UNIT 1 INTRODUCTION TO SAD

Structure **Page No.**

1.0 INTRODUCTION

In general, a System is based on Input-Process-Output (IPO model). Manual work can be replaced by computerized system for accuracy and speed of processing. So, before the development of any computerized system, developers should also understand all basic concepts about the system. To develop a system, a standard Methodology must be considered. Different approaches are available for the development of a system. Selecting the best approach is the responsibility of systems analyst and this selection is based on the requirements of end user, problem definition and the infrastructure provided. Standard principles should be followed for the development of good quality software.

1.1 OBJECTIVES

After going through this unit, you should be able to:

- learn the concepts related to Systems;
- know about Real Time Systems;
- know about Distributed Systems; and
- learn the process of developing a successful system.

1.2 FUNDAMENTALS OF SYSTEMS

System is a word derived from the Greek word ‘Systema’ which means an organized relationship among components.

A System may be defined as orderly grouping of interdependent components linked together according to a plan to achieve a specific goal. Each component is a part of total system and it has to do its own share of work for the system to achieve the desired goal.

An **Information system** is an arrangement of people, data, processes, information presentation and information technology that interacts to support and improve day-to-

day operations in a business as well as support the problem solving and decision making needs of management and users.

The characteristics of a System are as follows:

- **Organization** implies structure and order. It is an arrangement of components that helps to achieve objectives.
- **Interaction** refers to the procedure in which each component functions with other components of the system.
- **Interdependence** means that one component of the system depends on another component.
- **Integration** is concerned with how a system is tied together. It is more than sharing a physical part. It means that parts of system work together within the system even though each part performs a unique function.
- **Central Objective** is quite common that an organization may set one objective and operate to achieve another. The important point is that the users must be aware about the central objective well in advance.

1.2.1 Important Terms Related to Systems

Purpose, Boundary, Environment, Inputs, and Outputs are some important terms related to Systems.

- A System's **purpose** is the reason for its existence and the reference point for measuring its success.
- A System's **boundary** defines what is inside the system and what is outside.
- A System **Environment** is everything pertinent to the System that is outside of its boundaries.
- A System's **Inputs** are the physical objects and information that cross the boundary to enter it from its environment.
- A system's **Outputs** are the physical objects and information that go from the system into its environment.

1.2.2 Classification of Systems

Systems may be classified as follows:

a) Formal or Informal
b) Physical or Abstract
c) Open or Closed
d) Manual or Automated.

a) A **Formal System** is one that is planned in advance and is used according to schedule. In this system policies and procedures are documented well in advance. A real life example is to conduct a scheduled meeting at the end of every month in which agenda of the meeting has already been defined well in advance.
An **Informal System** is the system that is not described by procedures. It is not used.

According to a schedule. It works on as need basis. For example, Sales order processing system through telephone calls.

b) **Physical Systems** are tangible entities that may be static or dynamic.
Computer Systems, Vehicles, Buildings etc. are examples of physical systems.
Abstract systems are conceptual entities.

Example: Company

c) **Open System** is a system within its environment. It receives input from environment and provides output to environment**.**
Example: Any real life system, Information System, Organization etc.

Closed System: It is isolated from environment influences. It operates on factors within the System itself. It is also defined as a System that includes a feedback loop, a control element and feedback performance standard.

Figure1.1 shows a Closed loop system. *Performance Standard* is defined as objective that the System has to meet. A *Feedback loop* is defined as a portion of the System that enables the System to regulate itself. Signals are obtained from the System describing the System Status and are transmitted to the Control Mechanism. A *Control Element* compares the output with the performance standard and adjusts the system input accordingly.

Figure 1.1: Closed loop system(refer to Fig 1.1 in unit-1-pg-1.jpg)

d) **Manual and Automated systems**: The system, which does not require human intervention is called Automated system. In this system, the whole process is automatic.

Example: Traffic control system for metropolitan cities.

The system, which requires human intervention, is called a **Manual System**. Example: Face to face information centre at places like Railway stations etc.

1.2.3 Real Life Business Subsystems

A Subsystem is a component of a System, even though it can also be considered as a system in its own right. Consider a manufacturing firm. It consists of five subsystems namely, Product design, Production, Sales, Delivery and Service. .

The boundary is between the firm and its environment. In this system, all the subsystems work together to achieve a goal.

