications (operationalisations) of information organisation frameworks, followed by their purposes and contexts, to comprehend these variations. Frameworks for information organisations that use retrieval as a goal are based on several hypotheses. Predications are the assertions of purpose on which functions are built. They are operationalizations of purpose. They are a bridge between purpose and function. Retrieval, if we understand it to be the ability to find something. 3 relies on a spectrum of predications – specifically, control measures, matching measures, and display measures:

   i. Control Measure: One needs control over a group of papers so they can be retrieved in a group. According to Wilson, there are two different kinds of control: exploitative control and descriptive control. According to Wilson, exploitative control is the capacity to obtain the best text for the intended use of said text, while descriptive control is the capacity to arrange texts in some arbitrary order (Wilson, 1968, 25). (Wilson, 1968, 25). Catalogue implementation is governed by control. Additionally, it directs decisions regarding the use of standards for the different purposes of the catalogue (find, collocate, etc.).

ii. Matching Measure: A range of matching measures is the foundation for the second prediction, upon which retrieval is formed. In the existing systems, control is not required for matching but matching can be considered necessary for control. For instance, especially in full-text corpora, we do not need to get ownership over documents to match. In many situations, matching is necessary to show that one is in charge of a group of papers. Most online catalogues serve a combination of the two goals. However, the majority of web search engines do not work that way. Matching is dependent on control, but control is not dependent on matching.

iii. Display Measure: The built-in display is the third prediction based on retrieval. Even though this prediction also borrows from another goal (attestation), it is crucial to retrieval because it helps with control and matching. We need conceptual and practical techniques for displaying the outcomes of matching and control. Many people who deal with information systems have been concerned about the work on display, which is an ongoing area of research in information organisation frameworks (Carlyle, 2002; Yee, Swearingen, Li, and Hearst, 2003). The display is frequently taken for granted and not considered a separate operationalization of a system's purpose. Carlyle's work introduces this topic of bibliographic control and prompts us to consider our use of displays in information organisation frameworks in a purposeful manner.

B. Attestation: Attestation is a further objective of information organisation frameworks. Attestations regarding resources (descriptions of them, such as subject matter, title, relevance ranking, etc.) made by information organisation frameworks reinforce matching and control and enable subordinate functions. The predictions of these attestations may be explicit and static in the form of a title or subject matter representation. On the other hand, they may be dynamic and derived from relationships between documents as determined by query expansion algorithms or ranking algorithms. As seen in Flickr or Amazon.com's use of tagging, attestations require an authority link, either based on the terminology used (whether it belongs to an authorized scheme or not) or on the tagger's identity (indexer).

C. Inference: The third type of purpose used by information organisation frameworks is inference. There are many levels of inference. For instance, the inference is a feature of catalogues that enables users to identify certain documents (Svenonius, 2001). The structure of ontologies also enables people and machines to make inferences. Like control, inference necessitates some form of identity, terminology representation and attestation of authority.

Frameworks for information organisation show these goals and predictions in action and differ in various frameworks in terms of degree. For instance, machines may perform little to no inference during bibliographic control, but we can still see how structures used there could be changed to support inference; this would provide the structures we wish to take into account during evaluation a new layer of meaning. Making purposes clear paves the way for evaluation since it is possible to see the connections between purpose and function.

3. 3.3.2 Functions

The activities as a framework for organizing information into functions are what is discussed in this unit. According to Svenonius, the library catalogue's functions include making it easier for users to find, group, identify, pick, and get items. Sharing and annotation are two social tagging activities that may be seen in the Flickr examples, where the algorithm prioritizes these features over other unintended collocation-related capabilities.

The question of whether sharing can be viewed as finding, collocating, or identifying then arises. Here, the functions that result from the intersection of retrieval and attestation goals are present. It is another instance in which identification in attestation has an impact on Flickr's performance as a framework for information organisation. We can think of bibliographic control as an anonymous aid in finding, collocation, and identification depending on some third authority since most of what is done in bibliographic control is delegated (Fairthorne, 1961, 124–134). (published controlled vocabularies and standards). While Flickr's sharing feature is based on identity and social groupings, my social group chooses the terminology it uses and creates these unrestricted vocabularies for itself.

Therefore, in the instance of Flickr, sharing can be viewed as a social activity associated with a different type of identity from identity as it is understood in bibliographic control (my tags against your tags) (identity of an authoritative list of subjects and standards and training in applying these subject headings). Of course, it is interesting to observe the unintended uses of information organisation frameworks. We may search Flickr with the expectation that it will act as a catalogue, and in some situations, we may be pleasantly pleased, but we cannot judge Flickr based on this unintended feature or use it for a purpose other than what it was designed for.

3.3.3.3 Context Functions

Predication, purposes, and context all function together to create a context. The user, the information system, and the larger social structure in which the user and the information system work make up the context in this case. Therefore, the catalogue, catalogue users (including professionals), and the setting in which the users and the catalogue function comprise the context for bibliographic control. Flickr operates in a separate environment. We are not dealing with a catalogue in this instance. We are dealing with private photo collections that can be shown to a few people. No attempt has been made to edit these images. The tags that are used to identify these photographs are frequently shared via email or in-person conversations. In this case, the context is not anonymous.

3.3.4 Evaluation Rubric for Information Organisation Frameworks

A brief rubric is presented in this section. This article's evaluation criteria are not all-inclusive. It is a beginning, but this rubric can be made better by studying additional frameworks. The rubric's objectives are to (1) evaluate the goals of the information organisation framework, (2) evaluate its hypotheses, (3) evaluate the functions that support those goals, and (4) evaluate how well it accomplishes those goals. This rubric makes explicit these four categories to (a) speculate the information organisation framework – making explicit the tenets on which the framework was built and distinguishing intended use from accidental use, and (b) laying bare the relationship between intention and action in information organisation frameworks.

It can be difficult to interpret the fourth of the aforementioned points, which refers to how well an information organisation framework serves its purpose. The evaluation should be taken into account in different ways, with purpose fulfilment being just one of them. Even with this limited examination of evaluation, all that is left is the rubric.

3.5 Summary

You have learned about information organisation as a framework or system in this unit. You now have the knowledge you need to comprehend it better thanks to this unit. Additionally, you have learnt about social tagging, bibliographic control, information organisation systems and frameworks, as well as their goals, predictions, and evaluation criteria. Information organisation as a system or framework has been covered in this lesson. The unit also covered social tagging and bibliographic control, information organisation systems and frameworks, their goals and predictions, as well as their purposes, contexts, and evaluation criteria.

3.6 Glossary

Bibliographic control aims to provide the best textual means to a goal, which necessitates the creation of tools (which Wilson refers to as bibliographical instruments) that provide control over a body of works.

Social Tagging: Social tagging also known as “folksonomies”, are user-defined metadata collections. Users do not deliberately create folksonomies and there is rarely a prescribed purpose, but a folksonomy evolves when many users create or store content at particular sites and identify what they think the content is about.

3.7 Tutor-Marked Assignments (SAEs)

- ✓ Explain information organisation as a system or framework.
- ✓ Define social tagging and bibliographic control.
- ✓ What is meant by purpose and predication?

3.8 Possible Answers to Assessment Exercise

1. Explain information organisation as a system or framework.
   Frameworks for organizing information provide three functions: retrieval, attestation, and inference. Retrieval is the first including Control Measure, Matching Measure, Display Measure. Others are Attestation, inference.

2. A social tagging system called flickr.com describes itself as wanting to "allow new methods of organizing images" and "help people make their photos visible to the people that matter to them" (Flickr, 2005).

   According to Patrick Wilson (1968), bibliographic control aims to provide the best textual means to a goal, which necessitates the creation of tools (which Wilson refers to as bibliographical instruments) that provide control over a body of works.

3.9 References/Further Reading

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Module 3: Information Systems Evaluation and Data Related Issues

Unit 1: Evaluation of Information Systems and Services
Unit 2: Data Related Issues
Unit 3: Data Context Diagram and Data Flow Diagram

UNIT 1: Evaluation of Information Systems and Services

UNIT STRUCTURE

1.0 INTRODUCTION

This unit will introduce you to various concepts of information systems evaluation. This will give you a better understanding of what it is all about. You'll also learn about the information system evaluation process, approaches to information systems, the strategies for information systems evaluation.

1.2 INTENDED LEARNING OUTCOMES (ILOs)

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

- ✓ Describe evaluation and evaluation of information system,
- ✓ Describe the information system evaluation process.
- ✓ Discuss the approaches and strategies to the information system evaluation

1.3 MAIN CONTENT

1.3.1 The Concept of Evaluation

The evaluation's primary objectives can include cost-benefit analysis, competitive positioning, and labour relations, depending on the organisation's choices. As evidenced by their presence as formative or summative assessments, evaluation may be used for a variety of purposes. Examining an IS's hardware, apps, computer networks, records, and human capital will help you determine how successful it is. Maximizing an IS's performance is the fundamental goal of evaluating its usefulness, particularly in terms of maintaining quality. Administrators evaluate the worth of new or existing information structures through evaluation. Information System evaluation is a crucial area of research and application. With the spread of information technology, the focus has changed slightly away from questions about how and to what extent ISs contribute to organisational advancement and toward complex and collaborative appraisal. A crucial challenge in the field of ISs has been characterised as the performance evaluation of ISs. To clarify this issue, numerous philosophical and scientific studies have been carried out. There is ongoing debate regarding the best range of variables to use when evaluating the success of ISs from the user's perspective.

The task of evaluating ISs is not straightforward; rather, it is a time-consuming process requiring many stakeholders and a range of factors. The five categories of evaluation needs are strategic value, profitability, risk, successfully produced and procured, successfully used and managed. As a result, in our conceptual framework, there is a bidirectional partnership between the enterprise planning and ISs development processes and the ISs evaluation process, which can frequently respond to changes in the guiding principles for ISs investment.

1.3.2 **Information System Evaluation Process**

The evaluation process should identify and control the project's critical areas. Before developing the evaluation requirements and procedures and deciding who will participate in the evaluation, it is critical to identify all relevant stakeholders for the ISs project. To ensure that all facets of the ISs endeavour are considered and evaluated, a comprehensive collection of evaluation standards should be used. The evaluation of information systems must be integrated into the enterprise planning phase, the development of information systems, and the acquisition of information systems. A three-step framework has been proposed for the evaluation of ISs:

1. Intangible benefits evaluation

2. IS investment risk analysis

3. Tangible benefits evaluation.

The interventions should be conducted in the following order: evaluation of the risks and intangible rewards should come first, then evaluation of the tangible benefits. Since value cannot be determined until the IS has been utilised for a while, the success of the IS' development takes precedence over the success of the IS' utility. Although it is ideal for assessments of ISs to include all areas, the focus varies depending on who is doing the evaluation and where the impetus for the evaluation originated. There are three methods for judging information systems. These are discussed as follows:

1. Plan the evaluation:
2. Evaluate according to chosen evaluation type or a combination of several types
3. Draw conclusions

An evaluation plan is a component of a project's planning that deals with determining how the project will be followed and evaluated to ascertain its effectiveness and success. An efficient evaluation strategy should outline the project's monitoring procedures and goals.

1.3.3 Approaches to Information Systems

Comparing a rational and interpretive perspective,the logical point of view asserts that evaluation is mostly a theoretical process that involves calculating the prospective cost/benefit ratio following predetermined standards. It evaluates the most recent data to determine any tenable information for revision. When evaluating computer systems from an interpretive standpoint, ISs are seen as social systems that incorporate information technology. One can understand this confusing practice by adopting an interpretive perspective on IS evaluation: because ISs are fundamentally social systems with a technical component, they are evaluated politically/subjectively rather than logically/objectively.

Comparing formative and summative evaluation. Formative evaluation is a procedure that seeks to elicit feedback through the creation and implementation of an IS to identify areas for improvement and support the development of the transformation, enhancement, or action. It is also known as method evaluation or progress evaluation. Summative evaluation, also known as result or effect evaluation, is a type that happens after the development and implementation phases are finished. Its purpose is to collect information and feedback during the development stage to determine the outcomes, feasibility, impacts, and results of the produced IS.

Differences between Formative and Summative Evaluation

Some factors can be considered to differentiate between summative and formative evaluation. These factors and how they differentiate the two are described in Table 3.1

Table 3.1: Differences between Summative and Formative

Dimension	Summative	Formative
Target audience	Decision-makers, funders, or the public	Programme managers, practitioners
The concentration of data collection	Measures of the quantitative results	Qualitative evidence helps make the program's objectives, content, and structure clear
Role of evaluator	One-way communication and	Two-way interaction

	independent	
Methodology	Experimental and quantitative design	Heavy use of qualitative design
Frequency of data collection	Limited or one round of data collection	Continuous monitoring
Reporting procedures	Formal reports	Informal via group discussion and meetings
Frequency of reporting	After completion of the evaluation	During the overall process of evaluation

Source: Chen et al (2011)

1..4 **Strategies for Information Systems Evaluation**

There are three different strategies for information systems evaluation. These are goal-based evaluation; goal-free evaluation, and criteria-based evaluation. These are discussed in turn as follows:

1.4.1 **Goal-Based Evaluation**: This refers to evaluations that are motivated by specific organisational goals. The process of assessing how well a project or program achieves certain goals is known as goal-based evaluation. The planned services and program objectives are the main points of emphasis. Evaluations may be quantitative and follow the requirements of the standards. This strategy has drawn criticism from many observers since it solely considers technology and economic aspects, not human and social ones.

Furthermore, the critics contend that this might significantly harm both consumer loyalty and the system's organisational value. The main principle of this approach is to determine whether predefined goals are achieved, and if they are, in what ways and to what extent. This deductive approach is used. The priorities and the instrument used which may be quantitative or qualitative determine what is measured.

Goal-based evaluation has traditionally depended on methods for gathering objective data (Cronholm and Goldkuhl, 2003). However, it has come under heavy fire since, when solely objective methods are employed, goal-based evaluation frequently gives more weight to technical and economic factors than to human and social factors. The evaluation's conclusion might as a result overstate the quantitative significance of the innovation (such as a newly implemented information system) while underplaying significant societal, organisational, and human repercussions. As a result, while qualitative methods can be used in goal-based evaluation to examine more social or human-centred goals, quantitative approaches are suitable for evaluating statistically quantifiable targets.

1.4.2 **Goal-Free Evaluation**: This evaluation without any explicit aims is referred to as a goal-free evaluation. An inductive and context-sensitive technique is objective-free evaluation. This interpretive evaluation's main goals are to fully comprehend the subject at hand and to promote interest and dedication. It is frequently believed that the participation of a broad range of stakeholder groups is essential to this evaluation technique. If the evaluation requires only a small amount of time or money, this can potentially be a technical obstacle. It is referred to as an evaluation without objectives. The term "objective-free evaluation" refers to the process of acquiring information on a wide range of actual outcomes and assessing their significance in meeting stated needs. The evaluator makes a conscious effort to stop communicating curricular objectives to the personnel; no program preparation materials or brochures are read; only the program's results and quantifiable effects are examined. Goal-free evaluation's purpose is to minimize the risk of concentrating only on established program aims and so missing significant unanticipated consequences, as well as to get rid of the negative associations associated with the discovery of an unanticipated effect: Particularly in terms of new goals, the entire vocabulary of collateral impact, secondary effect, and even unintended effect seemed to be a slap in the face of what might very well be a crucial success.

An inductive technique called goal-free evaluation entails obtaining information on a variety of observable results before evaluating how important they are in meeting the sociotechnical goals that the information system is intended to address or create. Both quantitative and qualitative methodologies can be used in this evaluation methodology. Goal-free evaluations provide advantages, including lowering the likelihood of examining the pre-specified objectives too thoroughly and neglecting unexpected features, eliminating evaluation prejudices brought on by objectivity, and maintaining evaluator objectivity and flexibility.

1.4.3 Criteria-Based Evaluation:

Criteria-based evaluation is the process of evaluating utilising specified broad parameters as a standard. The concepts of consistency, principles, heuristics, and checklists are all examples of standard-oriented techniques. This method assesses the information system's interface and/or the relationship between users and the information system in addition to a set of predetermined criteria. By using criteria, one can place attention on key traits that are important to grasp from a particular angle. The emphasis on criteria simultaneously diminishes these qualities. The evaluation's focus and consequently the knowledge gained is guided by the criteria chosen. The evaluation criteria used imply that some traits are valued and highlighted by the assessors. The evaluation criteria, therefore, impose limitations on the possible outcomes.
Two prominent information systems have been identified in the literature by Cronholm and Goldkuhl (2003) to distinguish between two strategies: 1. Evaluating IS As-Such 2. Evaluating IS In-Use.

IS As-Such

In this scenario, only the evaluator and the IS are engaged. Data from the information system itself or possibly from information system documentation may be used in this manner. The evaluation approach is determined by the how strategy selected. Any of the evaluation methods may be used if one chose to evaluate information systems in this way. The evaluator can employ a goal-oriented, criteria-oriented, or objective-free approach. The evaluator's comprehension of the information system's effect on the organisation will determine the evaluation's outcome. This practice is used regardless of how users think the information system can help them with their tasks. The evaluation object is the information technology artefact itself. There is no research on how actual users use the product. The framework is the study object, as well as the intended use made evident by its mandated functionality. The system's capabilities are investigated by the evaluator.

IS In-Use

Analysing a case study in which a user interacts with an operational information system is a necessary step in operational information system evaluation. Because it involves a consumer, this scenario is more complicated than the ISs as a whole, but it also has the potential to have a more complete image. User interviews and their perceptions and interpretations of the consistency of the information system, assessments of users' interactions with the information system, the information system itself, and the information system documentation may all serve as evidence in this case. This method enables easier access to a wider range of data sources. The evaluator has the option of combining all pertinent data sources to achieve a high degree of triangulation when strict data consistency requirements are in place. The evaluator can pick from one or two potential data sources if they are working with constrained resources.

1.5 Information Systems Evaluation Challenges

The multiple problems that IS evaluation provides can be introduced to gain insight into the situation. Three problem areas, namely Evaluator Characteristics, Methodology, and Organisational Factors, can be used to taxonomize these difficulties. This will be referred to as the EC-MOF Taxonomy for the rest of the essay. The topic of Evaluator Characteristics focuses on issues relating to evaluators, such as the need to address evaluators' biases, credentials, inadequate training, relationships with staff, and adequate understanding of evaluation methodology.

The steps in the methodology are evaluation design, locating and enlisting potential participants, addressing measurement errors (i.e., measurement inaccuracy), choosing the measurement criteria, figuring out how to measure intangible criteria, choosing the evaluation level (e.g., macro vs. micro), and interpreting results. Organisational factors are evaluation-related organisational economic, administrative, and structural problems. Determine the evaluation's direct and indirect costs, support for evaluation preparation (such as conducting an IS requirements assessment), managing limited resources, and coordinating the evaluation with organisational objectives are a few examples of these factors.

The three categories listed above are not exclusive of one another. In actuality, many issues can be seen as spanning multiple categories. For instance, an evaluator's incorrect interpretation of a measurement problem (which results in a measurement error) has both measurement problem and evaluator problem characteristics (e.g., the evaluator was confused and failed to clarify the evaluation question). Given that evaluation has these kinds of cross-cutting problems, the difficulties can be shown graphically in a Venn Diagram, as shown in Figure 3.1.

Fig. 3.1Non-Exclusivity of EMO Taxonomy Categories

In addition to the complexity of the cross-category challenges, there are important bidirectional influences. For instance, issues with organisational factors may have an impact on issues with evaluator characteristics, which may have an impact on methodology issues. For this specific example, failing to effectively assess IS requirements have an impact on the validity of measurement criteria, which in turn has an impact on how the evaluator assesses certain criteria. An issue in one category can result in a problem (or problems) in another, which is another feature of bidirectional impacts. The result of the IS review is ultimately impacted by the combination of these issues and relationships.

1.6 Summary

From the discussion in this unit, you learned about the concept of evaluation; information system evaluation process; the approaches to information systems and the strategies involved in the information systems evaluation.

1.7 Glossary

Information evaluation – This refers to analyze information from a critical perspective. We also need to consider the relationships among different sources and how they work together to form "conversations" of diverse perspectives surrounding a particular research question.

Data: This refers to the quantities, characters, or symbols on which operations are performed by a computer, which may be stored and transmitted in the form of electrical signals and recorded on magnetic, optical, or mechanical recording media.

1.8 Self Assessment Exercise (SAEs)

1. Explain what you understand by evaluation. 2. Describe the process involved in the information system evaluation. 3. What are the approaches to information systems evaluation? 3.What are the strategies you can embark upon as LIS undergraduate for evaluating information systems?

1.9 References/Further Reading

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UNIT 2: DATA RELATED ISSUES

UNIT STRUCTURE

2.1 INTRODUCTION

In this section, we will examine the many definitions of data dictionaries. This will help you to grasp the various shades of meaning of data dictionary. In our discussion, you will be able to define variables, identify data types and elements, and determine ranges of values, code valid values, specify qualitative missing data, check for dependencies, identify calculable values, and learn best practices for data collection. All these topics are covered in this unit.

2.2 INTENDING LEARNING OUTCOMES (ILOs)

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

- ✓ Explain the meaning of data dictionary
- ✓ Describe variable name,
- ✓ Explain how to determine data type, data elements and ranges of values,

- ✓ Describe coding valid values, how to specify qualitative missing data and checking dependency,
- ✓ Identify calculable values,
- ✓ Describe the best practices in data gathering.

2. 3.0 MAIN CONTENT

2. 3.1 The Concept of Data Gathering

Data gathering entails the systematic process of collecting information on relevant factors to answer specific research questions, test hypotheses, and assess results. All academic disciplines, including the humanities, social sciences, businesses, and the physical and natural sciences. Although techniques differ depending on the discipline, the importance of ensuring accurate and truthful collection does not change.

2.3.1.1 Importance of Ensuring Accurate Data Gathering

Accurate data collecting is crucial to preserving the integrity of research, regardless of the subject of study or preferred method for defining data (qualitative, quantitative). Errors are less likely to occur when the right data-gathering tools are used (whether they are already available, updated versions of them, or brand-new ones). Consequences from improperly collected data include:

- ➢ Inability to accurately answer research questions,
- ➢ inability to replicate and validate the study,
- ➢ distorted findings resulting in resource waste,
- ➢ deceiving other researchers into pursuing fruitless avenues of investigation,
- ➢ compromising decisions for public policy, and
- ➢ harming both human and animal subjects.

2.3.1.2 Issues related to Maintaining Integrity of Data Gathering

To assist the detection of errors in the data gathering process, (deliberate falsifications) or not, maintaining data integrity is the main justification (systematic or random errors). Quality assurance and quality control are two strategies that help protect data integrity and guarantee the scientific validity of study results. Each strategy is used at various stages of the research timeline:

1. Quality control measures are taken before data collecting starts.
2. Activities that are performed both during and after data collection constitute quality control.

Quality Control Measures

Since data collecting comes before quality assurance, its primary goal is "prevention" (i.e., forestalling problems with data collection). The best way to protect the accuracy of data collecting is through prevention. The uniformity of protocol created in the thorough procedures manual for data collecting serves as the best example of this proactive step. The likelihood of failing to spot issues and mistakes early in the research attempt increases when guides are written poorly. There are several ways to show these shortcomings:

- Lack of clarity regarding the timing, procedures, and identity of the person(s) in charge of data review; incomplete listing of the things to be collected;
- vague descriptions of the data collection tools to be used rather than detailed step-by-step instructions on administering tests;
- failure to identify specific content and strategies for training or retraining staff members in charge of data collection; and
- cryptic instructions for utilising, adjusting, and calibrating data.

Making a thorough plan for hiring and training is a crucial part of quality assurance. Effectively conveying to trainees, the importance of precise data collection is essential throughout training. To handle the potential issue of workers who might unintentionally diverge from the original routine, the training component is especially crucial. Additional training should be provided to address this "drift" occurrence; this instruction needs to be included in the procedure’s handbook. It is challenging to generalise about how to set up a research protocol to facilitate quality assurance given the variety of qualitative research strategies (non-participant/participant observation, interview, archival, field study, ethnography, content analysis, oral history, biography, unobtrusive research, etc.). Indeed, non-participant/participant observers may only have the most general research questions to inform their early research attempts. There are frequently few or no other data collection tools because the researcher serves as the primary measurement device in a study. It can be necessary to create instruments on the fly to accommodate unexpected results.

Quality Control

Even though quality control actions (detection/monitoring and intervention) take place both during and after data collection, the specifics should be meticulously detailed in the procedure’s manual. Establishing monitoring systems requires a specific communication structure, which is a prerequisite. Following the discovery of data collection problems, there should be no ambiguity regarding the information flow between the primary investigators and staff personnel. A poorly designed communication system promotes slack oversight and reduces opportunities for error detection.

Direct staff observation during site visits, conference calls, or routine and frequent assessments of data report to spot discrepancies, excessive numbers, or invalid codes can all be used as forms of detection or monitoring. Site visits might not be appropriate for all disciplines, but without routine auditing of records whether quantitative or qualitative it will be challenging for investigators to confirm that data gathering is taking place following the manual's defined

methods. Additionally, it can be problematic to communicate any changes to staff members if the structure of communication is not clearly outlined in the procedure's manual.
Additionally, quality control determines the appropriate solutions, or "actions," to fix flawed data-gathering procedures and reduce recurrences. If data collection processes are imprecisely designed and the essential measures to reduce recurrence are not put in place through feedback and education, these actions are less likely to occur.

2. 3.1.3 Verification of Data Quality

Researchers are trained to include one or more secondary measures that can be used to verify the quality of information being obtained from the human subject in the social and behavioural sciences where primary data collection entails using human subjects. For instance, a researcher conducting a survey would be interested in learning more about the prevalence of risky behaviours among young adults as well as the social factors that influence the propensity and frequency of these risky

Respondents may be questioned about the same information at many points in the survey and in a variety of methods to check the accuracy of the data. It is also possible to gauge the sincerity of responses using measures of "social desirability." In this case, two issues need to be brought up:

I. cross-checks during the data collection process, and
II. data quality is a problem at both the observational level and across the board. Therefore, it is important to consider data quality for each measurement, each observation, and the overall set of data.

Each academic discipline has a chosen set of tools for gathering data. While precise lab notebook documentation is the hallmark of laboratory sciences, social sciences like sociology and cultural anthropology may prefer to use in-depth field notes. To maintain data integrity, thorough documenting of the data gathering process before, during, and after the activity is crucial, regardless of the discipline.

2. 3.1.4 Challenges of Data Gathering

- Errors in individual data items,
- systematic errors,
- protocol violations,
- issues with particular staff members or site performance,
- fraud or scientific misconduct, for example, are examples of data-gathering concerns that necessitate a quick response.
- Self-Assessment Exercises

✓ Explain data dictionary ✓ Define the variable name, ✓ Determining data type and data elements, ✓ Describe how to determine ranges of values.

2.3.2 Data Dictionary

A data dictionary helps researchers document the data that needs to be collected in a thorough and consistent manner. Without additional information such as definitions, characteristics, validity ranges, the context of data collection, units of measurements, or coding of variables, it is impossible to analyse or exchange data (for example, with other researchers).
A data dictionary is a file that aids in defining how a specific database is organised. The programmer or other users who might need access to the data might utilise the data dictionary to describe the data objects or items in a model. A data dictionary simply contains information on how to define and manage the data; this information is known as metadata. It does not contain the actual data from the database. The capacity to know the type of field, where it is in a database, what it means, etc. is made possible by building a data dictionary. It normally consists of a table with several columns that label the data and describe relationships.

An orderly table containing the names and definitions of data elements makes up a simple data dictionary. It may be used to define a single database, a subset of an organisation's data holdings, or the entirety of those holdings. Advanced data dictionaries may include entity relationship diagrams and database structures with reference keys.

2.3.2.1 What is Included in Data Dictionary

How does a data dictionary work? A data dictionary is made up of several data components, including data assets, entities, attributes, and value domains. There are various components at each level, but they should all have the following characteristics defined (Table 3-2):

Table 3-2: Inclusion in Data Dictionary

Data Component Name	Name of a data component that denotes a group of actual entities or features of those actual entities
Description	A short definition for the data element and name
Type	Component of physical data arranged in orderly manner
Required	Alternative and or requisite data element
Sample	A data component subset

Each entity or table has one line at the entity level that contains all the properties that are necessary for that entity, such as the name of the logical and physical data elements, the requirement ID (the reason the entity is present in the system), the security category (the consumers who can access the entity), and so on.

One line per attribute or column makes up the attribute level, which also includes the names of the logical and physical data elements (along with the names of their parent elements, such as entities or tables) and some logical and physical properties (such as data type and size, the null option, whether the attribute or column is a primary key, a foreign key, a unique or alternative key, a PII field, etc.).

Finally, a list of groups or collections of related values (such as sex codes, account types, credit card types, enrolment plans, etc.) defined as business rules, look-up tables or lists of valid values, and each value within each collection makes up the value domain level.

How to define variables should be among the other components of a data dictionary. Different advice regarding the selection of variable names is made in the literature and real-world applications. Simple variable names that refer to the questionnaire and the variable's content are preferable to self-explanatory names that include the question number with ascending numbering. For the variable name (short name), the following guidelines can be summed up generally as follows:

Use evocative identifiers when naming variables; the meaning of the variable should be understandable without extra context or documentation.
Use both short and long names: The short name, which serves as the column name in the database, must be distinct. The long name, which is typically used in forms as a description field or label, more thoroughly characterises the variable. Help texts and in-depth descriptions of variables can also be displayed.
Employ prefixes: Prefixes typically help a variable's identity within the Data Dictionary to be unambiguous. For instance, even when multiple forms are being used, a variable with a form prefix can be directly assigned to the source form.
Use suffixes: When several descriptive IDs are required for related variables as part of an enumeration (e.g., risk factor 1, risk factor 2, etc.), suffixes should be used. Suffixes can also be used to refer to certain data kinds or unit types.
When defining variable identifiers, the later data processing must be considered:
Based on current rules, the variable name shall not exceed: Please be mindful of any potential database and analytic software restrictions.
Use only lower case to prevent issues with the processing of the gathered data across operating system boundaries.

Avoid using reserved words: Words like "begin," date," table," system," and "name" are used in databases and many other technological systems. There could be unintended side effects during data processing as well as system faults if these reserved terms are utilized as variable names.
Avoid using umlauts: Umlauts, particularly those in the German language (such as ä, ü, and ö), can cause issues with data storage and processing.

Avoid using blank spaces and special characters: Variable names with these characters (such as "-", "%", "$", "&", "/", "(,")") already make database creation more difficult because they may not be legal depending on the database system and lead to system issues. However, it is possible to join words together within a variable name using underscores (").
Enable global dissemination by using English variable names, if possible, to aid in the comprehension and applicability of the variables in global studies and publications.
Give structural details: References to the questionnaire's structure should be included in the names of the variable fields (chapter or section numbers). When only a portion of the acquired data sets is exported for data analysis, this structural information is necessary.

Table 3-3: Examples for "bad" variable names

Variable name	Problem	Improved variable name (short name)
Waiting-time (h)	Upper case, special characters, blanks	frm_admission_waitingtime_hours
n1, n2, n3	No reference to variable content	frm_admission_accidentcause1, frm_admission _accidentcause2, frm_admission _accidentcause3
date1	Not descriptive enough	frm_ admission _date

2.3.2.2 Determining Data Type and Data Elements

Nearly all data gathered on a variable can be represented by the following data types, if necessary:
Integers: Integers are especially well suited for frequency specification and the representation of categorical data, such as coded selection alternatives for the accident's cause.
Floating point numbers: For metric values, such as the measurement of blood alcohol concentration, floating point numbers are particularly useful. Every time, the necessary decimal places must be given.
Character strings: Texts can use character strings. Always specify the string's maximum length, for example, "explanation of the accident (max. 255 characters)".
Date and Time: Depending on the data capture tool and database system, date and time may be displayed in a variety of ways. It is feasible to use character strings. In any instance, the date and time format should be consistently established, such as "hh:mm" or "dd.mm.yyyy".

Data Element Domain

The environment that the data element is situated in. A participant's address, phone number, title, and email address, for instance, could be included in information about the participant (the domain).

- The data element's individual identification number is used in technical papers.
- Data Element Name: A name for the data element that is universally recognized.
- Data Element Field Names: The names given to this data element in database schemas and computer programs.
- Data Element Definition: An explanation of the data element's significance.
- Scientific or another unit of measurement that relates to the data value is the data element's unit of measurement.
- Data Element Value: The value that was reported.
- Data Element Precision: The level of reporting for the data element value.

- Data Type for a Data Element is the type of data (characters, numeric, etc.), its size, and, if necessary, any representations that might be applicable to the data element.
- Data Element Size: The number of decimal places that must be kept in the database and the maximum field length in characters.
- Limitations on Data Element Fields: Data Element is either a null field, a conditional field, or a mandatory field (Y/N): Fields marked with a Y must be filled out. When a related field is filled out, conditional field (C) must be filled out as well (e.g. if a city name is required a Zip Code may also be required). Fields that must have data are also referred to as "not null" fields. The term "Null" denotes an unknown data type (note: a null value differs from a blank or zero value).
- Data Element Default Value: A predetermined value that may be constant or variable, such as the current date and time.
- Data Element Edit Mask: An illustration of the appropriate data arrangement, such as yyyy/mm/dd
- Business rules for data elements (may include any of the following information):
- Details about intra-element validation, data element coding (acceptable values), and references to other papers' explanation of validation criteria and coding (code tables, etc.).
- Related data components are List of names of closely related data elements when the connection is significant.
- Data element security classification: Use restrictions or organisation-specific security classification level.
- Reference to the tables in the database that the element is used in, together with information on the element's function in each table. Indicate whether the data element is the table's primary or secondary key.
- Definitions and sources necessary to comprehend the significance of the data element: To comprehend the purpose and use of the data element, there must be brief definitions of the application domain and references to related documents.
- Data in the data element's source: A brief explanation of the data's source. contains the formulas used to produce the value of the data element.
- The data element definition's valid dates: dates for the data element's start and the potential end of validity are also included. The data may span several periods.
- External references: References to books, other publications, legislation, etc. History references: The date the data element was defined in its current form. References to superseded data elements, etc.
- Version information for the data element document, such as a version number. Formal references to configuration management or version control may be included here.
- The data element document's written date indicates when this version was created.
- References for quality control include endorsements, dates, and other information particular to the organisation.

2.3.2.3 Defining Ranges of Values

To reduce the possibility of entering implausible values during the data collecting process, a proper range of values for each variable should be defined. The values must not be too narrow and must include the whole range of realistic values. For future quality control and analysis, if possible, indicate the scale of measurement. This makes it possible to distinguish between value ranges and hence aids data analysis. For instance, the variable "accident cause" (values range 1..5, nominal, integer) is examined differently from the variable "body size," which can also be supplied as an integer but is metric and, as a result, allows for a comparison of values and mean values.

Table 3-4: Examples of variables and possible values ranges

Objective/ Variable	Possible values rang	Scale of measurement
Selectable options 1,2 and 3	1,2,3	Nominal
measurement in percentage	0 – 100	Ordinal
Height in cm	1 – 299	Cardinal
Admission date	01.01.2015 - 31.12.2015	Cardinal

2.3.2.4 Coding Valid Values

Each potential response must be expressed clearly if answering a question requires choosing from one or more predetermined options or response categories. The coding needs to represent and mutually exclude all potential solutions and be transparent, expandable, and consistent. Alphanumeric and numeric codes are applied for this purpose.

Table 3-5: Examples for coding valid values. In these examples the assignment of value and coding is based on the order of values and coding

Objective	Valid values	Possible coding
Standard question	**No, Yes**	0,1
Gender	Male, Female	M, F
Accident cause	scalding, flame, explosion, acid, alkaline solution	1,2,3,4,5

More examples and tips can be found in Jensen U. Guidelines for the management of research data (Leitlinienzum Management von Forschungsdaten). Technical Report. Köln: Gesis - Leibniz Institute for Social Sciences, Social Sciences; 2012 Jul.

2.3.2.5 Specifying Qualitative Missing

In general, it is best to be as specific as you can when describing missing data. If this is ignored, it will be unable to determine, during the examination of the obtained data records, whether a variable was wrongly entered or the missing data was brought on by, for instance:
Insufficient information (respondent is unsure about the solution); Reluctance (respondent refuses to respond)

Unable to collect data because of survey errors (applicable question/answer pair) a test was not administered or a question was not asked; inadequate documentation
All missing values must be encoded to be able to make qualitative claims about them and, consequently, to demonstrate the completeness of the data for statistical analyses and reports.
When coding the qualitative missings, make sure there is uniformity and take into account the possible ranges of values. The Guidelines for research data management [German, original title: LeitlinienzurForschungsdatenmanagement] offer a wealth of advice and real-world examples (as demonstrated in Jensen U. (Leitlinienzum Management von Forschungsdaten). Technical Report, July 2012, Gesis - Leibniz Institute for Social Sciences, Köln.

For missings outside of the permitted value ranges, use codes: Use negative codes for missings or the highest numeric codes that can be presented outside of the allowed value ranges (for example, 99977 for not asked, 99978 for no answer provided, etc). (e. g. -1, -2, etc.).
Another option is to base the coding of qualitative missings on samples from the FHIR Project. [Online]; 2014 [cited 2015 2 24]. Value Set for Codes in HL7 Null-flavors. Online at: http://hl7.org/implement/standards/fhir/null-flavor.html. Open Clinica 6.
ii. Null-Value Codierung in Open Clinica.. Available from: Glossary.html#nullValues at community.openclinica.com/OpenClinica/3.0.

2.3.2.6 Checking Dependency

The relationship between two variables, as well as the consequent condition, must be made explicit if one variable can only be gathered if the other has a particular value.

Table 3-6: Examples for dependencies of variables

Variable A	Variable B	Dependencies
frm1_accident_cause_11 (accident cause: other)	frm1_accident_description (description of accident‘s context)	Only when "other" was chosen as the accident cause must a description of the accident's context be provided.
frm1_krea_mgdl (creatinine value in mg/dl)	frm1_krea_umoll (creatinine value in µmol/l)	Creatinine cannot be entered at the same time in both mg/dl and mol/l units.
frm1_admission_date (admission date)	frm1_discharge_date (discharge date from hospital)	The date of discharge must coincide with, or be later than, the date of admission.

Examples of gender-specific problems include Men can "skip" the questionnaire's equivalent questions that ask about pregnancy if they want not to respond to them. Jump variables are used in the Data Dictionary to identify these leaps. Jump variables make it possible to consider and support during data collection the needs of the later analysis, quality control, and plausibility check.

2.3.2.7 Identifying Calculable Values

Automatic computations of variables, including the body mass index (BMI), which is a number generated from a person's height and weight, can lessen the workload of the survey and the irregularities that result from human calculation errors. However, bad calculations can progressively degrade the data's quality. Therefore, it is still necessary to verify and examine the data that has been submitted.
Determine calculable values: You can specify the formulas required based on the dependencies between variables.
The data collection for a study should only contain the variables required to address the study's or registry's research topic. These necessary variables make up the minimal data set (core data elements).
If additional variables are collected, mandatory and optional data within the study's data set should be distinguished clearly. By using optional variables, one runs the risk of entering data incorrectly, which could cause issues with later data analyses.

2.3.2.8 Best Practices in Data Gathering

The GEP states that when characterising variables and their properties, national and international standards should be utilised, where applicable. As a result, data from research and registries are supported in terms of quality and comparability. References for classifying variables and their features as well as describing information can be found in well-known classification standards.

Even with careful planning and preparation, the definition of variables necessitates extensive communication between all parties involved regarding the necessity and appropriateness of the variables, ranges of values, data types, and dependencies. Emerging obscurities and issues should be recorded, communicated, and resolved in collaboration with all involved parties during the development of the Data Dictionary to reduce the additional costs, which were already mentioned resulting from belated changes and adaptations of the Data Dictionary.

A question should not include multiple choice responses, such as asking you to list several accident causes. These responses, which are frequently kept in the database as concatenated data components (typically separated by commas), make it more difficult to analyse the data and lower the quality of the information acquired. Adapt the query as appropriate. A variable should always have a single value to examine data correctly. If additional variables are required, use frm1 accidentcause1, frm1 accidentcause2, etc., and enter whether the variable is "true" or "false" for each answer option.