1.3 REAL TIME SYSTEMS

A real time system describes an interactive processing system with severe time limitations. A real time system is used when there are rigid time requirements on the flow of data. A real time System is considered to function correctly only if it returns the correct result within imposed time constraints. There are two types of Real Time systems. They are :

- **Hard Real Time Systems** which guarantee that critical tasks are completed on time.
- **Soft Real Time Systems which** are less restrictive type of real time systems where a critical real time task gets priority over other tasks, and retains the priority until it completes them. Systems that control scientific experiments, medical imaging systems, industrial control systems and some display systems are real time systems.

Check Your Progress 1

Select the appropriate choice given under each question.

1. _____ are comprehensive, multiple-step approaches to system development that will guide your work and influence the quality of your final product.

   a) Techniques
   b) Tools
   c) Methodologies
   d) Data flows.

2. The person in an organization who has the primary responsibility for systems analysis and design is _____.

   a) The end user
   b) The systems analyst
   c) The internal auditor
   d) Business manager.

3. An overall strategy to information systems development that focuses on the ideal organization data, rather than where and how data are used best defines the ____.

   a) Process-oriented approach
   b) Data-organization approach
   c) Data-oriented approach
   d) Information-oriented approach.

4. Which of the following is not a true statement concerning the differences between the process-oriented and data-oriented approaches to systems development?

   a) The process oriented approach has limited design stability
   b) Much uncontrolled data duplication exists with the data oriented approach
   c) The data oriented approach designs data files for the enterprise
   d) None of the above.

5. Non-information system professionals in an organization who specify the business requirements and who use software applications are called:

   a) Programmers
   b) Network managers
   c) Code designers
   d) End users.

6. Which of the following is not one of the four classes of information systems?

   a) Transaction processing systems
   b) Decision support systems
   c) Expert systems
   d) Production systems.

1.4 DISTRIBUTED SYSTEMS

A Distributed System in which the Data, Process, and Interface component of information System are distributed to multiple locations in a computer network. Accordingly, the processing workload required to support these components is also distributed across multiple computers on the network. In this system, each processor has its own local memory. The processors communicate with one another through various communication lines, such as high buses or telephone lines. The processors in a distributed system may vary in size and function. They may include small

microprocessors, workstations, minicomputers, and large general-purpose computer systems. The implementation of a distributed system is complicated and difficult, but still is in demand. Some of the reasons are that modern businesses are already distributed. So, they need distributed solutions. In general, solutions developed using a distributed systems paradigm are user-friendlier. They have the following advantages:

- Resource sharing
- Computation speedup
- Reliability
- Communication.

The five Layers of Distributed System architecture are:

- **Presentation Layer** is the actual user interface. The inputs are received by this layer and the outputs are presented by this layer.
- **Presentation Logic layer** includes processing required to establish user interface. Example: Editing input data, formatting output data.
- **Application Logic Layer** includes all the logic and processing required to support the actual business application and rules
  Example: Calculations.
- **Data Manipulation Layer** includes all the command and logic required to store and retrieve data to and from the database.
- **Data Layer** is actual stored data in the database.

Check Your Progress 2

1. Define the following terms:

   - Information system
   - Strategic information
   - Tactical information
   - Operational information
   - Repository

2. What is the difference between information requirements determination and specification?
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   ……

3. What are the characteristics of a good information system?
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1.5 DEVELOPMENT OF A SUCCESSFUL SYSTEM

The success of any system depends on the approach of building it. If the development approach is right, the system will work successfully. Figure 1.2 depicts a System Development Life Cycle. System development life cycle (SDLC) is a standard methodology for the development of Information System. It mainly consists of four phases: System Analysis, System Design, System Construction & Implementation and System Support. Every phase consist of inputs, tasks and outputs. Traditional SDLC was strictly sequential. The developers first complete the previous phase then start the

next phase. But now concept of Repository is introduced in SDLC and it is known as FAST methodology where work is done across shared repository. It means that all the inputs and outputs of phases must be stored in the repository. At any time developers can backtrack to previous phase and they can also work on two phases simultaneously.