A question should not include multiple choice responses, such as asking you to list several accident causes. These responses, which are frequently kept in the database as concatenated data

components (typically separated by commas), make it more difficult to analyse the data and lower the quality of the information acquired. Adapt the query as appropriate. A variable should always have a single value to examine data correctly. If further variables are required, use frm1 accidentcause1, frm1 accidentcause2, etc., and enter whether the variable is "true" or "false" for each answer choice.

The data dictionary is a dynamic resource that requires ongoing upkeep.

If using erwin, users should use Report Designer to create the data dictionary from their data model.

For more on data naming, consult the CMS Data Naming Quick Reference Guide3.

For information on data definition, consult the CMS Data Definition Quick Reference Guide4.

1 Refer to the CMS Data Description Guidelines webpage to download the Data Dictionary Template.

2 Refer to the CMS Data Description Guidelines webpage to download the Data Dictionary Template.

3 For additional data naming guidance, refer to the CMS Data Naming Quick Reference Guide.

4 For additional data definition guidance, refer to the CMS Data Definition Quick Reference Guide.

2.4 Summary

You learned what a data dictionary is through the discussion in this unit. You have already encountered material that is comparable to that found in data dictionaries, such as how to define variable names, identify data types and elements, and identify value ranges. In this course, you also learned about coding valid values, how to describe qualitative missing data, how to check for dependencies, how to identify calculable values, and recommended practices for data collection.

2.5 Glossary

Data element: A basic unit of information that has a unique meaning and subcategories (data items) of distinct value. Examples of data elements include gender, race, and geographic location.

Data dictionary: a set of information describing the contents, format, and structure of a database and the relationship between its elements, used to control access to and manipulation of the database.

Data directory: This is a document that identifies the master source of specific data along with replicas of that data in the distributed database environment.

2.6 **Self-Assessment Exercises**

- ✓ Describe the data element domain
- ✓ Describe the best practices for data gathering.

2.7. Possible Answer to the Assessment exercises

1. Data element domain are:

- ➢ The data element's individual identification number is used in technical papers.
- ➢ Data Element Name: A name for the data element that is universally recognized.
- ➢ Data Element Field Names: The names given to this data element in database schemas and computer programs.
- ➢ Data Element Definition: An explanation of the data element's significance.
- ➢ Scientific or another unit of measurement that relates to the data value is the data element's unit of measurement.

2. The best practices for data gathering are:

References for classifying variables and their features as well as describing information can be found in well-known classification standards.

Emerging obscurities and issues should be recorded, communicated, and resolved in collaboration with all involved parties during the development of the Data Dictionary to reduce the additional costs, which were already mentioned resulting from belated changes and adaptations of the Data Dictionary.

A question should not include multiple choice responses, such as asking you to list several accident causes. These responses, which are frequently kept in the database as concatenated data components (typically separated by commas), make it more difficult to analyse the data and lower the quality of the information acquired. Adapt the query as appropriate.

A variable should always have a single value to examine data correctly.

2.8 References/Further Reading

Guidelines and Recommendations to assure good epidemiologic practice (GEP) (2008). Retrieved from http://dgepi.de/fileadmin/pdf/GEP_LL_english_f.pdf.

Jensen U. (2012). Guidelines for the management of research data (Leitlinienzum Management von Forschungsdaten). Technical Report. Köln: Gesis - Leibniz Institute for Social Sciences, Social Sciences.

FHIR Project. (2014). Value Set for Codes in HL7 Null-flavors. [Online].; 2014 [cited 2015 2 24]. Available from: http://hl7.org/implement/standards/fhir/null-flavor.html.

Open Clinica. Null-Value Codierung in Open Clinica. [Online]. Retrieved from: https://community.openclinica.com/OpenClinica/3.0/doc/glossary.html#nullValues

Unit 3: **Data Context Diagram and Data Flow Diagram**

UNIT STRUCTURE

Please, follow the outline above in presenting the main content.

3.1 INTRODUCTION

A system context diagram in engineering is a diagram that defines the boundary between the system, or part of a system, and its environment, showing the entities that interact with it. This diagram is a high-level view of a system. It is similar to a block diagram. This unit will introduce you to context diagram and data flow diagram. about a context diagram defines the boundary between the system, or a part of a system, and its environment, showing the entities that interact with it. A data flow diagram on the other hand, represents the flow of data through a process.It provides information on outputs and inputs of each entity and the process.We will discuss the benefits, limitations and context diagram and data flow diagram in the information system. Similarly, the unit will expose you to the comparison between context and flow diagrams, it will give an example of context diagrams and discuss the tips that can enable the creation of a context diagram.

3. 2 INTENDED LEARNING OUTCOMES (ILOs)

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

- ✓ Describe the concept of context diagram,
- ✓ Describe the elements of a context diagram
- ✓ Discuss the benefits of a context diagram
- ✓ Explain the limitations of the context diagram.
- ✓ Compare the context diagram and data flow diagram.
- ✓ Give examples of the context diagram
- ✓ Explain how to create a context diagram.
- ✓ Discuss the tips on making an ideal context diagram

3.3.Data Context Diagram

The highest level in a Data Flow Diagram is the context diagram, commonly known as the Level O Data Flow Diagram. Business analysts frequently utilise this tool to comprehend the specifics and limitations of the system that needs to be created for a project. It draws attention to the information flow between the system and outside elements. A high-level view of a system is provided by a context diagram. An entity's scope, boundaries, and relationship to other elements like stakeholders are all outlined in this simple sketch. An overview of a process is given by a context diagram, which emphasises the interaction of the process with external factors rather than its internal sub-processes. The latter is frequently used for more sophisticated data flow diagrams.

Context bubbles are initially drawn in the chart's centre to form the context diagram. A conceptual border that encloses a collection of connected processes and project activities is frequently depicted as a circle. Since a context diagram only provides a high-level picture of the system, the intricate details of its internal structure are hidden. Information concealing is the action of doing something. A project's requirements document includes a context diagram. The Context diagram is not intended for use by engineers or technicians, but rather by the project stakeholders. Therefore, it should be written in plain and understandable language so that when stakeholders analyse it, they can quickly understand the items.

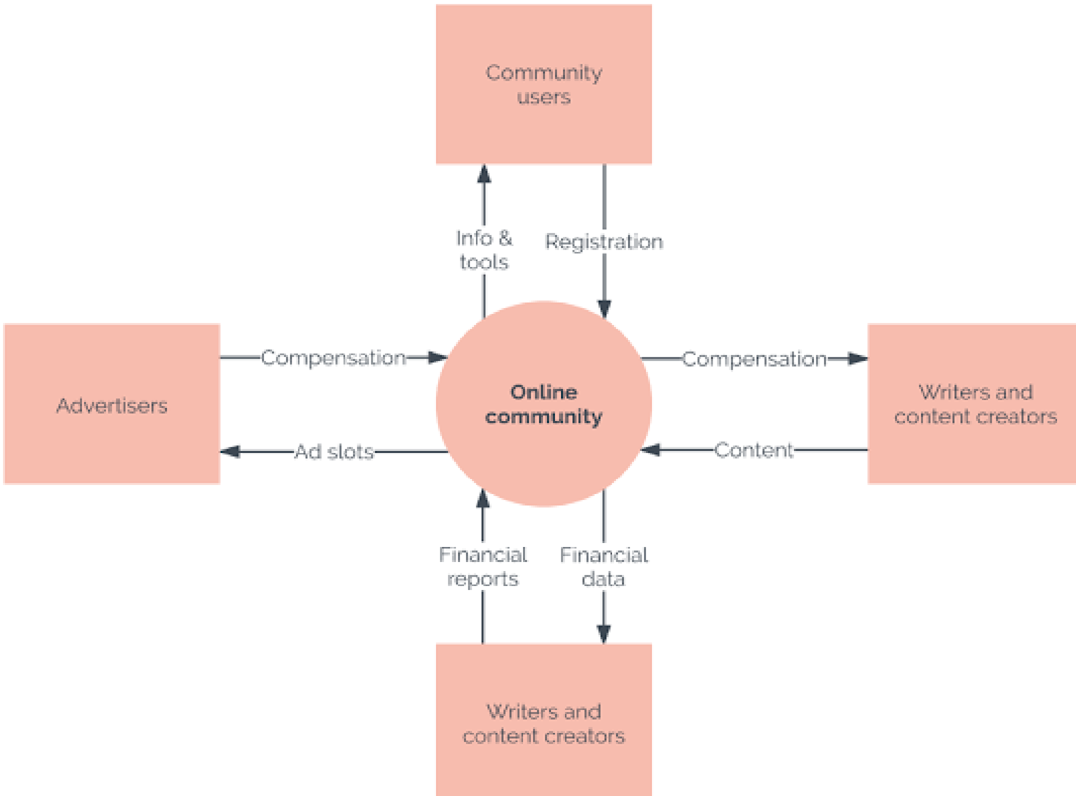


Fig. 3-3: A Context diagram (Source: Edrasoft, 2022).

3.3.1.1. Elements of Context Diagram

A context diagram comprises three key elements:

i. P**roduct**: The endeavour, system, or thing that has to be defined. It is represented by a circle that contains everything under its control (such as processes, job positions, and responsibilities). Circle diagrams are essentially the norm for displaying subjects as components of a whole.

ii. **External entities or agents:** The individuals, groups, and entities that are external to the product but have some sort of interaction with it (i.e., decision-makers, suppliers, customers). Squares or rectangles are used to illustrate them.

iii. **Flow lines, third**: These show the exact ways that external entities interact with the product and are represented by arrows. To indicate the precise sort of data being transmitted or the activity being taken, the arrows are frequently accompanied by text.

3. **3.1.2 Use of Context Diagram**

Of great importance to project stakeholders, the **system context diagram** draws all attention to external factors and events to consider in designing a whole set of a system's restrictions and requirements. It is essential at the beginning of a project to help decipher the project domain you are investigating.

A system context diagram represents all the external components that may interact with the system, hence displaying the entire software system as a unit. This type of chart puts the system in the middle and surrounds it with its external parts, associated entities, and surroundings. Details of the interior structure of the system are explicitly left out.

Also, a **context diagram** can be used to reduce risks in a project greatly. Since they are mostly useful for the business partners in a project, they are very keen to spot high-level design bloopers that would have otherwise cost them a plan. Hence reviewing a **context diagram** is useful in setting the project's budget correctly.

3.3.1.3 Benefits of a Context Diagram

There are many benefits associated with the context diagram. These include but are not limited to:

i. A context diagram focuses on the exterior elements that must be considered when developing the internal architecture of a project or product.
ii. It is particularly beneficial when proponents are first beginning to interpret the landscape they are dealing with during the planning phase. At this stage, a context diagram can make sure that the systems created are pertinent to the project's needs and constraints, thereby minimising any risks.
iii. In addition, context diagrams are less complicated and easier to grasp than most complex schematics, which call for some technical expertise. It's a great tool for team members to receive important information and for helping them understand projects better.
iv. Context diagrams are a great way to encourage brainstorming among individuals who create and evaluate them.
v. A context diagram can be used to highlight errors and omissions in a business strategy or set of project requirements. Thus, you can limit project risks by making the necessary modifications and adjustments before the project's implementation.
vi. It also creates a clear and concise outline of the project's scope.
vii. It improves the discovery and validation of early events that launch the entire project's processes, such as initial sub-process requirements, external components,

inputs into and outputs from the project process, and inputs to and outputs from the project process.

viii. A context diagram is simple to modify and, if necessary, can be enlarged to multiple layers to display new information that has recently come to light.

ix. There are no restrictions on the shapes and symbols that can be used when making a system context diagram: you can use rectangles, ovals, stick figures, drawings, or other shapes to help convey a system's overall structure rapidly.

x. Context diagrams assist clarify which user groups the development team views as its customers by depicting the application's downstream user groups and systems. The choice of project to invest in is made simpler for project sponsors.

xi. It is not necessary to have technical expertise or knowledge to comprehend a context diagram.

Other benefits that can be added are summarised:

1. Increased data calibre
2. Reliable data utilisation;
3. Better data documentation and control;
4. Quicker and simpler data analysis
5. Simpler programming
6. Greater confidence in data integrity
7. Enhanced effectiveness.

3. 3.1.4 Limitations of Context Diagrams

The use of a context diagram has various drawbacks.
System context diagrams are unable to provide information regarding the order or timing of project processes.
They take a long time to make errors and fix them.
System context diagrams often do not show data sources, external communications, alternate situations, or anything else that is not part of the main function or system. Diagrams of data flow make up for it. Workflows and actors that initiate data flows are readily apparent in these flowcharts. With actors, they depict the entire course of the production. Contrarily, context diagrams are limited to showing only the current process.

3. 3.1.5 Context Diagram vs. Data Flow Diagram

There are certain similarities and differences between the context diagram and the flow diagram. These are trashed out in Table 3-7.

Table 3-7: Similarities and Differences between Context Diagram and Flow Diagram

Similarities	
Both can be used to analyse a system that already exists as well as design a fresh one. Both explain the four parts of a system external items, processes, data stores, and data flow—using a common set of symbols and shapes.	
They show information on the same data flow, demonstrating processes that can be improved.	
Differences	
Context Diagram	**Data Flow Diagram**
The processes are business activities	The techniques include computer programs, manual processes, and information processing techniques.
Datastores are collections of information.	Databases, electronic files, and paper files make up the data stores.
It models a new set of activities and functions.	It models a new system of implementation.
It captures the current and necessary activities required for a process.	It shows the necessary databases, hardware, and software.
It acts as a communication tool for non-technical staff members engaged in business operations.	It offers instructions on how to direct the project process to the technical team working on the system.

3. 3.1.6 Context Diagram Examples

The system context diagram is used in most libraries and information centres because it is simple to create and interpret. For illustration:
The elements of a computerised system that distributes and maintains information about book borrowing are shown in Fig. 1. By enabling them to update their loans and making it available on their circulation desk, it helps circulation librarians manage their sales and online book lending activity. These include both physical and online borrowing.
Example 1: See Fig. 3-4

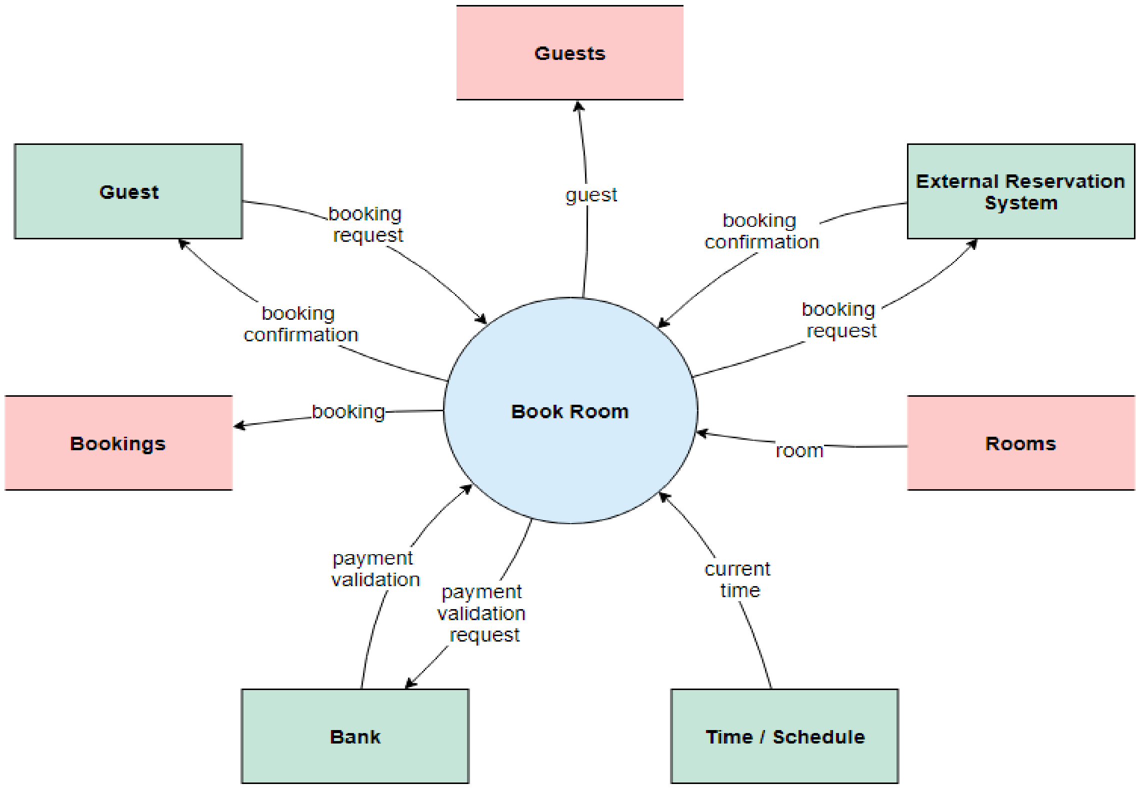


Fig. 3-4: Example of a System Context Diagram (Source: Edrasoft, 2022).

Example 2:

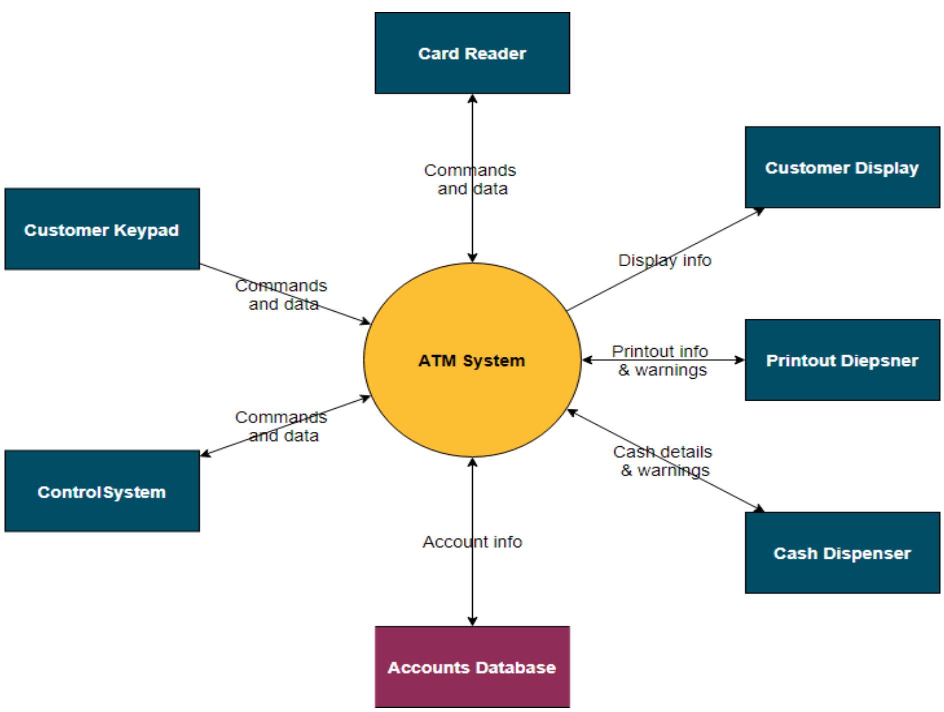


Fig. 3: Example of a Context Diagram (Source: Edrasoft, 2022).

3. 3.1.7 How to Create a Context Diagram

Here, you'll learn how to create a Context diagram on your own using the great program EdrawMax. You can utilise it online and save a lot of storage space by doing it directly from the app's website. To create a context diagram, you must make sure that:

- Read the narrative. If not, you might need to write one.
- You should highlight the activities and external and internal entities in the narrative.
- Create a table with the identified entities and activities and systematically assign numbers to each one.
- Draw attention to the table's data flow.
- Draw the bubble chart.
- Locate and delete any error routines from the table.
- Arrange the following parts chronologically.

Following the procedures below, group the activities into the relevant process bubbles before beginning to construct the system context diagram.

Step 1: Access the software's website, register, confirm and log in. To open a painting canvas, tap on the Home icon and select the + page.
Step 2: Select the proper category by clicking Open Libraries. To get a sense of what you need to draw, it is advisable to use the templates in System Context Diagram Templates.
Step 3: Drag the appropriate shapes onto the canvas to build the context diagram. Double-click the form to enter data into it. Select the shape, and then use the control handles to change its size, location, or orientation.
Step 4: Tap the Connector symbol to connect the shapes. Connectors come in four different flavours. A connector can add text by double-clicking it and writing a description.
Step 5: When you are satisfied with the diagram you have generated, click the File menu and choose the Export and Send option. Tap on Save after selecting the format and location where the layout will be saved.

3. 3.1.8 Tips on Making an Ideal Context Diagram

This section provides you with a sheet to ensure that you develop a unique context diagram.

- In the centre of the canvas, begin drawing the diagram.
- Only include those outside the system that are directly connected when listing external entities.
- Describe how the exterior components fit together as a unit to form a system. Discuss the important interactions with the system and the kind of information the group will require from it.
- Display the relationship by drawing a line connecting the unit and the system. An arrow on each track indicates the direction in which the details are to flow. Notably, data can only flow in one direction. Do the same for all nearby external entities.

- Make use of a digital design tool, such as Venngage, to quickly create a context diagram. Venngage has a sizable collection of expertly created templates with helpful features for quick personalisation.
- You can subtly change the features of your diagram to highlight crucial information or just to make the complete system representation more visually appealing. You may easily alter your symbols' colours, line weights, and typefaces using Venngage's drag-and-drop interface.
- If this is your first time creating a context diagram, it would be best to start by sketching one out on paper. You can use this as a general guide as you subsequently use your computer to produce high-quality designs.
- If at all possible, include important project stakeholders and subject-matter experts in your diagram-creation session. The procedure will be more fruitful and efficient the more brains there are.
- Make sure all the pertinent entities are displayed in your diagram. Before approving it, give it a thorough examination and, if feasible, ask colleagues to confirm its veracity.
- Lastly, write your labels and explanations in simple language. By doing this, you can be certain that your data will be understood by the team and stakeholders.

Self-Assessment Exercises

- What do you understand by context diagram?
- Explain the elements of a context diagram
- What are the benefits of a context diagram?
- Identify the limitations of the context diagram

3.5 Summary

The discussed context diagram's advantages and disadvantages have been considered. The unit also discussed the similarities and differences between context and flow diagrams, provided examples of context diagrams, and defined guidelines for creating context diagrams. Visit https://edrawmax.online to study more at your leisure right now.

3.6 Glossary

System context diagram draws all attention to external factors and events to consider in designing a whole set of a system’s restrictions and requirements.

Context diagram: A context diagram outlines how external entities interact with an internal software system. It's primarily used to help businesses wrap their heads around the scope of a system. As a result, they can figure out how best to design a new system and its requirements or how to improve an existing system.

3.7 Self-Assessment Exercises

- ✓ Compare the context diagram and data flow diagram
- ✓ Describe with examples, the context diagram
- ✓ Describe how to create a context diagram
- ✓ What are the tips for creating an ideal context diagram?

3.8 References, Further Reading and Web Sources

Regenstrief Institute, Inc. LOINC.org. [Online].; 2015 [cited 2015 4 12]. Available from: https://loinc.org/

Institut für MedizinischeInformatik, Statistik und Epidemiologie (IMISE). Nationales Metadata Repository. [Online].; 2015 [cited 2015 4 12]. Available from: https://mdr.imise.uni-leipzig.de/

Boslaugh S. (2004).An Intermediate guide to SPSS programming: Using syntax for data management. 1st ed.: place ????SAGE Publications.

3.9 Possible Answers to Self-Assessment Exercises

- What do you understand by context diagram?
  A system context diagram represents all the external components that may interact with the system, hence displaying the entire software system as a unit. This type of chart puts the system in the middle and surrounds it with its external parts, associated entities, and surroundings. Details of the interior structure of the system are explicitly left out. Also, **a** context diagram can be used to reduce risks in a project greatly. Since they are mostly useful for the business partners in a project, they are very keen to spot high-level design bloopers that would have otherwise cost them a plan.

- Explain the elements of a context diagram?
  Product:
  External entities or agents:
  Flow lines, third:

- What are the benefits of a context diagram?

  There are many benefits of context diagram. Parts of it are:
  1. Increased data calibre
  2. Reliable data utilisation;
  3. Better data documentation and control;
  4. Quicker and simpler data analysis
  5. Simpler programming

6. Greater confidence in data integrity
7. Enhanced effectiveness.

- Identify the limitations of the context diagram?

Module 4: Design and Modelling of Information System and Approach to System Implementation

Unit 1: Design and Modelling of Information System
Unit 2: Strategic approaches to System Implementation
Unit 3: Challenges of System Implementation

UNIT 1: Design and Modelling of Information System

UNIT STRUCTURE

1.1 INTRODUCTION

This unit will introduce you to the concepts of system modelling. This will give you a better understanding of what the concept is all about. You'll also learn about the types of system modelling, modelling design, procurement and construction, asset management and software.

1.2 INTENDED LEARNING OUTCOMES

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

- ✓ Describe system modelling,
- ✓ Explain the types of system modelling,
- ✓ Discuss the modelling design, procurement and construction, asset management and software.

1.3 The Concept of System Modelling

The benefits and drawbacks of the context diagram under discussion have been considered. The unit also provided examples of context diagrams, outlined guidelines for creating context diagrams, and discussed the similarities and differences between context and flow diagrams. Visit https://edrawmax.online right now to learn more at your convenience.

Digitally modelling is a complicated connected system is known as system information modelling or SIM. A system's shared information resource, or system information model, serves as a solid foundation for knowledge throughout the system's life cycle. Simulating an intricately interconnected system is a process known as system information modelling (SIM). Digital representations of interconnected systems, such as power and communication systems, are called system information models. The SIM's simulated objects and the physical system's objects are one-to-one. As they would be in the actual world, components, connections, and functions are defined and linked.

The interdisciplinary study of the use of models to envision and build systems in IT development is known as systems modelling or system modelling.

1.3.1 Types of System Modelling

Function modelling using methods like the Functional Flow Block Diagram is a typical sort of systems modelling. Functional decomposition can be used to expand these models, and they can be connected to requirement models for further system division.

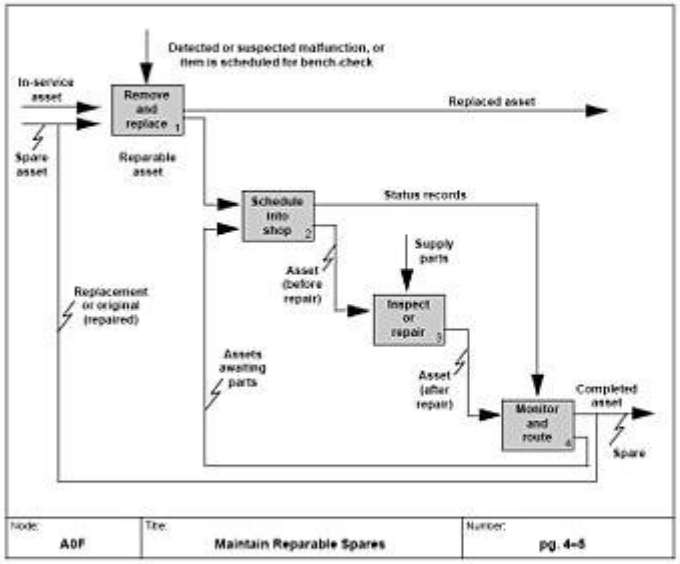
A different kind of systems modelling from functional modelling is architectural modelling, which employs the systems architecture to conceptually describe a system's structure, behaviour, and other aspects.

It is possible to classify the Business Process Modelling Notation (BPMN), a graphical notation for describing business processes in a workflow, as systems modelling language.

Different scopes and scales of complexity are represented for systems in IT development, such as:

Functional Model: An organised representation of the functions (activities, actions, processes, and operations) inside the modelled system or subject area is known as a functional model.

Your discussion on types of system modelling appears disjointed to me. Every paragraph is standalone – no connection to the previous or the ideas after it. I have pointed out this before, your discussions are difficult to understand. Most often, the ideas do not connect. They are not simplified for ODL students to catch up with.



This diagram is not labelled and no source is provided.

A function model (Fig 4-1) is a graphical representation of an enterprise's function within a specific scope, akin to an activity or process model. The functions and processes are described, information needs are discovered, opportunities are found, and a foundation for pricing products and services is established using the function model.

System architecture is a conceptual framework that describes a system's structure and other aspects. An architecture description is a formal description and representation of a system that is set up to facilitate analysis of its structures and behaviours.

A system architecture can comprise designed subsystems and components that cooperate in implementing the system. There have been attempts to codify system architectural description languages, collectively referred to as architecture description languages.

Libraries and other organisations can define systems architecture in a variety of ways, such as:

- The principles guide a system's design and growth, as manifested in the components of the system, their interactions with one another and the environment, and their basic organisational structure.
- An allocated arrangement of physical elements that provide the design solution for a consumer product or life-cycle process is intended to satisfy the functional architecture requirements and the requirements baseline.
- A representation of a system, including a mapping of functionality onto hardware and software components, a mapping of the software architecture onto the hardware, and human interaction with these components.
- The most significant, widespread, top-level strategic innovations, decisions, and related justifications about the overall structure (i.e., the fundamental components and their interactions), as well as related traits and behaviour, are collectively referred to as architecture.

- An explanation of a computer system's layout and components. If it is documented, it may contain details like a thorough list of the hardware, software, and networking capabilities that are now available; a description of long-term objectives and priorities for future acquisitions; and a strategy for updating and/or replacing out-of-date gear and software.
- A formal description of a system or a comprehensive component-level plan of the system to direct implementation.
- The structure of components, their interrelationships, and the principles and guidelines controlling their design and evolution across time.
- The composite of product design architectures and their life-cycle processes.
- A system architecture can be viewed as a collection of representations of a current (or upcoming) system. These representations start off describing a broad, high-level functional organisation and then gradually get more specific and concrete.
- System architecture communicates the informational content of the components that make up a system, the connections between those components, and the rules that control those connections.
- Hardware, software, documentation, facilities, manual procedures, or roles played by organisations or individuals are just a few examples of the architectural components and relationships between them that can be described in an architecture description.

1.3.2 Design

When using a SIM, design and documentation can be done simultaneously. As an EICS's design develops, a SIM can be produced. Modellers and draftsmen are no longer needed. All physical equipment and the accompanying connections that must be built can be modelled in a relational database when a SIM is used to build a connected system. Type and location attributes are used to categorise components. The 'Type' element is used to specify the functions of the equipment. The physical location of equipment is described via the 'Location' element. "Connectors" are models for the connections between pieces of equipment. Each item may be given an attribute, such as a device module, standards, or vendor documentation, to help with the design.

A read-only copy of the model is created after the design phase is finished, exported, and made available to other project team members. Following their various degrees of authorisation, the users can access all or some of the design information included within the SIM. It is possible to create and attach to the model private user data.

1.3.3 Procurement and Construction

A SIM, a digital realisation of the design, can be sent to various parties, including the procurement team and construction contractors once the design is accepted for construction. Digital information management makes it unnecessary to use paper drawings for information management. A construction timeline and procurement plan can be made for any individual object in the SIM. With established weighting criteria, construction activities can be assigned to objects or work packs. This enables the managers to track the development of the procurement and construction down to the level of the individual object and to take defensible actions.

1.3.4 Asset management

Asset managers benefit most from SIMs since they allow data to be stored in a single digital model. The asset owner is often given paper drawings in the form of "A Built Drawings" in a traditional CAD environment. These drawings, in principle, represent the actual building of each system, component, and link of a project. The "As Built" drawings must be used whenever an asset manager wants to maintain, repair, or improve any asset component. However, it takes a lot of time and effort to recover the information from various designs. Any inaccuracy or omission in the drawings could make it more difficult to understand the design.

A 1:1 mapping can be done when engineering is done using a SIM and recorded in a digital format. The SIM allows for the definition and scheduling of operations, including testing, calibration, inspection, repair, minor change, and isolation. To adhere to the owners' asset management strategy, the SIM data can also be easily exported and entered into other third-party asset management applications. The SIM can also serve as a training tool that operators can frequently use to help them become familiar with the design.

1.3.5 Software

Digital Asset Delivery (DAD), a commercial proprietary software program, was created using the idea of System Information Modelling (SIM). DAD's first release, which was largely a modelling tool used to build and record the information system, came out in 1997. DAD has been tested and used on numerous projects since it was created, including but not limited to Greenfield and Brownfield, power, control, and ICT systems. To support complex and quickly evolving information system projects, the DAD software has been regularly updated and maintained. Version 13 of DAD is the most recent. DAD offers several tools to capture the complexity of modern systems, such as:

LAYERS (e.g. Assembly (Physical): How is it built? Control (Functional): How does it work? etc.),

RELATIONSHIPS - links between components on different layers

GROUPS - components and connectors with common features.

In close collaboration with its partner application Activity Exchange, DAD enables users to define, organise, track, and exchange work that needs to be done on any project by leveraging the power of the digital model. Each unique record of work can be finished and added to the digital model for historical continuity and future use. All human interactions with system components, including design review, procurement, construction, commissioning, and maintenance, are managed in real-time through Activity Exchange.

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1.4 **Summary**

You gained an understanding of system modelling ideas from the discussion in this unit. Now that you know what the idea is all about, you can better understand it. Additionally, you have learned about various kinds of software, asset management, modelling design, procurement, and construction. You can now reread the entire unit to refresh your memory.

1.5. Glossary

Digital Asset Delivery (DAD), a commercial proprietary software program, was created using the idea of System Information Modelling (SIM). DAD's first release, which was largely a modelling tool used to build and record the information system, came out in 1997.

Asset Management: Asset management is the practice of increasing total wealth over time by acquiring, maintaining, and trading investments that have the potential to grow in value. Asset management professionals perform this service for others.

Digitally modelling: digital modelling is a complicated connected system is known as system information modelling or SIM. A system's shared information resource, or system information model, serves as a solid foundation for knowledge throughout the system's life cycle.

1.6 **Tutor-Marked Assignments (SAEs) move to the appropriate place**

- ✓ Describe system modelling,
- ✓ Explain the types of system modelling,
- ✓ Discuss the modelling design, procurement and construction, asset management and software.

1.7 Possible Answers to Self-Assessment Exercises

Digitally modelling is a complicated connected system is known as system information modelling or SIM. A system's shared information resource, or system information model, serves as a solid foundation for knowledge throughout the system's life cycle.

Types of System Modelling

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1.8 References, Further Reading and Web Sources

Bálint Molnár, AndrásBenczúr, &AndrásBéleczki (2016). Formal approach to modelling of modern information systems. *International Journal of Information Systems and Project Management*, 4(4), 69-89.

Molnár, B. & Benczúr, A. (2013). Facet of modelling Web Information Systems from a document-centric View. *International Journal of Web Portals (IJWP),* 5(4), 57-70.

Yang, J., Ginige, A., Mayr, H. C., &Kutsche, R.-D. (Eds.). (2009). Information Systems: Modeling, Development, and Integration. *Lecture Notes in Business Information Processing.* doi:10.1007/978-3-642-01112-2.

UNIT 2: Strategic approaches to System Implementation

UNIT STRUCTURE

2.1 INTRODUCTION

This unit will introduce you to information system implementation strategy. This will give you a better understanding of how information systems can be implemented. In this unit, you will also learn the key aspects of information system implementation strategy, system implementation methodologies, and system deployment strategies.

2. 2. INTENDED LEARNING OUTCOMES (ILOs)

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

- ✓ Explain the information implementation strategy,
- ✓ Describe the aspects of information system implementation strategies,
- ✓ Identify the implementation methodologies, and
- ✓ Explain the system deployment strategies.

2.3.1 System Implementation Strategy

Understanding essential definitions and concepts can better understand the strategy and approach for implementing information systems. A company plans and manages a system application's deployment through the information system implementation strategy. Implementation strategies deal with defining and organising the mapping of the library procedures to a system. Industry best practices serve as the fundamental inspiration for information system strategies, which can be modified to meet the demands of a company. The methodology for implementing information systems is where the business declares its strategic decisions regarding how to carry out the implementation and chooses a targeted route for system deployment.

Establishing how an information system should be constructed (i.e., physical system design), ensuring that the information system is operational and used, and ensuring that the information system complies with quality standards is known as systems implementation (i.e., quality assurance).

Building a fully functional system, installing it in an organisation, replacing outdated systems, generating system and user documentation, and instructing users are the goals of system implementation.

The processes, actions, and duties involved in implementing an information system are called system implementation. During the implementation of an information system, the elements, variables, and actions are under control. The distribution of the information system to predetermined recipients is referred to as an information deployment. There is a difference between these concepts: deployment includes distributing information systems based on company business requirements, whereas implementation refers to constructing the structures required for distribution. Sunset is a term used to describe when a legacy system is no longer in use after an information system has been deployed. Information contractors and consultants are knowledgeable information specialists hired for a particular project or service.

These people are typically trained professionals who decide to carry out crucial information system tasks for a client. The business employs the information system contractor according to a working agreement and is made available for a predetermined amount of time in exchange for accomplishing predetermined duties. Cloud computing, a type of Internet-based technology where shared servers give resources, software, and data to computers and other devices on demand, is an emerging breakthrough utilised for information system implementations.

2. 3.2 Key Aspects of Information System Implementation

Executives and stakeholders in the library must make a crucial decision on the implementation plan for the information system. The change plan that assures alignment with the broader organisational objectives and goals is described in the implementation strategy (Al-Mashari&Zairi, 2000). The plan outlines the organisational values and method for carrying out the information implementation. Key considerations for maintaining the strategic focus of the ERP implementation project are shown in Figure 1.

Fig. 4.2: Key Aspect of Information System Implementation (Source: Dunaway (2016).

Each of the aspects in the figure is now explained in detail as follows:

Project Drivers: Project drivers are crucial and frequently overlooked during implementation. Due to various business goals and pressures, the information system's justifications and anticipated advantages may change. Strategic goals must be kept at the centre of the strategy and include clear justifications for implementation for projects to succeed. Setting expectations for the project with stakeholders is essential for management executives. Their responsibility is to see to it that the broad business requirements are developed, and project goals are established. An essential tool for sustaining and completing the ERP implementation process is implementation methodologies that incorporate project management procedures.
Project Resources: Project resources are essential to completing the tasks assigned by the ERP implementation methodology. One of the crucial choices in the implementation process is acquiring the proper resources. The appropriate abilities and expertise are needed to accomplish project objectives, regardless of whether people are internal core subject matter experts or external resources like consultants or contractors. It can be disastrous if the implementation project lacks the necessary resources. The resources for the project assist in identifying risks that might obstruct or delay implementation.
Project Management: The planning, organisation, timing, resourcing, and schedules that determine the start and finish of the implementation are all included in project management. The implementation of project management equips the project team with the framework and oversight necessary to maintain the project's course. Project management plays a crucial part in

implementation. Frequently, competing projects and unforeseen problems can cause the project's implementation to fail. The mechanism for monitoring the implementation and coming up with remedies is provided by project management.

System Functional Modules: A library chooses the system functional modules to implement based on the demands of its operational processes. The objective is to implement an information system solution that will give the library a tactical edge. The functional components of the system should be transparent to all companies and fit the business processes. Real-time data, information movement, and business operations should seamlessly integrate. The most well-known factor influencing a company's decision to install an information system is its integration capabilities.

Existing Platforms, Systems, and Data: The implementation of an information system depends on the platforms, systems, and data already present in a library. The implementation strategy should cover how the legacy system environment will be managed concerning the new information system. Data conversion for usage in the information system, interface development to bridge data from the legacy system, and configuration rule establishment for operational transaction processing are all possible requirements. One of the most challenging obstacles in installing an information system can be the transition from old systems. To ensure a seamless transition and "sunset" systems, meticulous planning, attention to detail, and careful execution are required.

Cost Allocation: One of the most expensive technological projects a company may undertake is the implementation of information systems. The packaged library software, hardware, professional services (consulting, ongoing maintenance, updates, and optimisation), and internal expenditures make up the entire cost of information system ownership. Determining the appropriate budget and funding sources is essential to implement the information system solution. It is important to consider the project's duration and payback periods to calculate the anticipated return on investment.