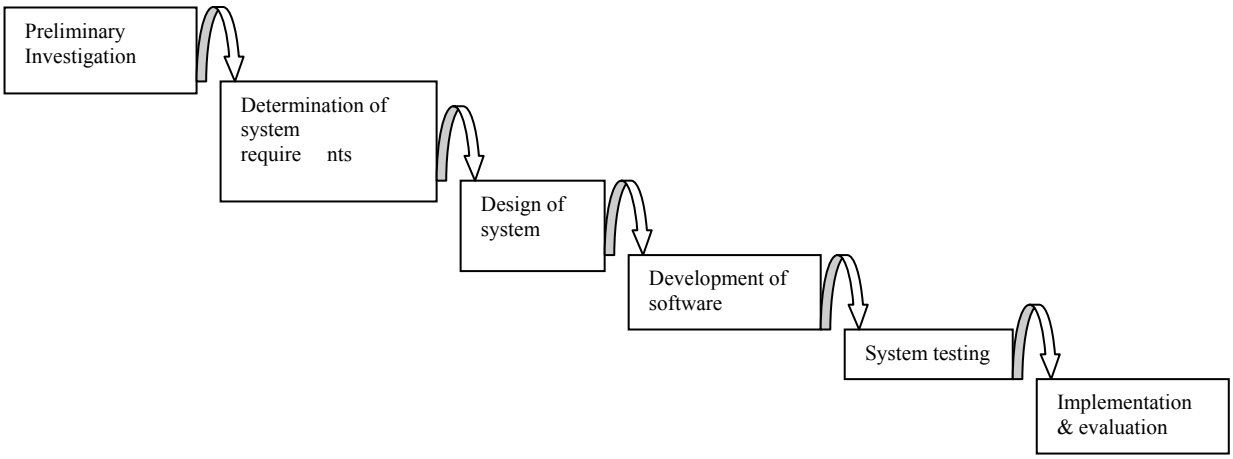

Figure 1.2: System Development Life Cycle

For making a successful system, the following principles should be followed:

(1) Both customers and developers should be involved for accuracy in the information.

(2) A problem solving approach should be adopted. The classic problem solving approach is as follows:

a) Study, understand the problem and its context
b) Define the requirements of a solution
c) Identify candidate solutions and select the best solution
d) Design and implement the solution
e) Observe and evaluate the solution's impact and refine the solution accordingly.

(3) Phases and activities should be established.

(4) For consistent development of a system, some standards should be established.

These standards are:

Documentation standards: It should be an ongoing activity during the system development life cycle.

Quality Standards: Checks should be established at every phase for ensuring that the output of every phase meets the business and technology expectations.

Automated Tool standards: Hardware and software platforms should be finalized for the development of Information system. Automated tool standards prescribe technology that will be used to develop and maintain information systems and to ensure consistency, completeness, and quality.

(5) Development of information system should be considered as capital investment: The developer of an information system should think about several solutions of a particular problem and every solution should be evaluated for cost-effectiveness and risk management. *Cost-effectiveness* is defined as the result obtained by striking a balance between the cost of developing and operating an

information system and the benefits derived from that system. Risk management is defined as the process of identifying, evaluating and controlling what might go wrong in a project before it becomes a threat to the successful completion of the project or implementation of the information system.

Multiple feasibility checkpoints should be built into system development methodology. At each feasibility checkpoint, all costs are considered sunk (i.e. not recoverable). Thus, the project should be re- evaluated at each checkpoint to determine if it remains feasible to continue investing time, effort, and resources. At each checkpoint, the developers should consider the following options:

- Cancel the project if it is no longer feasible.
- Re-evaluates and adjusts the cost and schedule if project scope is to be increased.
- Reduce the scope if the project budget and schedule are frozen and not sufficient to cover all the project objectives.

(6) *Divide and Conquer* approach is the way of making a complex problem easier. In this approach, the larger problem (System) is divided into smaller problems (Subsystem).

(7) For development of a successful system, the system should be designed for growth and change. When the System is implemented, it enters the operations and support stage of Life Cycle (Please refer to figure 1.3).

Figure 1.3: System Maintenance (refer to Fig 1.4 in unit-1-pg2.jpg)

During this stage, the developers encounter the need for changes that range from correcting simple mistakes to redesigning the system to accommodate changing technology to making modifications to support changing user requirements. These changes direct the developers to rework formerly completed phases of the life cycle.

1.6 VARIOUS APPROACHES FOR DEVELOPMENT OF INFORMATION SYSTEMS

Various approaches are available for development of Information Systems. They are:

- **Model Driven**: It emphasizes the drawing of pictorial system models to document and validate both existing and/or proposed systems. Ultimately, the system model becomes the blueprint for designing and constructing an improved system.
- **Accelerated approach**: A prototyping approach emphasizes the construction of model of a system. Designing and building a scaled-down but functional version of the desired system is known as Prototyping. A prototype is a working system that is developed to test ideas and assumptions about the new system. It consists

of working software that accepts input, perform calculations, produces printed or display information or perform other meaningful activities.