1. 3.3 System Implementation Activities

Several important actions make up system implementation. Figure 4-3 shows five main activities in this phase: coding, testing, installation, documentation, and training. This phase's goals include documenting the work done, offering assistance to current and future users, and converting the physical system specifications into functional and reliable software and hardware.

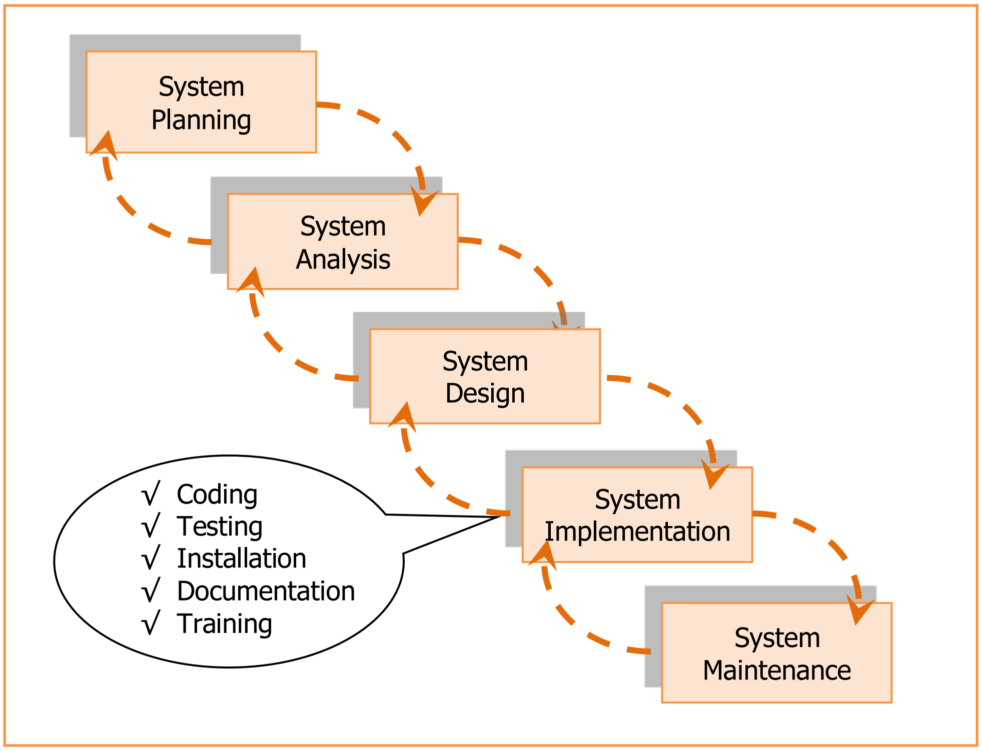

Figure 4-3: Five Activities in the System Implementation Phase

2.3.3.1 CODING

The process of coding is how the programmingteam converts the physical specifications generated in the earlier stages into functional computer codes. Coding is the process of employing software that has already been established to program all the designs created during the earlier phases. Most programmers will be working on their code at this time, seated in front of computers. Each software module will be evaluated individually, then as a component of a bigger program, and finally as the entire system during the coding process. The team should simultaneously release system and user documentation to aid users in using the system.
The coding activity involves many supporting exercises. System analysts, programmers, system designers, and database administrators typically participate in all these processes. These events are scheduled concurrently with other events:

• Network construction and testing
Many times, new or improved systems are built around already-existing networks. If so, just disregard it. But before creating and testing the database, coding, and installing computer programs, it should be implemented if the system's development calls for new or improved networks. Most systems created today are web-based, or at the very least intranet-based.
• Testing and developing databases
Any system must have a database, so to speak. As previously indicated, the database is where we keep all of the data. Since the computer program shares a database, this task must oversee other

programming tasks. This task is needed if the system development calls for a new or improved database.
• Setup and evaluate fresh software
Most system development projects necessitate the organisation to buy or rent new software. Once the prior task is finished, this software should be installed and tested if necessary.
• Setup and evaluate fresh software
Most system development projects necessitate the organisation to buy or rent new software, though not all of them do. Once the prior task is finished, this program should be installed and tested if necessary.

Unit testing

Unit testing is carried out at the individual program or module level. It can also refer to module testing. Unit testing is used to find and minimise execution problems that lead to anomalous program termination and logic errors that would have gone unnoticed during desk checking. Programmers must test individual programs communicating with files and other applications during unit testing. However, a broader group test is required because the modules are there and interact with other modules in the system. We call this integration testing.

System Testing

We must undertake system testing, which covers the complete system after the integration testing is finished. With an integration test, it is comparable. The distinction is that we incorporate programs into systems when we test them. We can presume that the system has been thoroughly tested and is free of any mistakes or bugs once the system testing is finished. Therefore, it is currently prepared for installation in the companies.

2.3.3.3 INSTALLATION

Installation is the transition from the old system to the improved or new system. This also refers to the conversion of an outdated system to a more modern one. At this point, all users must stop relying on the existing system and start relying on the new system. Direct, parallel, single-location and staggered installation are the four methods available. The scope and complexity of the organisations and the system will determine which approaches are used.

Direct Installation

A sudden cut-over installation is another term for direct installation. Direct installation entails turning off the old system and turning on the new one Figure 4-3. The old system will be shut down at this hour on this date, and the new system will take over. This strategy carries a high risk because there might still be significant issues that aren't discovered until the system has been in use. Users will directly be affected by errors caused by the new system, and how they perform their duties will depend on it. If the system cannot be used on that date, there may be a delay while the errors are fixed.

This strategy can be required, for instance, if the system cannot be implemented before a corporate policy takes effect on a certain date. Making sure that the system works well is crucial if the firm intends to employ this strategy because it will make it less hazardous. Even though it's a risky approach, it might lower the installation costs.

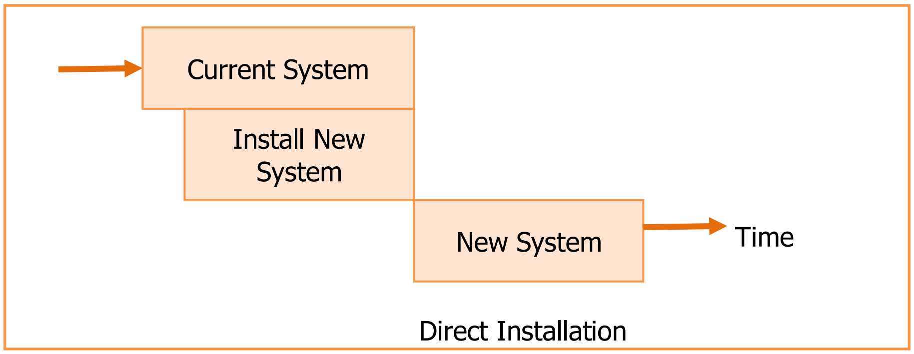

Figure 4-4: Direct Installation

Parallel Installation

As shown in Figure 4-4, a parallel installation occurs when both the old and new systems are running concurrently up until the management decides the old system can be turned off. This strategy is referred to as a riskless strategy because all significant issues are resolved before the old system is shut off. Direct installation is the reverse of this strategy. Despite being risk-free, it came at a considerable expense because the company needed to run two systems concurrently. Running two identical systems simultaneously can be quite expensive, both in terms of maintaining them and paying the salaries of the employees. Users can occasionally become perplexed because of having to deal with two systems.

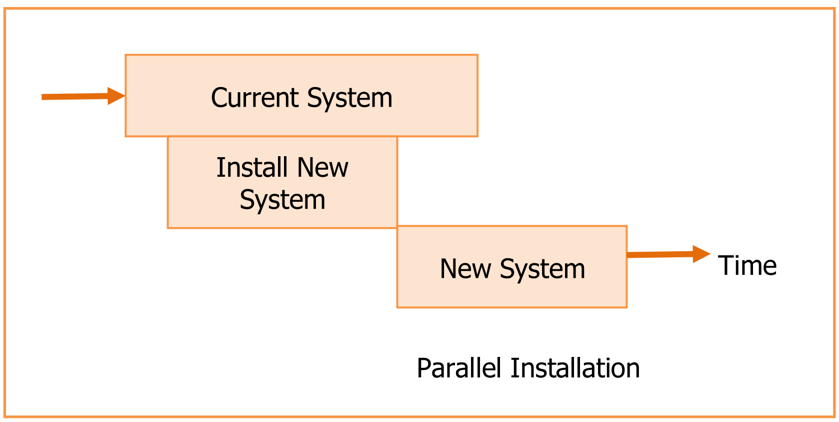

Figure 4-4: Parallel Installation

Single-location Installation

Site or pilot installation are both terms for a single location. This strategy involves the organisation testing out a new system at a single location before deciding how the complete system should be implemented across the organisation, as shown in Figure 4-5. Direct installation or parallel installation are both options for a single-site installation. Compared to direct and parallel installation, it is a moderate strategy. One department or one branch office might be referred to as a single location. The system will be installed at the other place as soon as the first location approves it. Since all the significant issues at the initial test location have been resolved, the installation at another site can be done directly at this point.

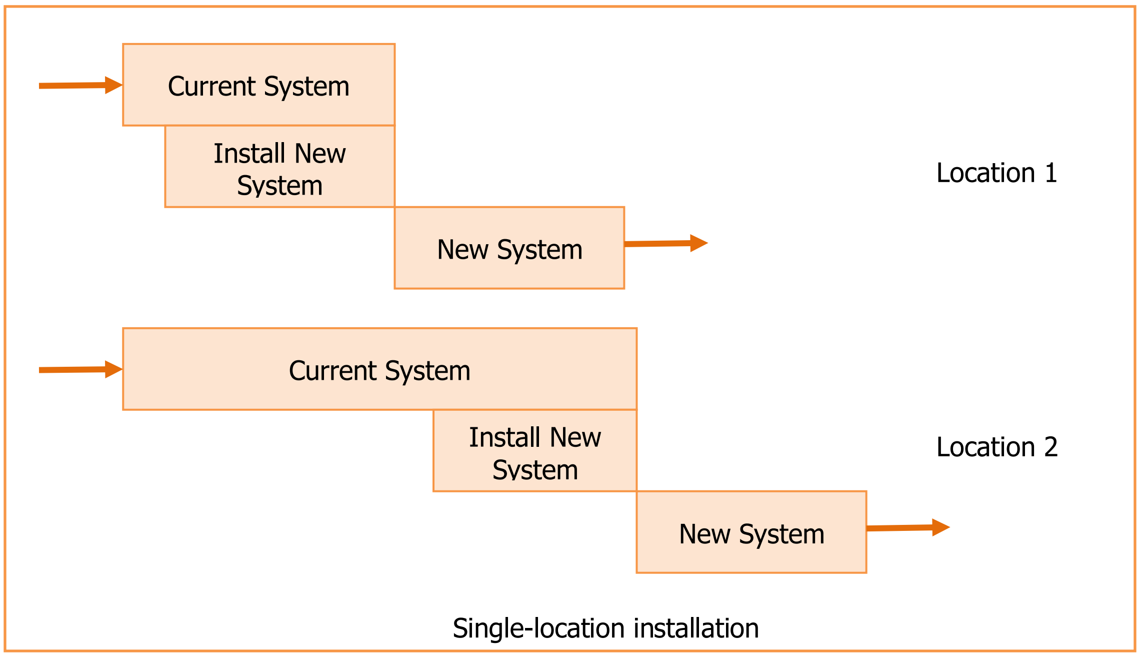

Figure 4-5: Single-location Installation

Phased Installation

Like single-location installation, phase installation (Fig. 4.6) differs in that the new system is installed in functional components. A new system is implemented incrementally, module by module. Up until the installation of the entire system, various modules from the new and old systems are utilised in tandem. Phased installation, like single-location installation, aims to reduce installation-related risk. A phased installation is comparable to rolling out the system in a series of releases. As a result, phased installation necessitates meticulous version control, repeated conversion at each phase, and a lengthy time of change. Users may become frustrated and perplexed as a result.

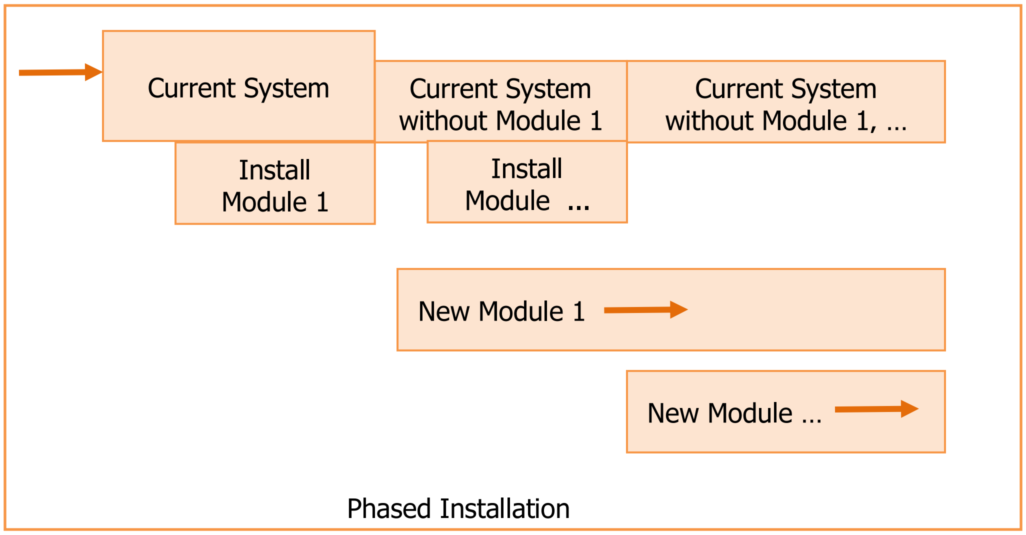

Figure 4-6: Phased installation

Verification testing

Alpha testing is often referred to as verification testing. This testing operates the system with simulated data in a simulated environment. It involves looking for mistakes and omissions in the design standards and end users that were stated in the earlier testing phase.

Validation testing

Beta testing is another name for validation testing. This testing uses actual data to run the system in a real-world setting. This testing included several tests for system performance, peak workload processing performance, and the human engineering test.

- Test methods and processes
- testing for backup and recovery

2.3.3.4 DOCUMENTING THE SYSTEM

Each system development requires a different set of documentation. System documentation and user documentation are the two fundamental categories of documentation.

System Documentation

System design specifications, internal workings, and functionality are all thoroughly documented in the system documentation. For the maintenance person who will be in charge of the system's operation in the future, system documentation is developed. There are two types of system documentation: internal and external.

- Internal paperwork

Internal documentation is either created at compile time or is included in the software source code.

• External references

Data flow and entity-relationship diagrams are two examples of structured diagramming approaches that are used in external documentation, which is a type of system documentation. Although it doesn't cover the code itself, it can give the system documentation's main users helpful information.

User Documentation

As previously said, user documentation is meant for system users, whereas system documentation is meant for programmers who maintain the systems. Written and visual information on the system, including what it does, how it works, and how to use it, make up user documentation. Different kinds of user documentation include:

i. reference manual - contains a comprehensive list of system commands and functions

ii. fast reference guide: short, to-the-point explanations of the most important information about using a system.

iii. User's manual: This resource tells users how to use a computer system to carry out tasks.

2. 3.3.5 TRAINING

It's vital to teach users the new system, even though the documentation is designed to support themthroughout the life of the system. The team typically uses the written materials created to aid them during training sessions. The users of the system must be trained and given documentation that will help them navigate the new system as part of the conversion from the old to the new. Although one-on-one instruction is an option, group instruction is preferred. Group instruction can shorten the duration and cost of the training while also encouraging group participation and system feedback. During the training session, there are a few things to keep in mind. An introduction to the system should be covered in the training session's curriculum, and system manual.

2. 3.4 Information System Implementation Methodologies

Since there is a significant chance of failure and it can be a very expensive process, information organisations must analyse the information system implementation approach. Usually, businesses will implement an information system according to a predetermined approach framework. A technique is used to organise, schedule, and manage the information system implementation process. The information project team may have developed tools, templates, specific deliverables, and artefacts that are included in the methodology. A methodology can be seen as the road map where the actual implementation work starts.

Industry-specific joint ventures, company-driven methodology, information system vendor-led methodologies, or a mix of company-driven and information system vendor-led methodologies may be the most popular implementation techniques. An implementation methodology may be company-driven and rely on internal software processes, or it may be vendor-led and rely on a pre-designed methodology. Regardless of the project type, organisation driven implementation strategies often control all software implementations. In general, the methodology is adaptable and may be changed to meet the requirements of a certain kind of software project. Vendors of information systems have their tested technique that is frequently applied while implementing

information systems for customers. The vendor-led process could also need to be altered or modified somewhat to meet an organisation's implementation needs. The approaches are:
Joint Venture: Joint ventures are cooperative implementation techniques used by comparable businesses in a specific industry. To address economic problems, performance implications, technology, outsourcing, value creation, operations, and many other topics to improve corporate performance, corporations frequently join consortiums with other comparable organisations. By connecting with important industry players, the consortiums serve as a source for benchmarking and best practices that can help with developing a competitive edge and improving client support. Additionally, the interaction exchange makes it easier to share technology implementation methods that are beneficial for information system implementations.

Organisation Driven: The majority of businesses have a department in charge of developing, supporting, and maintaining their software programs. Most businesses have a procedure in place to control the creation, upkeep, and deployment of software applications. The technique is based on goals and specifications given by the firm. An instance of a project that is most likely covered and controlled by these processes is the implementation of an information system. A business typically has standardised procedures that are well known and trustworthy. Nevertheless, when necessary, it is always possible to deviate from the established procedure.

Information System Vendor Led: Many vendors of information systems have created proprietary implementation methodologies. The approach for implementing information systems includes numerous templates, roadmaps, blueprints, and tools. Vendors of information systems like Oracle, SAP, and Microsoft have defined implementation strategies that they use. For instance, the SAP ASAP approach offers an Implementation Assistant that enables a business to select from some different roadmap types and variants to suit implementation needs. Application Implementation Methodology is the name of Oracle's implementation methodology and strategy combined. The methodology is a fundamental framework with many templates to assist with the tasks carried out during ERP implementation.
They can adapt and use their methods in almost any situation. Microsoft has created Sure Step, a methodical implementation strategy for its information system solution. The Sure Step methodology offers thorough instructions on the roles needed to carry out tasks as well as tried-and-true best practices. It includes phases for optimisation and upgrades in addition to the full implementation.

Combined Organisation-Driven and Information System Vendor Led: When the company-driven and information system vendor led are coupled for an implementation, significant information system success can be attained. The finest implementation demands for a company are tailored using the best practices of both types of implementation methodologies. The specific resource roles and their use should be determined if a vendor-led or a combination of vendor-led and company-driven methodology is employed. For the deployment of an information system to be successful, it is crucial to determine how the resources are acquired as well as their roles and duties. The best elements of each methodology are combined by libraries and information vendors to fulfil the project aims. In areas where there may be weaknesses, this combination will create a methodology that captures the strengths.

2.3.5 System Deployment Strategies

Organisations often use a variety of well-known and well-liked implementation tactics, including big bang, phased rollout, parallel adoption, and a combination of phased-rollout and parallel adoption, to choose the optimum way to carry out the implementation. The business goals of a company, the financial limitations, the resources at hand, and the urgency of the situation all play a role in choosing which strategy to implement. Each implementation strategy has advantages and disadvantages, which are thoroughly discussed.

Big-Bang

Big bang, as its name suggests, is a method for implementing all enterprise functions and ERP modules simultaneously as a significant event (Mabert et al., 2003). At a predetermined time and at a scheduled go-live event, the entire organisation switches over to the new system with all users. This may involve a significant implementation spanning several nations, business units, or product lines, and it typically has an impact on the entire company. The new ERP system is launched once the implementation operations have been completed successfully and "lights out" on the old system has been achieved. If possible, at all, going back to the legacy environment becomes quite difficult. In case something goes wrong, you must have backup plans in writing.