- **Joint Application Development**: It is defined as a structured approach in which users, managers, and analysts work together for several days in a series of intensive meetings to specify or review system requirements. In this approach, requirements are identified and design details are finalized.

1.6.1 Structured Analysis and Design Approach

The goal of structured system analysis and design is to reduce maintenance time and effort. Modeling is the act of drawing one or more graphical representations of a System. Model driven development techniques emphasize the drawing of models to help visualize and analyze problems, define business requirements and design Information systems. The first model driven approach is Structured Analysis and Design approach.

Structured Analysis is a development method for the analysis of existing manual systems or automated systems, leading to development of specifications (expected functionality or behaviour) for proposed system. The objective of structured analysis approach is to organize the tasks associated with requirement determination to provide an accurate and complete understanding of a current situation. The major tasks of structured system analysis approach are:

- Preliminary Investigation
- Problem Analysis
- Requirement Analysis
- Decision Analysis.

It is a process-centred technique that is used to model business requirements for a system. Structured analysis introduced a process-modeling tool called the *Data flow diagram*, used to illustrate business process requirements. With the help of DFD, the systems analyst can show the system overview. Data modeling tools such as *Entity relationship diagrams* are used to illustrate business data requirements. With the help of ERD, the analyst, can show database overview.

Structured Design utilizes graphic description (Output of system analysis) and focuses on development of software specifications. The goal of structured design is to lead to development of programs consisting of functionally independent modules that perform relatively independently of one another. It is a specific program design technique, not a comprehensive design method. Thus it does not specify file or database design, input or output layout or the hardware on which the application will run. It provides specification of program modules that are functionally independent.

It is a process-centred technique that transforms the structured analysis models into good software design models. Structured Design introduced a modeling tool called Structure Charts. They are used to illustrate software (program) structure to fulfil business requirements. Structure charts describe the interaction between independent module and the data passing between the modules. These module specifications can be passed to programmers prior to the writing of program code. In structure chart the whole application is divided into modules (set of program instructions) and modules are designed according to some principles of design. These principles are:

Modularity and partitioning: Each system should consist of a hierarchy of modules. Lower level modules are generally smaller in scope and size compared to higher level modules. They serve to partition processes into separate functions.

Coupling: Modules should be loosely coupled. It means that modules should have little dependence on other modules in a system.

Cohesion: Modules should be highly cohesive. It means that modules should carry out a single processing function.

Span of control: Modules should interact with and manage the functions of a limited number of lower level modules. It means that the number of called modules should be limited (in a calling module).

Size of Module: The number of instructions contained in a module should be limited so that module size is generally small.

Shared use of Functions: Functions should not be duplicated in separate modules may be shared. It means that functions can be written in a single module and it can be invoked by any other module when needed.

1.6.2 Prototype

A prototyping approach emphasizes the construction model of a system. Designing and building a scaled-down but functional version of a desired system is the process known as Prototyping. A prototype is a working system that is developed to test ideas and assumptions about the new system. It consists of working software that accepts input, performs calculations, produces printed or displayed information or performs other meaningful activities. It is the first version or iteration of an information system i.e. an original model. Customer evaluates this model. This can be effectively done only if the data are real and the situations are live. Changes are expected as the system is used. This approach is useful when the requirements are not well defined. A prototype is usually a test model. It is an interactive process. It may begin with only new functions and be expanded to include others that are identified later. The steps of Prototyping process are depicted in Figure 1.4. They are:

- Identify the user's known information requirements and features needed in the system.
- Develop a working prototype.
- Revise the prototype based on feedback received from customer
- Repeat these steps as needed to achieve a satisfactory system.

Actual development of a working prototype is the responsibility of a systems analyst. The difference between a prototype model and an actual information system is that, a prototype will not include the error checking, input data validation, security and processing completeness of a finished application. It will not offer user help as in the final system.

But, sometimes, the prototype can evolve into the product to be built. The prototype can be easily developed with tools of fourth generation languages (4GL's) and with the help of Computer Aided Software Engineering (CASE) tools. Prototyping approach is a form of rapid application development (RAD).

Figure 1.4: Prototype approach (refer to Fig 1.5 in unit-1-pg2.jpg)

1.6.3 Joint Application Development

It is defined as a structured approach in which users, managers, and analysts work together for several days in a series of intensive meetings to specify or review system requirements. The important feature of JAD is joint requirements planning, which is a process whereby highly structured group meetings are conducted to analyze problems and define requirements.