Advantages of Big-Bang

All user training is finished before the initial rollout, and the ERP system goes live on schedule, which means that:

- Implementation pain points and challenges become more obvious after going-live;
- Implementation time is shorter;
- Cost may be significantly lower than with a longer, more drawn-out implementation;

Disadvantages of Big-Bang

- Employees are under pressure to learn the new system before the targeted implementation date, which could result in details being missed in the haste to change.
- A failure in one part of the system could have an impact on other parts;
- Falling back to the legacy system may be more difficult than first thought; A noticeable drop in performance after the installation

Mini Big-Bang: Phased-Rollout

The phased rollout approach is another method that emphasises phasing in modules one or two at a time for a slower implementation pace (Mabert et al., 2003). The phased-rollout technique involves rolling out the ERP system gradually through several phases and over extended periods. In a series of predetermined processes, users transition to the new systems. The concept is to let project teams take their time while still carrying out their regular job duties as they plan, map business processes, customise, and test the system. The drawback is that compared to big bang projects, phased projects frequently lack tremendous urgency and focus. Additionally, it might result in "change fatigue," which can make workers burn out.

Projects can be exhausting for employees because they involve ongoing change over extended periods as opposed to being completed quickly. There are, of course, many choices, including numerous iterations and fusions of various implementation strategies. A phased-rollout plan offers benefits and drawbacks, much like the big bang. Below are some of the prevalent viewpoints:

Advantages

- Lessons learned can be applied to subsequently phased rollouts;
- there is ample time for deployment adjustments;
- users have more time to get used to the new system; and
- the project team members' implementation skills have improved.

Disadvantage

The following disadvantages of a staggered rollout versus a big bang implementation:

- Less urgency;
- Continuous change over a longer period;
- Difficulty of fallback to the legacy system;
- Employee change weariness;

This type of roll-out may delay the whole process and bring about complexities during implementation. Generally, interface programs are required to bridge the gap between legacy systems and the new ERP system until the new ERP system becomes fully functional.

Advantages

- Provides the ability to meet the needs of departments
- Step by step approach to implementation
- Less risk
- Change management impact potentially less than with a big bang implementation strategy

Disadvantages

- Longer implementation timeline
- Delayed integration of whole business processes
- This may generate more integration complexities
- The large number of technical resources to create interface programs

Phased Rollout by Activity Priority

Phased Rollout by Business Priority. This approach is similar to the modular approach; the difference is that the main consideration of the business priority phased rollout is the need for urgency. The business priority may turn out to be a modular implementation strategy once the business priority is established.

Once the strategy has been established, important business units are involved in the selection of one or more crucial business processes, and the implementation will eventually develop into a full-fledged information system implementation. Small to mid-sized businesses typically choose this information system installation technique. This kind of approach largely relies on the operational components of the business to determine the order of the rollout's priorities. This method is distinct and tailored to the business environment and information system deployment strategies of each organisation. This kind of implementation requirement may arise for several causes. For instance, a business may have commitments related to company acquisitions, anticipated product or service launch dates, time-sensitive legal requirements, or all of the above.

Advantages

- Closely relates to the objectives of a special library operation
- Possibility of stronger control by the information organisation
- Greater emphasis on the goals of operation process re-engineering

Disadvantages

- May lack sufficient planning if used a reactive strategy
- Increased integration complexities
- Increased risk.

Phased Rollout by Operation Unit

According to this method, staggered deployment occurs within a corporation for one or more business units or divisions at a time. This is another technique that is frequently used by big multinational corporations. The business unit serves as an example of a corporate reporting structure for a legal entity. Operation units can succeed because they frequently have a reasonable amount of autonomy. They are directly accountable to their stakeholders, and have the resources, and the power to staff resources across the entire business unit.

Advantages

- Ability to leverage lessons learned from prior implementation rollouts
- Focus more on entity integration
- Improved employee acceptance
- Limited risk

Disadvantages

- Implementation timeline
- May generate more integration complexities
- Limits the scope of the implementation

Phased- Rollout by Geographical Location

A strategy that is widely used by information organisations with many locations is a phased rollout by region. In the current business world, when companies are more globally distributed, this form of phased roll-out is necessary since some local factors are specific to how operation processes work. For large information organisations with independent sites, this is fairly typical. By bridging the organisational, political, and cultural aspects of information dissemination, this strategy primarily aims to standardise library operations.

Implementations of geographic global information systems are much riskier and more difficult than those of domestic or single-site systems, and they necessitate the simultaneous installation of effective change management procedures. The complexity of the implementation rollouts is further increased by the fact that global rollouts must also consider local reporting and legal requirements that are specific to each country or region.

Parallel -Rollout

The execution of the legacy and new information systems simultaneously is referred to as a parallel adoption. While using the legacy system, users learn the new one. Due to the largely avoided issues with data integrity and migration, many information system vendors favour this approach. By using this approach, the adage "Garbage In, Garbage Out" is challenged. Since each transaction needs to be entered into both the legacy and new systems. This method is not the most effective.

Combination Rollout

A mix of both strategies is created by combining parallel adoption with a gradual deployment. Even while a particular strategy may be effective for most businesses, it might not be the greatest strategy for that particular business. The suitability of the implementation approach is determined by the circumstances. A phased rollout might not always be the most effective or efficient deployment strategy. Nevertheless, the implementation can be modified to match the information system's scope and objectives.

Pilot Rollout

A certain functional area is implemented first in the pilot implementation. The idea is to rank the functional areas and implement them starting with those that will be most helpful. The method calls for more thorough planning and administration to cope with the data flow and interfaces between the old and newly developed module(s). Although it is one of the solutions with the lowest risk, its rollout takes the longest.

1. 5.Summary

In conclusion, you have studied the information system implementation strategy from the discussion in this unit. Additionally, you learnt how to implement an information system. The major components of information system implementation strategy, system implementation methodology, and system deployment strategies have been established in this unit.

2.6 Glossary

Project Drivers: Project drivers are crucial and frequently overlooked during implementation. Due to various business goals and pressures, the information system's justifications and anticipated advantages may change.

Project Resources: Project resources are essential to completing the tasks assigned by the ERP implementation methodology. One of the crucial choices in the implementation process is acquiring the proper resources.

Project Management: The planning, organisation, timing, resourcing, and schedules that determine the start and finish of the implementation are all included in project management. The implementation of project management equips the project team with the framework and oversight necessary to maintain the project's course.

Coding: The process of coding is how the programmingteam converts the physical specifications generated in the earlier stages into functional computer codes. Coding is the process of employing software that has already been established to program all the designs created during the earlier phases.

Self-Assessment Exercises

- ✓ What is the strategy for information implementation?
- ✓ Describe the key aspect of system implementation strategy.

2.7 References, Further Reading and Web Sources

Phase 4 (2013). System implementation lesson 12 https://www.mediu.edu.my › uploads › 2013/03

O'Reily (2022).Chapter 12 moving into implementation.
https://www.oreilly.com/library/view/system-analysis-and/9781118057629/22_chap12.html

2.8 Possible Answers to Self-Assessment Exercises

- ✓ What is the strategy for information implementation?

Joint Venture:
Organisation Driven:
Information System Vendor Led:
Combined Organisation-Driven and Information System Vendor Led:

- ✓ Describe the key aspects of system implementation strategies.

Project Drivers
Project Resources:
Project Management:
System FunctionalModules:
Existing Platforms, Systems, and Data:
Cost Allocation:

Unit 3: Challenges of System Implementation

UNIT STRUCTURE

3.1 INTRODUCTION

This unit will introduce you to the challenges of implementing information system. You'll also learn the various challenges that have been identified confronting system implementation of information system including management challenges, human challenges, technical challenges, environmental challenges, and time challenges.

3.2 INTENDED LEARNING OUTCOMES (ILOs)

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

- ✓ List the challenges confronting the implementation of information systems.
- ✓ Discuss each of the challenges confronting information system implementation.

3.3 The Challenges of Information System Implementation

When information system is implemented, many problems could arise. Every stage of the development of the information system has these issues. They influence how information systems are planned, designed, and put into place in businesses. Most of the difficulties encountered during the information system development phase also arise throughout the implementation phase. These difficulties include a lack of resources, poor project management techniques, poor communication, and user support. Some of these difficulties, though, are more relevant during the implementation phase.

A. Management Challenges: The information system must offer a method for dealing with various problems and awareness of all information management facets. More than half of respondents, according to researchers, rated the implementation problems as extremely problematic. It means that after the IS strategy plan has been created, top management must be convinced to support the planned system development. Senior management may occasionally fail to grasp the goal or have doubts about the effectiveness of the IS strategies. Therefore, it is advised that executives consider their role in carrying out the strategy before confirming the time and resources needed to create the ISS. The necessity to harmonise management's information systems strategy with business strategy is one of the issues it faces today. They will also be consulted when making important choices like abandoning the old system and implementing the new one. Top managers approve major organisational decisions, and their insistence on using the system for approvals assures that the procedures' creators use it. Change is now a regular part of organisational operations in the modern corporate environment, and a resistant employee might compromise an organisation's growth and operations. The literature has demonstrated that employee resistance to change was the main obstacle most organisations encountered while implementing information systems. The employees' unwillingness to learn new skills or the IT department's opposition to change owing to its connection to a specific product were the causes of the resistance.

B. Human Challenges:

The characteristics of users who would have a significant impact on success while active in the development may differ from those of users who will be involved in the implementation, according to Procaccino et al. (2000). Influence over other users and the capacity to influence change are highly desired traits throughout the system's implementation phase. Human concerns are those that affect every employee in the company. Most reasons why ISS implementation failed were due to human impediments or barriers, such as a lack of funding for user education, difficulty hiring qualified people, and difficulty finding professionals qualified to carry out information technology tasks.

One of the key difficulties in creating an information system is the issue of meeting user expectations. Lack of computer proficiency was also mentioned as a major obstacle to the development of IS. The organisation's employees are lacking in basic computer knowledge. Further defining resistance to change as "employee conduct intended to insulate an individual from the effects of real or perceived change," Ahmed et al. (2006) added this definition. Employees who are fighting change have the capacity to challenge, disrupt, or transform preconceived notions, discourses, and power dynamics. Employees who oppose change are lacking in a powerful corporate identity that supports change. This is made worse by the comfort zone to which many employees have grown accustomed in their day-to-day activities, which results in a lack of readiness to accept new technologies. Users may reject change out of pure aversion to trying something new (O'Brien, 2007).

C. Technical Challenges: Technical systems challenges are problems with the information technologies' hardware and software components. Then there is the communication barrier. Infrastructures (hardware and software) were also mentioned as a factor that hinders the development of IS. It is also difficult to switch from one system to another or upgrade older systems.

D. Environment Challenges: Without the appropriate infrastructure, establishing an information system is doomed to fail. Poor infrastructure is one of the difficulties in implementing information systems in large corporations. For software to be implemented successfully, infrastructure including data centres, networks, and even personal PCs are essential. Before establishing information systems, it is necessary to conduct a technological assessment to ascertain whether the current hardware and software infrastructure can support the new system. The network resources should also be examined to determine whether they are adequate to connect all parties. It is important to buy new hardware and accompanying software early on to avoid having them impede the deployment of the information system.

E. Time Challenges: Lack of accurate time analysis is one problem that makes it difficult to develop information systems. Extending the time for planning or executing the system may result in the cancellation of the entire project because the strategies may need to be revised to meet user needs during that time, which could make the project ineffective. The capacity to deploy the system on schedule and with a minimal amount of risk is one of the problems facing the implementation of the IS strategy that have been covered in literature.

Heeks (2002) investigated the reasons why information system implementations fail completely, partially, or sustainably. This is brought on by design and actuality gaps, the study found. Software created and developed in western nations and used in developing nations has these flaws built right in. It has noted that the designer might as well be automating a fiction. These discrepancies result from the "soft political" reality in poor countries and the logic of operations in industrialised nations. Information about technology, resources, procedures, and goals is provided to the gaps. The discrepancies between the design and real usage will be filled by local improvisations. Numerous research studies have shown additional difficulties with information system installation.

More difficulties were noted in the literature, including organisational politics, unfavourable attitudes toward quality improvement, comfort zones, inadequate end-user training, and rapid technological improvements. The following distinctive difficulties faced by Kenyan State Corporations: complex data conversion, expensive licenses, poor IT literacy levels, necessary adaptations, and security concerns. The problems include introducing new technology, disputes between user departments, inadequate documentation, and unethical behaviour.

3.5 Summary

This unit discussed the challenges that are confronting information systems. The unit identified challenges such as management, human, technical, environmental, and time challenges.

3.6 Glossary:

Management Challenges: The necessity to harmonise management's information systems strategy with business strategy is one of the issues it faces today.

Human Challenges: The characteristics or human concerns are those that affect every employee in the company.

Technical Challenges: Technical systems challenges are problems with the information technologies' hardware and software components.

Time Challenges: Lack of accurate time analysis is one problem that makes it difficult to develop information systems.

3.7 Self-Assessment Exercises (SAEs)

- ✓ Describe the management challenges confronting the implementation of information system
- ✓ Discuss environmental and time challenges as they affect information system implementation.

3.8 References, Further Readings and Web Sources

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3.9 Possible Answers to Self-Assessment Exercises

- ✓ Describe the human challenges confronting the implementation of information system

  Management Challenges: The information system must offer a method for dealing with various problems and awareness of all information management facets. More than half of respondents, according to researchers, rated the implementation problems as extremely problematic. It means that after the IS strategy plan has been created; top management must be convinced to support the planned system development. Senior management may occasionally fail to grasp the goal or have doubts about the effectiveness of the IS strategies. Therefore, it is advised that executives consider their role in carrying out the strategy before confirming the time and resources needed to create the ISS. The necessity to harmonise management's information systems strategy with business strategy is one of the issues it faces today. They will also be consulted when making important choices like abandoning the old system and implementing the new one. Top managers approve major organisational decisions, and their insistence on using the system for approvals assures that the procedures' creators use it. Change is now a regular part of organisational operations in the modern corporate environment, and a resistant employee might compromise an organisation's growth and operations. The literature has demonstrated that employee resistance to change was the main obstacle most organisations encountered while implementing information systems. The employees' unwillingness to learn new skills or the IT department's opposition to change owing to its connection to a specific product was the causes of the resistance.

- ✓ Discuss environmental and time challenges as they affect information system implementation.

  Environment Challenges: Without the appropriate infrastructure, establishing an information system is doomed to fail. Poor infrastructure is one of the difficulties in implementing information systems in large corporations. For software to be implemented successfully, infrastructure including data centres, networks, and even personal PCs are essential. Before establishing information systems, it is necessary to conduct a technological assessment to ascertain whether the current hardware and software infrastructure can support the new system. The network resources should also be examined to determine whether they are adequate to connect all parties. It is important to buy new hardware and accompanying software early on to avoid having them impede the deployment of the information system.

  Time Challenges: Lack of accurate time analysis is one problem that makes it difficult to develop information systems. Extending the time for planning or executing the system may result in the cancellation of the entire project because the strategies may need to be revised to meet user needs during that time, which could make the project ineffective. The capacity to deploy the system on schedule and with a minimal amount of risk is one of the problems facing the implementation of the IS strategy that have been covered in literature.

Module 5: Current Trends in Information System Analysis and Design; Problems-Solving Perspectives

UNIT 1: Information System Analysis and Design

UNIT STRUCTURE

1.0 INTRODUCTION

You will learn about how to analyse and design system.. In this unit we will discuss the different information-gathering methods. In our interaction, we will examine system design, system documentation, system conversion to a new system, post-implementation review, system testing, system maintenance, and the system analysis and design life cycle.

1.2 INTEND LEARNING OUTCOMES (ILOs)

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

- ✓ Explain system analysis and design
- ✓ Explain information system analysis
- ✓ Describe the new system's requirements.
- ✓ Describe the post-implementation review, testing and maintenance of the system.
- ✓ Explain the system analysis and design life cycle.

1.3 Information System Analysis and Design

Developing a new replacement system, typically a computerised system to perform the same functions is known as systems analysis and design. Complex systems projects might take months or even years to complete. Systems Designers or Analysts are the terms used to describe those who work in this field. On this note, the individual who performs both analysis and design will be referred to as a "Systems Analyst" or simply an "Analyst."

Analysts need a variety of talents. To successfully convert user requirements into computer-based systems, they must combine technical proficiency with social and interpersonal abilities, including diplomacy and the capacity to put people at ease. Before transitioning to analysis, analysts frequently begin their careers as computer programmers. Analyst programmers, who combine programming and analysis, are employed by some organisations. Some analysts, however, begin in a functional area like sales or finance and receive training in computing concepts before transitioning to analysis.

The user often provides the Terms of Reference at the start of a systems project. These describe the parameters of the system that will be examined and detail any limitations that the analyst will face. To ensure compatibility with other systems, a new system can, for instance, be required to work on already-existing hardware or impose limitations on file formats. If the system is complicated, a feasibility study may be conducted to determine whether creating a new system and establishing the project's scope is worthwhile.

A systems project can be divided into the following stages:

i. Analysis: After the study's parameters have been established, a thorough investigation is conducted to ascertain the functions of the current system and the specifications for the new one. This will entail interviewing the users of the current system and going over all the related documents.

ii. Design: Specifying a new system is the process of design. This describes the duties to be performed and the input, output, and file storage of the data. A logical design is initially created, defining the tasks to be completed by the new system without attaching them to particular hardware or software. After that, a physical design is created with accurate information regarding the hardware, software, file formats, etc.

iii. Implementation: The transition to the new system and software creation (programming) are both parts of the implementation. This can happen instantly or gradually. Training users on how to utilise the new system is another aspect of implementation.

iv. Testing: Testing involves a system or integration testing to ensure that the programs perform properly together as a whole system and program testing to guarantee that the individual programs operate appropriately in isolation. Both of these sorts of testing are performed by the analyst. Acceptance testing, the last step, is done by the user to make sure the system satisfies the requirements.

v. Maintenance: Once a system is operational, maintenance entails making changes to it. This covers both ad hoc adjustments to address newly found defects and scheduled maintenance to address changing conditions in the organisation (such as the introduction of new product lines) and the external environment (e.g. changes in tax structure).

This section needs to include what is required under a general discussion of information systems analysis and design. Your presentation is a disjointed display of facts related to information systems analysis and design, missing out on the core subject of the topic.

1.3.1. Analysis

The remainder of the systems analysis and design cycle is built on analysis. The analyst studies the current system and starts to form opinions about the future system throughout the analysis phase. The collection and analysis of data regarding the current system is the main task of the analysis phase. The systems analysis and design cycle do not always move forward linearly, with each phase finishing before moving on to the next. It is frequently necessary to return to an earlier stage. if moving on to the following stage would lead to flawed analysis, design, or implementation Due to the strong relationship between the analysis and design phases, it is typical to go back to the analysis phase multiple times before finishing the design phase.

1.3.2. Information Gathering

The present system's end users, who are frequently also potential users of the new system, are the most crucial sources of information. They could include beginners as well as experts. During the analysis and design phases, the data acquired from end users will be essential. Later, the analyst will also speak with programmers, network engineers, and other technical staff members to examine the technical components of the system. The organisation's current paperwork or documents can be a secondary source of information for the analyst. The formal information flow through the current system is represented by documents.

To understand how data flows and is used in the present system, the analyst must gather sample copies of all relevant documents, including input forms, output papers, reports, invoices, etc. The future file design for the new system may benefit from this information. The analyst must document all the data they have acquired appropriately. The majority of organisations have standards that outline the proper procedure. This usually involves using standard forms, like the ones you will encounter in this course.

1.3.3 Information Gathering Techniques

A variety of methods will be used by the analyst to acquire data on the present system. Interviewing, surveys and observation are the three most crucial. An interview is a conversation where the analyst and the end user exchange information. It has a predetermined goal and is pre-planned. Open-ended and closed-ended questions are the two main categories. Open-ended inquiries are unrestrictive and impartial. They encourage interviewees to divulge information while allowing them to respond to questions however they choose. However, this could result in the interviewer being more influenced by the interviewee's responses than by their own. Sometimes irrelevant information is revealed in response to open-ended questions.