The typical participants in a JAD are listed below:

JAD session leader: The JAD leader organizes and runs the JAD. This person is trained in group management and facilitation as well as system analysis. The JAD leader sets the agenda and sees that it is met. The JAD leader remains neutral on issues and does not contribute ideas or opinions but rather concentrates on keeping the group on the agenda, resolving conflicts and disagreements, and soliciting all ideas.

(1) **Users:** The key users of the system under consideration are vital participants in a JAD. They are the only ones who have a clear understanding of what it means to use the system on a daily basis.

(2) **Managers:** The role of managers during JAD is to approve project objectives, establish project priorities, approve schedules and costs and approve identified training needs and implementation plans.

(3) **Sponsors:** A JAD must be sponsored by someone at a relatively high level in the company i.e. the person from top management. If the sponsor attends any session, it is usually at the very beginning or at the end.

(4) **Systems Analysts:** Members of the systems analysis team attend the JAD session although their actual participation may be limited. Analysts are there to learn from customers and managers, but not to run or dominate the process.

(5) **Scribe:** The scribe takes down the notes during the JAD sessions. This is usually done on a personal computer or a laptop. Notes may be taken using a word processor. Diagrams may directly be entered into a CASE tool.

(6) **IS staff** like systems analysts, other IS staff such as programmers, database analysts, IS planners and data centre personnel may attend to learn from the discussions and possibly to contribute their ideas on the technical feasibility of proposed ideas or on technical limitations of current systems.

The following are the various benefits of Joint Application Development:

- actively involves users and management in project development,
- reduces the amount of time required to develop a system, and
- incorporates prototyping as a means for confirming requirements and obtaining design approvals.

Check Your Progress 3

1. List the fundamental principles of S/W Development Life Cycle.

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1.7 SUMMARY

In this unit, all the basic concepts that are necessary to understand the system, types and characteristics are given. Concepts about real and distributed systems are also discussed. Development of a successful information system depends on principles of SDLC. Different approaches are available for development of information systems. These are Model Driven (structure analysis and design approach), Accelerated (prototype) and JAD approach. Selection of the approach is based on the end user requirements, problem identified and infrastructure provided.

1.8 SOLUTIONS/ ANSWERS

Check Your Progress 1

1. c
2. b
3. c
4. b
5. d
6. d

Check Your Progress 2

1. **Information system:** It is an arrangement of people, data, processes, information presentation and information technology that interacts to support and improve day-to-day operations of a business as well as support the problem solving and decision making needs of management and users.

   Strategic Information: This is the information needed for long range planning and top-level management of any organization that uses it. This information is unstructured or semi-structured and the volume of this information in any organization is very small.

   Tactical Information: This type of information is needed to take short term decisions to run the business efficiently and middle level managers' use it. The volume of tactical information is more than the volume of strategic information.

   Operational Information: This type of information is used for day-to-day operations of a business organization and first level management in the organization uses it. It is usually easy to obtain by straightforward clerical processing of data. The volume of this information is much more than volume of tactical information.

   Repository: It is defined as data store of accumulated system knowledge i.e. system models, detailed specifications, and any other documentation that has been accumulated during the system's development. This knowledge is reusable and critical to the production system's ongoing support. The repository is implemented with various automated tools and it is often centralized as an enterprise business and IT resource.

2. Information requirement determination attempts to find the strategic, tactical and operational information that is needed to effectively manage an organization. Information specification defines the manner in which the information will be presented and the analyzed data, it consists of.

3. The following are characteristics of a good information system:

   - meeting customer's requirements,
   - modular design, and
   - easily maintainable.

Check Your Progress 3

1. The following are the fundamental principles of SDLC:

   - Management and users should be involved because they can explain the problem that is to be taken for design and development in accurate manner.
   - A problem solving approach should be adopted
   - Phases and activities should be established.
   - Some standards should be established for consistent development of System.
   - Development of Information System should be considered as capital Investment.
   - Divide and Conquer approach should be adopted. It is one way of making complex problem easier.
   - For making a system successful, it should be designed for growth and change.

1.9 FURTHER READINGS

- Jeffrey L. Whitten, Lonnie D. Bentley, Kevin C. Dittman; *System analysis and design methods*; Tata McGraw-Hill ;Fifth Edition;2001.
- By Jeffrey A. Hoffer , Joey F. George , Joseph S. Valacich; *Modern Systems Analysis and Design*; Pearson Education; Third Edition;2002.

Reference Web sites

http://www.rspa.com