Specific and giving the interviewer more control over the interview are closed-ended questions. However, they only get the results they want and prevent interviewees from being frank and providing pertinent information that the interviewer did not foresee. For instance, what portion of the billing system consumes the most time? Making sure that closed-ended questions aren't biased or leading is the interviewer's responsibility. The two categories of questions, primary and secondary can both be open- or closed-ended. Primary Questions focus on a certain subject. Secondary questions come after a primary question and elicit additional information.

i. **Questionnaires**

With the aid of questionnaires, the analyst can gather data from a sizable population that may be dispersed over various sites. Standardised question formats can produce more accurate data than other fact-finding methods, and widespread distribution guarantees that respondents' identities are kept private. This may prompt more sincere reactions. But with questionnaires, the analyst cannot examine the respondents' facial expressions or emotions. Questionnaire completion may not be a top priority for respondents. If no one responds, the respondents may end up being a self-selected group, which may cause issues with the credibility of the data. People can express their thoughts, feelings, and experiences on open-ended questionnaires and investigate a problem.
By offering respondents a limited number of options, closed-ended questions provide respondents with more control. For obtaining factual information, this format is fantastic. It costs money to create and disseminate surveys. The questionnaire's goals must be considered as analysts choose the most practical and understandable structure. Before they are produced and distributed, questionnaires should be tested. The information they can supply should be considered when choosing survey respondents. Analysts must confirm that they have the training and expertise necessary to respond to the questions.

ii. **Observation**

Another method for gathering knowledge is observation, which involves watching how people do various aspects of their employment. The analyst can use it to ascertain what is being done, how it is done, who is doing it, when it is done, how long it takes, where it is being done, and why it is being done. Additionally, participation in employee operations is made possible by observation. The analyst might learn from this hands-on approach that a form is poorly designed or that insufficient time is allotted for a particular procedure. Additionally, the analyst might find more efficient ways to complete a task.

Consistency Checking

The analyst must verify the consistency of data acquired from various sources. To do consistency checks, information should typically come from at least two sources. Any discrepancies must be looked into. Although not unheard of, intentionally giving incorrect information to an analyst is unusual. However, as everyone has a unique set of experiences and recollections, there are frequent discrepancies.

1. 3.5 Documenting the Current System

The analyst must ensure that the system is completely documented once all the data has been gathered. The analyst will need to determine all the key elements of the current system, including data flows, data stores, procedures, subsystems, and sources and destinations for data. There will be one or more data flow diagrams used to record them. What follows is a quick explanation of data flow diagrams. In the Case Study, which makes up the following two sections of these notes, several instances of its use are provided. The present system's procedures must also be described by the analyst.

A few paragraphs of standard English can be used as a simple narrative as one method of doing this. The usage of Structure Diagrams, a graphical technique inspired by structured programming, or Structured English, a stricter version of English that is written similarly to a programming language, are two other techniques. The following section goes into further depth about both methods.

1.4 Requirements of the New System

The analyst will also need to determine the new system's requirements. In general, it will be necessary for the new system to be able to do the same functions as the current system but more effectively. The following section goes into additional depth about this.

1. 5 Design

Two levels of design are necessary; the first level produces a logical design that outlines the functions the new system will perform without tying them to particular hardware or software. After that, a physical design is created with accurate information regarding the hardware, software, file formats, etc. The logical plan will consist of:

Logical Data Flow Diagrams: Outlining the general functions of the new system. These adhere to the same rules as the previously utilised data flow diagrams.

A general narrative outlining the new system's functionality.

The new system operations and data stores are listed in the data dictionary, and the file structure outlines how the data will be organised into relevant files or tables.

1.6 Systems Documentation

The written information that explains how a system operates is known as documentation. It offers explanations of how software functions and the steps users take. Everyone acknowledges the importance of thorough system documentation, but those who should provide it frequently fail. The four key areas where documentation is needed are as follows:

- User documentation: explains how to operate the system and carry out tasks to users. This could be found online or in a manual of procedures. Additionally, the documentation explains to users how to complete data entry screens and source documents, produce reports, and validate output. It ought to correctly represent what users discovered during training.
- Systems documentation: outlines the capabilities of the system. It serves as a communication tool to keep everyone updated on the system's design and offers management a reliable foundation for reviewing and assessing the system's design.
- Software documentation: Outlining the reasoning behind each function of the software helps with system upkeep. This is helpful when the system is up and running and needs updating or upgrading.
- Operations documentation: This provides the knowledge needed for computer operators to change files, disks, etc. It includes diagrams and important details about the system's operational facet.

1.7 Converting to the New System

The conversion procedure entails switching from the existing system to the new system. Conversion can be quite easy if the software is basic and compatible with the existing hardware. However, conversion becomes very complicated if the new system calls for new software, a new database management system, new hardware and system software, new networks, and significant changes to existing procedures.

The following methods of systems conversion are used:

- Direct Conversion: The old system is eliminated and the new one is immediately established. There is no going back to the previous arrangement. When there is no system in place or it is of little utility, this strategy may be adopted even though it is potentially risky.
- Parallel Conversion: Both systems are used concurrently for a predetermined amount of time. Due to the fact that the output from the old system can always be utilised, this provides some protection against the failure of the new system.
- Phased Conversion: the old system is gradually replaced with the new system over a predetermined period. This reduces the dangers of direct conversion and gives consumers time to adapt to changes.
- Pilot Conversion: The new system is initially implemented in a specific branch or area of an organisation. Once any initial issues have been resolved, it is gradually implemented throughout the remainder of the organisation.

1.8 Post-Implementation Review

- Systems factors: effectiveness and efficiency
- Input/output, hardware, and software design components; estimation accuracy; operating timelines; costs and advantages
- Supporting elements: training and resources

1.9 Testing

At least three levels of testing are required for a new system:

- The programmers who created the system typically perform software testing. To guarantee that any program operates correctly, legitimate pieces of data must be processed correctly to create the desired output, while faulty pieces of data must be discarded with a clear error message.
- The systems analyst typically oversees integration testing to make sure all the programs that make up the system function properly, i.e., that the data output from one program may be effectively used as input data to the next. Because of the various ways that program specifications are interpreted, this area is known for revealing issues.
- Users do acceptance testing to make sure the new system satisfies user needs in operational circumstances. A representative sample of persons who will use the new system should be included in the test group. The final opportunity to make modifications before the software goes live is during acceptance testing.
- Test Results Live and fake test data are two different sorts. Each has benefits and drawbacks of its own.
- Live Data: Live test data is information that a company actively uses. Users may be asked to enter data from their typical activities by an analyst. It can be challenging to get enough real-world data to thoroughly test a system. Live data typically has a low proportion of errors; therefore it doesn't test all possible data combinations that could enter the system.
- Artificial Data: Test data that has been produced solely for testing purposes. It can be created to test all conceivable formats and value combinations, along with all potential error scenarios. A test data generator program that tests all the system's logic paths can frequently generate this kind of data.

1.10 Maintaining the System

The life cycle's development phase ends with the implementation of the new system. The system's life cycle is now transitioning towards the maintenance stage. Throughout the system's operational life, maintenance will be needed for both the hardware and the software. To carry out initial maintenance, the data gathered during the post-implementation evaluation is employed. The major sources of requests for maintenance after this will be periodic evaluations and user requests. The workload for maintenance should decrease when the initial maintenance is completed. However, after a few years, the volume of maintenance requests will likely increase, raising the expense and labour requirements.

Types of Systems Maintenance
There are three main types of systems maintenance:
Maintaining Hardware
The cycle starts over and a new system is created when a system starts to cause users serious problems. The expense of maintaining software is rising continuously. According to current estimates, some organisations spend 80% of their system spending on maintenance. In the worst-case scenario, the whole budget could be spent in this area without any new systems being created.

1.11 The Systems Analysis and Design Cycle

The systems analysis and design cycle are often described as being iterative. This is because it is always possible to backtrack to earlier stages and stages can be repeated as often as required until all the objectives of the system have been achieved.

1.12 Summary

Overall, this course has explained systems analysis and design. The many information collection methods, such as how to document the current system and the needs of the new system, were outlined, as well as how to gather information. The unit also included system analysis and design life cycle, system design, system documentation, conversion to the new system, post-implementation review, system testing, and system maintenance. Take a moment to read through the material once more to refresh your memory.

1.13 Glossary

Analysis: It is a thorough investigation is conducted to ascertain the functions of the current system and the specifications for the new one. This will entail interviewing the users of the current system and going over all the related documents.

Design: This describes the duties to be performed and the input, output, and file storage of the data. A logical design is initially created, defining the tasks to be completed by the new system without attaching them to particular hardware or software.

Implementation: The transition to the new system and software creation (programming) are both parts of the implementation. This can happen instantly or gradually. Training users on how to utilise the new system is another aspect of implementation.

Testing: Testing involves a system or integration testing to ensure that the programs perform properly together as a whole system and program testing to guarantee that the individual programs operate appropriately in isolation. Both of these sorts of testing are performed by the analyst. Acceptance testing, the last step, is done by the user to make sure the system satisfies the requirements.

Maintenance: This covers both ad hoc adjustments to address newly found defects and scheduled maintenance to address changing conditions in the organisation (such as the introduction of new product lines) and the external environment (e.g. changes in tax structure).

Information gathering, or data collection: This is a process where you follow a series of steps to conduct research and answer questions or resolve problems you have. Though information gathering isn't bound by cybersecurity, it is an essential skill to have in the field.

Self-Assessment Exercises

- ✓ What is meant by system analysis and design?
- ✓ Describe the various information gathering techniques.
- ✓ Describe the stages involved in

1.3.1. Analysis

The remainder of the systems analysis and design cycle is built on analysis. The analyst studies the current system and starts to form opinions about the future system throughout the analysis phase. The collection and analysis of data regarding the current system is the main task of the analysis phase. The systems analysis and design cycle do not always move forward linearly, with each phase finishing before moving on to the next. It is frequently necessary to return to an earlier stage. if moving on to the following stage would lead to flawed analysis, design, or implementation Due to the strong relationship between the analysis and design phases, it is typical to go back to the analysis phase multiple times before finishing the design phase.

1.3.2. Information Gathering

The present system's end users, who are frequently also potential users of the new system, are the most crucial sources of information. They could include beginners as well as experts. During the analysis and design phases, the data acquired from end users will be essential. Later, the analyst will also speak with programmers, network engineers, and other technical staff members to examine the technical components of the system

The following terms are used in this unit and are listed and defined as follows: These terms should be moved to the Glossary

- **Data** refers to the unstructured "facts" that have been obtained; information refers to data that has had a structure put on it, for as by combining elements into records or ordering them;
- **A system** is a collection of processes that work in concert to complete a certain task. Systems can be computerised or manual.

- A computerised system will undoubtedly contain both hardware and software components, as well as maybe manual components;
- Systems analysis is the process of examining and documenting the performance of an existing system.
- A sub-system is a component portion of a system that performs a clearly defined subtask.
- Systems boundary: the bounds of the system;
- systems design: a breakdown of the system specification into logical and physical components; and systems specification: a full description of the tasks required of a new system.
- Environment: the region with the system boundary;
- Information flow: the pathways by which information travels between sub-systems or between a system and its environment.
- Interface: the connections between the system and its environment or other related systems, such as the link between an order acceptance system and an invoicing system.

1.13 Possible Answer to the Self Assessment Questions

What is meant by system analysis and design?

> Developing a new replacement system, typically a computerised system to perform the same functions is known as systems analysis and design. Complex systems projects might take months or even years to complete. Systems Designers or Analysts are the terms used to describe those who work in this field.

Describe the various information gathering techniques

Questionnaires: With the aid of questionnaires, the analyst can gather data from a sizable population that may be dispersed over various sites. Standardised question formats can produce more accurate data than other fact-finding methods, and widespread distribution guarantees that respondents' identities are kept private. This may prompt more sincere reactions.

Observation: Another method for gathering knowledge is observation, which involves watching how people do various aspects of their employment. The analyst can use it to ascertain what is being done, how it is done, who is doing it, when it is done, how long it takes, where it is being done, and why it is being done. Additionally, participation in employee operations is made possible by observation. The analyst might learn from this hands-on approach that a form is poorly designed or that insufficient time is allotted for a particular procedure. Additionally, the analyst might find more efficient ways to complete a task.

What are the stages involved in system projects?

The stages involved in system projects are:

i. Analysis: After the study's parameters have been established, a thorough investigation is conducted to ascertain the functions of the current system and the specifications for the new one. This will entail interviewing the users of the current system and going over all the related documents.
ii. Design: Specifying a new system is the process of design. This describes the duties to be performed and the input, output, and file storage of the data. A logical design is initially created, defining the tasks to be completed by the new system without attaching them to particular hardware or software. After that, a physical design is created with accurate information regarding the hardware, software, file formats, etc.
iii. Implementation: The transition to the new system and software creation (programming) are both parts of the implementation. This can happen instantly or gradually. Training users on how to utilise the new system is another aspect of implementation.
iv. Testing: Testing involves a system or integration testing to ensure that the programs perform properly together as a whole system and program testing to guarantee that the individual programs operate appropriately in isolation. Both of these sorts of testing are performed by the analyst. Acceptance testing, the last step, is done by the user to make sure the system satisfies the requirements.
v. Maintenance: Once a system is operational, maintenance entails making changes to it. This covers both ad hoc adjustments to address newly found defects and scheduled maintenance to address changing conditions in the organisation (such as the introduction of new product lines) and the external environment (e.g. changes in tax structure).

This section needs to include what is required under a general discussion of information systems analysis and design. Your presentation is a disjointed display of facts related to information systems analysis and design, missing out on the core subject of the topic.

1.14 References, Further Readings and Web Sources

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Unit 2: Current Trends in Information System Analysis

UNIT STRUCTURE

2.0 INTRODUCTION

This unit introduces you to the current trends in information systems analysis. Therefore, we will be examining such trends such as global expansion, social trends, personal trends, the trend in mobile, wearable, printable, findable, cloud computing, big data, blockchain, use of drones, quantum computing, cybersecurity and artificial intelligence, and virtual reality.

2.2 INTENDED LEARNING OUTCOMES (ILOs)

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

- ✓ Describe the current trends in information systems.
- ✓ Identify the events that are associated with information discussed in this unit.
- ✓ Explain the various information systems and the emerging ones.

2.3.1 Current Trends in Information System Analysis

- Since its introduction in the 1950s, information systems have advanced quickly. Today's handheld gadgets are more potent than the computers that helped put a man on the moon in 1969. You now have access to the entire globe, thanks to the Internet, which opens up new possibilities for communication and teamwork. You might get a competitive edge in a future job by implementing some of the information systems/devices you learn about in this lesson when you study trends in information system analysis. No doubt, there has been a great development in the current trends in information system analysis. Some of the trends are examined in the unit.

2.3.1.1 Global Expansion in Information System

The first thing to be aware of is how globalisation is still growing. The use of digital devices is expanding along with the use of the Internet everywhere in the world. The industrialised world continues to have high penetration rates in the percentage of the population that uses the Internet, but other continents are growing. The usage of mobile phones is also expanding globally, in addition to the penetration of the Internet. According to Statista, in 2023, the current number of smartphone users in the world today is 6.92 billion**,** meaning 86.11% of the world's population owns a smartphone**.** This figure is up considerably from 2016, when only 3.668 billion users were 49.40% of that year's global population. In 2023, including both smart and feature phones, the current number of mobile phone users is 7.33 billion**,** which makes 91.21% of people in the world cell phone owners (Statista, 2023).

2.3.1.2 Social Media Use

Another trend that is still growing steadily is social media usage. In 2023, an estimated 4.9 billion people use social media across the world. The number of social media users worldwide has swelled to a record 4.9 billion people globally. What's more, this number is expected to jump to approximately 5.85 billion users by 2027 (Forbes Advisor, 2023).

2.3.1.3 Personal trend

Users of information systems have expected to be able to customise their experiences to suit their preferences ever since the introduction of Web 2.0 and e-commerce. Manufacturers of digital gadgets allow us to customise how we use them, from distinctive desktop backgrounds on computers to bespoke ringtones on smartphones. More recently, businesses like Netflix have started offering personalised viewing recommendations to their customers. In the future, we will start to see devices precisely tailored to our interests based on data gathered about us.

2.3.1.4 Mobile Technology

The development of mobile technology has been one of the most significant trends in digital technologies during the past ten years. The development of mobile technology has been incredibly rapid, starting with the basic telephone in the 1990s and progressing to today's smartphones. Here are a few crucial signs of this trend:

1. 5G Global Adoption: The June 2022 Ericson Mobility Report shows that around 580 million mobile consumers chose 5G subscriptions by the end of 2021. In 2022, the number is expected to hit 1 billion, which by 2027 will be 4.4 billion.
2. Progressive Web Applications: Progressive Web Apps (PWA), also referred to as Hybrid apps, are utilized to build web technologies that are on track to become mobile app future trends.
3. Mobile payments: Payment apps have been around for a while now and as of now the market is strong and diverse, with great solutions coming from banks, operators and independent service providers contributing to its continuous growth.
4. m-Commerce/Mobile Commerce: Mobile commerce was one of the most significant mobile trends in 2022 and will be in 2023. Adhering to the lockdown and social distancing scenario, mobile commerce sales have risen at a surprising rate.
5. Wearables: From smart jewelry (rings, wristbands, watches) to body-mounted sensors and fitness trackers, people use wearables for various purposes. According to Statica, the number of wearables will reach more than 1 billion by the end of 2022. In 2023 the wearables market is set to surpass $54 billion according to Global data.
6. Foldable Devices: Within the categories of digitalization, the employment of foldable devices will remarkably increase between 2023 and 2027. According to Technavio, the size of the market is expected to grow by more than $73 billion.
7. Mobile Virtual Reality: Virtual reality is something creative folks around the world have been trying to tackle for a long time now, with varying results. Enter 2022 and Metaverse. Regardless of how we perceive this project, it surely has left an impact.
8. Mobile Augmented Reality: This is a technology that has already give us some terrific functionalities and truly immersive experiences in mobile apps for e-commerce (isn't fighting 3D models of furniture in your place on camera just neat, lifestyle (this means virtual house decoration, trying new makeup or clothes on camera or insider an app, entertainment and gaming.
9. Beacon Technology: Beacon technology means using small devices (beacons) to communicate with mobile phones and apps in their proximity. Beacons can be used to greet mobile app users of shopping apps in real life locations… and send them some extra offers.
10. Super Apps: Super Apps is a term for large mobile applications that integrate multiple functionalities, thus replacing a number of smaller, separate apps.

As can be seen, the advent of mobile technologies especially 5G will connect majority of people around the world.

2.3.1.5 Wearable

The typical smartphone user checks their device 150 times a day for tasks including social media (13 times), music streaming (22 times), phone calls (22 times), and messaging (23 times) Technology could perform many of these tasks more effectively if they were physically incorporated into our bodies or worn on them. Wearable technology is what it is called.
Technology like hearing aids and later Bluetooth earpieces have been part of wearables for a long time. Smartwatches, body cameras, sports watches, and various fitness monitors are now included in the product lines. The Gartner Group's table below summarises historical and projected sales.

Table 5.1: Wearable Devices Worldwide (millions of units)

Device	**2016**	**2017**	**2018**	**2021**
Smartwatch	34.80	41.50	48.20	80.96
Head-mounted display	16.09	22.01	28.28	67.17
Body-worn camera	0.17	1.05	1.59	5.62
Bluetooth headset	128.50	150.00	168.00	206.00
Wristband	34.97	44.10	48.84	63.86
Sports watch	21.23	21.43	21.65	22.31
Other fitness monitor	55.46	55.7	56.23	58.73
Total	**265.88**	**310.37**	**347.53**	**504.65**

Wearable Devices Actual and Forecast (Source: Gartner Group, August 2021)

2.3.1.6 Mobile

It will become easier than ever to share data for mutual benefit as more people utilise smartphones and wearables. Passively providing some of this information is possible, such as when you report your location to update traffic statistics. Active reporting of other data is possible, such as adding your review of a restaurant to a review website.
The community-based Waze smartphone app keeps track of your path and the speed at which you are approaching your destination. You can have access to the data sent by all the other app users in exchange for sending your data. Based on real-time reports from other users, Waze routes you around traffic and accidents.
Yelp! allowsusers add ratings and reviews of nearby establishments to a database, making that information available to customers via its website or mobile app. Yelp! has grown to be a significant source of business for many businesses since it allows users to search through a list of restaurants, stores, and services while also gathering reviews for each. Unlike data collected

passively, however, Yelp! relies on its users to take the time to provide honest ratings and reviews.

2.3.1.7 Printable

The 3-D printer is one of the most incredible inventions to have been created recently. Virtually any 3-D object may be printed using a 3-D printer if it has a computer-generated model. 3-D printers function by building up the model layer by layer utilising pliable substances like various types of glass, metals, or even wax.
Making product prototypes with 3-D printing is a great way to test a design's viability and marketability. Working prosthetic legs and an ear that can hear beyond and beyond normal hearing have both been produced using 3-D printing. On modern US military aircraft like the F-18, 3-D printed components are now used.

Some amazing trending productions from 3D printers are:

- Buildings. A building-building 3D printing robot was unveiled by MIT researchers in 2017. It has two arms, one big and one small. The little arm sprays various materials, such as concrete and insulation, as the main arm moves around the building's exterior. A dome-shaped building can be built in just 14 hours overall.
- Musical equipment. Metal and plastic are used in 3D printing to create instruments like flutes, fiddles, and acoustic guitars. You can view a violin-making example by clicking here.
- Medical Role Models. To assist clinicians in their education, medical models are being employed in orthopaedics, transplant surgery, and oncology. Surgeons were able to prevent a patient from suffering a cerebral aneurysm by using a brain model that was 3D printed.
- Clothing. How would you want to have precisely fitting clothing? A person is measured using specialised software, and then the apparel is printed using 3D technology using those exact specifications. The result is clothing that fits well and uses fewer resources. Finding materials that wouldn't break was the initial issue. More information regarding 3D printing clothing and footwear is available.
- The "maker" movement has adopted a variety of technology. Simply expressed, the word "Maker" refers to a new group of creators bringing manufacturing out of the traditional industrial environment and into the world of the personal desktop computer by utilising open-source techniques and cutting-edge technology. Until recently, those who owned factories were the only ones who could manufacture. Over the past five years, manufacturing has benefited from the Web's democratising power. You can manufacture today by pressing a button.

2.3.1.8 Findable

The term "Internet of Things" (IoT) refers to gadgets that have been integrated into a range of items, such as jet engines, lightbulbs, toys, appliances, lights, and vehicles, and connected to the Internet via Wi-Fi, Bluetooth, or LTE. IoT is primarily the result of the convergence of three elements: IPv6, a new Internet address system, affordable processors, and wireless communication. These tiny, embedded items (things) can now send and receive data as a result. Remote control devices can turn on or off lights. Thermostats can be reset in the presence of anyone. Another drawback is that your insurance provider may observe and assess how you operate your vehicle.

In recent years, processors have shrunk and grown more affordable, which has increased the number of gadgets that include them. Consider vehicle technical developments. Now, your car may record information on your driving habits, including acceleration and braking. It can even record where you go and which radio stations you listen to. Discounts are available from insurance providers in exchange for permission to observe your driving habits. Additionally, consider the convenience of being promptly advised of predicted traffic delays each time you change your morning commute to work.

You might not typically think of IoT gadgets as being online. Additionally, no human intervention is required for the connection. A fitness band might be an IoT, but a PC is not one. IoT could be "independent," not immediately or continuously depending on human action.
Another word to use would be "interconnected," meaning that IoTs are linked to one another and data servers or data collection points. This connectivity or data uploading is essentially automatic.

Another excellent word to describe IoTs is "ubiquitous." It is reasonable to assume that gadgets connected to the Internet of Things (IoT) are transmitting data regarding circumstances and occurrences that occasionally are not at the forefront of our minds. IoTs are used now to monitor various things, including traffic, air quality, soil moisture, bridge conditions, consumer electronics, autonomous vehicles, and an endless list of other things. How many IoTs exist today might be the first thought that pops into your head.
A study by the Gartner Group that sought to pinpoint the locations of IoTs was published in January 2017. They claimed that more than half of all IoTs arein consumer electronics. Additionally, they highlighted that from 2016 to the anticipated levels for 2017, IoT growth rose by over 30%. What is the position today?

IoT advantages may be seen almost everywhere. This is a brief list:

- Improvement of Procedures: Temperature, humidity, and barometric pressure are just a few of the characteristics that IoTs in manufacturing track. These variables all require adjusting when applying manufacturing formulas.
- Component surveillance: IoTs are integrated into components throughout the manufacturing process, and the performance of each component is subsequently tracked.
- Security systems for homes: IoTs make it easy to monitor activity both inside and outside of your house.

- Intelligent Thermostats: The use of IoTs to remotely manage home thermostats enables homeowners to use resources more effectively.
- Residential Lights: IoTs enable data access at all times and remote control of both interior and outside lighting.
- Prior to installing IoTs in the form of thermostats, security systems, and remote lighting in a home, security risks need to be identified and addressed. Here are a few security issues that demand attention.
- Eavesdropping. Smart speaker systems in homes have been compromised, allowing strangers to overhear conversations taking place inside.
- Smart Watches with Internet access. These tools are occasionally used to keep tabs on where family members' children are. Unfortunately, hackers have been able to go inside, listen in again, and find out where the kids are.
- Careless Owner Use. Smart thermometers, security systems, and other gadgets all come with a default password. Many owners overlook changing the password, giving hackers simple access.

The trending and development in information systems across the world include but are not limited:

2.3.1.9 Cloud Computing

One of the most recent developments in information technology that has had a greater daily impact on organisation growth is cloud computing. According to some, cloud computing consists of a pool of shared resources, such as servers, storage, networks, services, and applications, that may be used by both individuals and organisations on a pay-per-use basis in an economical way. The majority of the time, third-party companies who offer cloud computing services to users on a pay-per-use basis own and operate those services. Customers who use cloud computing benefit greatly from a variety of computer services, such as SaaS (software as a service) Customers are very accustomed to the SaaS model of cloud computing.

The top layer of cloud computing architecture is known as "Software as a Service" and provides customers with full applications via the internet. CRM tools like Salesforce, storage options like Google Drive and Drop Box, and productivity tools like Google Apps are some of the most well-known software as a service (SaaS) application currently used by businesses.

2.1.10 Big Data

In 2018, the importance of big data-related technologies will keep increasing. Digital marketing is currently more common than traditional marketing because of its tremendous return on investment, impact quickness, and measurability. Because many digital marketing campaigns can rely on massive amounts of data to ensure effectiveness and a wider reach, big data is now being applied to big business. Because of this, businesses now depend on data management to guarantee conversions from online connections.

2.3.1.11 Blockchain

Evolution: Since blockchain technology has been advancing quickly over the past several months and still has a ton of promise, it should unquestionably be listed among the top tech trends in the 4IR era. Even though most people only identify blockchain technology with cryptocurrency, it may be successfully used in a wide range of other industries. The development of the industrial blockchain image and its separation from bitcoin and other cryptocurrencies will take up the majority of the year 2019. Most likely, we will see blockchain converge with other technologies like the Internet of Things, machine learning, and fog computing. As a result, more real-world use cases will be presented, increasing the need for blockchain specialists.

2.3.1.12 Use of Drones Technology

Drones are likely to be mentioned in any list of the most recent information technology developments. Since a few years ago, the development and application of drones have given rise to a whole business is known as the UAV (unmanned air vehicle) or UAS (unmanned air systems) industry. It is evolving at an incredible rate. Autonomous aircraft are frequently utilised in farming, military surveillance, accident monitoring, and other fields. Investment in the drone business will rise in the upcoming year. There will be an increase in commercial drone delivery ventures worldwide. To handle drone traffic in the skies, NASA will finish the Unmanned Aerial System Traffic Management (UTM) project.

2.3.1.13 Quantum Computing

You might be surprised to learn that traditional computers perform pretty slowly. According to information technology trends 2019, the newest generation of computers will be quantum computers. They are currently actively growing and will greatly outpace their ancestors. A brand-new method of sending and processing data based on the principles of quantum physics is known as quantum computing. Traditional computers manage information using binary coding (bits). The bit can only be in one of its two fundamental states, zero or one. The qubits used by the quantum computer are based on the superposition principle.

The zero and one basic states of the qubit are also present. Superposition, however, allows it to combine values and exist in all these states simultaneously. The parallelism of quantum computing makes it possible to arrive at the answer quickly without considering all potential system state variations. Additionally, a quantum computing device does not require a lot of computational power or RAM. Imagine that a binary system needs trillions of bits to calculate a system of 100 particles, whereas a qubit system only needs 100 qubits. Applications for quantum computing have already been built, and developers will work to advance and promote their use.

2.3.1.14 Cybersecurity and Artificial Intelligence

Even though cyber security is becoming increasingly crucial to daily life and business, managing it is becoming more and more difficult. Because of the high level of sophistication of exploits, cybersecurity threats are difficult for IT professionals to manage. AI is necessary to improve data analytics and automated scripts because pure automation is no longer sufficient. Humans are anticipated to continue acting, which is why there is a connection to ethics. However, cyberattacks can still be launched against AI. Making Artificial Intelligence/Deep Learning (AI/DL) strategies more resistant to hostile traffic in any application field is necessary to manage and regulate these issues affecting the two technologies. This is anticipated to be used in the nearest future.

2.3.1.15 Virtual Reality

Virtual reality-related technology is gaining popularity. Many businesses are becoming more prepared for diverse conditions before joining them, thanks to virtual reality software. In the upcoming years, the medical field is anticipated to adopt virtual reality for some procedures and patient interactions. Virtual training sessions for businesses can save expenses, meet staffing needs, and improve education.

2.4 Summary

The current trends in information systems have been covered in this unit. Globalisation, social trends, personal trends, mobile, wearable, printable, and findable trends, cloud computing, big data, blockchain, use of drones, quantum computing, cybersecurity, artificial intelligence, and virtual reality are just a few of the information systems trends that have been covered in this unit. It's time to review the information you have read in the unit to refresh your memory.

2.6. Glossary

Cloud Computing: Cloud computing is the on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user. Large clouds often have functions distributed over multiple locations, each of which is a data center.

Big Data: This is refers to as data that contains greater variety, arriving in increasing volumes and with more velocity. This is also known as the three Vs. Put simply, big data is larger, more complex data sets, especially from new data sources.

Blockchain: A blockchain is essentially a digital ledger of transactions that is duplicated and distributed across the entire network of computer systems on the blockchain. A blockchain is a distributed database or ledger shared among a computer network's nodes. They are best known for their crucial role in cryptocurrency systems for maintaining a secure and decentralized record of transactions, but they are not limited to cryptocurrency uses. Blockchains can be used to make data in any industry immutable—the term used to describe the inability to be altered.

Cybersecurity: Cyber security is the practice of defending computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks. It's also known as information technology security or electronic information security.

Virtual Reality: Virtual reality (VR) is a simulated experience that employs pose tracking and 3D near-eye displays to give the user an immersive feel of a virtual world. Virtual reality is a simulated 3D environment that enables users to explore and interact with a virtual surrounding in a way that approximates reality, as it is perceived through the users' senses

2.5 (SAEs) Self-Assessment Exercises (SAEs) move to the appropriate place

- ✓ Identify the various information systems and the newly emerging ones.

2.7 **References, Further Readings and Web Sources.**

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2.8 Possible Answers to self-Assessment Exercises

Identify the various information systems and the newly emerging ones.

New information systems are:
Cloud Computing
Big Data
Blockchain
Evolution
Use of Drones Technology
Quantum Computing
Cybersecurity and Artificial Intelligence
Virtual Reality

Identify the various information systems and the newly emerging ones.

Current Trends in Information System Analysis

Global Expansion in Information System
Social Media Use
Personal trend
Mobile Technology

The development of mobile technology has been incredibly rapid, starting with the basic telephone in the 1990s and progressing to today's smartphones. Here are a few crucial signs of this trend:

1. 5G Global Adoption.
2. Progressive Web Applications
3. Mobile payments.
4. m-Commerce/Mobile Commerce:
5. Wearables: From smart jewelry
6. Foldable Devices.
7. Mobile Virtual Reality:
8. Mobile Augmented Reality.
9. Beacon Technology.

Unit 3: Problem-Solving Perspectives in System Analysis

UNIT STRUCTURE

3.1 INTRODUCTION

This unit will expose you to the problem-solving perspectives in systems analysis. The unit will also inform you of the procedure for solving problems through system analysis.

3.2 INTENDED LEARNING OUTCOMES (ILOs)

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

- ✓ Explain problem-solving.
- ✓ Describe how problem-solving relates to or is applied in system analysis.
- ✓ Describe the various methodologies and models for problem-solving in system analysis.

3.3.1 Problem Solving Perspectives in System Analysis

The systems approach to problem solving uses a systems orientation to define problems and opportunities and develop solutions. Problem solving is the act of defining a problem; determining the cause of the problem; identifying, prioritizing, and selecting alternatives for a solution; and implementing a solution. Studying a problem and formulating a solution involve the following interrelated activities:

i. Recognise and define a problem or opportunity using systems thinking.
ii. Develop and evaluate alternative system solutions.
iii. Select the system solution that best meets your requirements.
iv. Design the selected system solution.
v. Implement and evaluate the success of the designed system.

A system analysis is a technique for locating issues and resolving them that considers each element of the overall system to accomplish objectives. The methodical analysis will reveal what the integrated whole looks like and how it functions. Based on this description of system analysis, the overarching framework of phases will reveal how people, structure, items, tasks, and goals are interdependent. Using time, money, and resources effectively in both work and life can be improved with this information or the decision-making process. A systems analysis includes outlining the steps leading to a particular outcome. Each system will be unique based on the product or service, but the majority will follow a general structure, recognise the human element, and assess the connections among all system stakeholders, including but not limited to policy or decision makers, leaders, employees, customers, recipients, creditors, suppliers, and rivals.

- Specify each user's objectives and duties or jobs within the system. Think about the policies and processes in place as well as the expectations.
- Construct a model that graphically displays the system's dependencies and usage patterns.
- Determine whether the process is effective and meets needs by defining the main pathways that illustrate supply and demand or establish hierarchies of processes that affect people, products, or services. Think about the steps that call for decisions and how those choices affect what comes next.
- Consider the effective actions and those that can benefit from modification to increase functionality. This can entail identifying a problem and tracing the cause backwards.
- Construct a plan and an approach to testing the solution. Feedback will be necessary to establish best practices or create flexibility to examine alternatives.
- Reiterate these processes for a continuous cycle of quality assurance that keeps track of evolving circumstances and takes risk into account.

An effective system analysis depends on objective observation. In a systematic examination, it should be essential to challenge widely held assumptions. Each person will have a perspective formed through interactions with or experiences within the system. Similar to individuals, organisations may have different missions and goals.

The relationships within operations are a starting point to evaluate how users fit into the overall system (Fig 5.1).

Source: Overview of System Analysis & Design by Jawahar Vetter; and Dharminder Kumar (https://www.ddegjust.ac.in/studymaterial/pgdca/ms-04.pdf).

Systems analysis offers actionable data on how each component fits into the whole process, which spans the continuum from conception to deployment of a workable product or service, followed by ongoing operational, maintenance, and support activities.

Anyone preparing to do a systems analysis could feel overpowered by the numerous approaches and models now commonplace in corporate planning. To give a comprehensive system analysis, various models may be helpful alone or in combination. The analyst should first concentrate on what is already known about the system before adding to their understanding by assessing both internal and external elements.

3.4 System Analysis and Methodologies/Models for Problem-Solving

System analysis methodologies and models can be employed to tackle complex societal problems. In particular, critical factors that contribute to enhancing integration are:

3.4.1 Whole system(s) design

A collaborative and integrative strategy called whole system(s) design tries to improve society's reaction to complex issues like sustainability difficulties. It employs educational strategybased on a comprehensive approach to systems research and design practice. Systems thinking provides a foundation for synthesising information, whereas design practice fosters original research and inventive activity. With this strategy, designers decide what systems approach and design tools to use depending on their knowledge of each unique problem circumstance. SSMs like Inquiring Systems Design and Social Systems Design are utilised in whole system(s) design.

This method of systems design advocates using a cooperative, non-impositional approach to the problem situation. Instead, stakeholders should be given more control over how the system runs.

3.4.2 Systems-oriented design

A skill-based system-oriented design (SOD) strategy aims to improve designs, visualisations, and systems practices. This all-encompassing strategy was established in project-based learning to produce a new generation of designers capable of handling increased complexity. To improve the ability of a given socio-technical system to address its function and achieve sustainability, it takes into account various hierarchies and boundaries within the system. As a result, it suggests creating a system that consists of a coherent set of procedures and product-service pairings that work together to carry out the system's intended function.

3.4.3 Product–service systems (PSS)

Most frequently, a PSS is used to describe the fusion of products and services. But across various disciplines, including Operational Research, Information Systems, Systems Engineering, Cyber-Physical Systems, Innovation and Business Management, and Marketing, the basic premise of PSS to provide functions that satisfy human needs through product-service combinations can be found. Although there is disagreement over the PSS's origins in systems science, numerous authors have provided evidence that this methodology is inherently holistic (Mukaze & Velásquez, 2012). A system thinking approach to PSS is essential for academics to conceptualise and understand the system properly. Product Service System has the potential to significantly alter current production and consumption habits to advance socioeconomic development in an environmentally friendly manner. Additionally, PSS can encourage greater system effectiveness in complex societal contexts, resulting in higher levels of well-being at lower costs.

3.4.4 Design for development

New design disciplines have emerged due to resource constraints and the necessity to accommodate growing shifts in the scope of the issues facing the development of society's infrastructure. In the setting of emerging economies, where there are no formal systems in place and few socio-technical networks and infrastructures, applying a systems viewpoint in design may be the most successful and, thus, most necessary (Sklar & Madsen 2010). Design for Development (DfD) is a problem-solving design strategy geared toward marginalised groups. These design strategies support social, human, and economic development. These new approaches acknowledge the need for a societal perspective that considers the design's potential to enhance stakeholders' well-being by satisfying current generations' unmet fundamental needs while fostering sustainable production and consumption for future generations. For instance, some approaches aim to improve social and economic sustainability performance, such as Design for the Base of the Pyramid.

Other strategies, such as the Capability Approach (CA), encourage stakeholders to use their resources (human capabilities) and available problem-solving techniques. Design for Development methodologies have increased knowledge of how designers approach problems. It has been suggested that systems thinking needs to be incorporated into the design, as in methods like Whole System Design (WSD) and PSS, to increase the human potential of marginalised groups using design. According to the systems thinking approach, problem solvers should enable communities to address their pressing issues.

Although, it has been argued that CA ignores questions of power dynamics and concludes that Critical Theory used by Information Systems and Science and Technology Studies can be helpful. Critical theory of technology and Critical research in information systems are its two main strands. Similar to Critical Systems Thinking, these methods seek to expose the social structure of power, control, dominance, and oppression to advance emancipatory social practices.

3.5 Summary

This unit has discussed the problem-solving perspectives in systems analysis. The unit featured and explained the procedure of solving the problem through system analysis. The unit discussed various methodologies and models available for solving the problem in system analysis. In addition, the unit also shed light on some common concepts that enable better understanding of the concepts by the readers.

3.6 Glossary

Problem solving: Problem solving is the act of defining a problem; determining the cause of the problem; identifying, prioritizing, and selecting alternatives for a solution; and implementing a solution.

System analysis: System analysis is conducted for the purpose of studying a system or its parts in order to identify its objectives. It is a problem solving technique that improves the system and ensures that all the components of the system work efficiently to accomplish their purpose. Analysis specifies what the system should do.

System oriented design: Systems-oriented design uses system thinking in order to capture the complexity of systems addressed in design practice. The main mission of S.O.D. is to build the designers' own interpretation and implementation of systems thinking.

(SAEs) move to the appropriate place

- ✓ Define problem-solving.
- ✓ What methodologies and models are available for problem-solving in system analysis?

3.7 References, Further Readings and Web Sources

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3.8 Possible Answers to Self-Assessment Exercises

1. Problem solving is the act of defining a problem; determining the cause of the problem; identifying, prioritizing, and selecting alternatives for a solution; and implementing a solution.

2. The methodologies and models available for problem-solving in system analysis are:

Whole system(s) design

Systems-oriented design
Product–service systems (PSS)
Design for development