

2. System Development Life Cycle Methodology

➤ Systems Development Process:

In business, System Development refers to the process of examining a business situation with the intent of improving it through better procedures and methods. There are two major components of SDP as Follows.

1. System Analysis : is the process of gathering and interpreting facts, diagnosing problems, and using the information to recommend improvements to the system
2. System Design: is the process of planning a new business system or one to replace or complement an existing system.

➤ System Development Methodology

It refers to the framework that is used to structure, plan and control the process of developing an information system. The methodology is characterized by the following

1. The project is divided into a number of identifiable processes, and each process has a starting point and an ending point.
2. Specific reports and other documentation, called Deliverables must be produced periodically.
3. Users, Managers and auditors are required to participate in formation of system.
4. System must be tested thoroughly prior to implementation.
5. A training plan is developed for new user of new system
6. Formal program change controls are established to preclude unauthorized changes.
7. A post-implementation review of all developed system must be performed.

➤ Approaches to System Development

1. Waterfall
2. Prototyping
3. Incremental
4. Spiral
5. Rapid Application Development
6. Agile Methodologies

1. The traditional/ Waterfall Approach/Sequential Approach:

The waterfall approach is a traditional development approach in which each developer in a development team works in different phases. These phases include requirement analysis, specifications and design requirements, coding, final testing, and release. The waterfall approach is used on small projects because it eliminates testing to identify problems early in the process.

2. Prototyping Model

The traditional approach sometimes may take years to analyze, design and implement a system. In order to avoid such delays, organizations are increasingly using prototyping techniques to develop smaller systems such as DSS, MIS and expert systems. The goal of prototyping approach is to develop smaller or pilot version called a prototype of part of all of a system.

➤ Basic Principles/Steps

1. Identify information system requirements
2. Develop the initial prototype
3. Test and Revise
4. Obtain user signoff of the approved prototype.

➤ Advantages/Strengths of Prototyping

1. Improves both user participation in system development and communication among project stakeholders
2. Especially useful for resolving unclear objectives; developing and validating user requirements.
3. Helps to easily identify confusing or difficult functions and missing functionality.
4. May generate specifications for a product application.
5. Encourages innovation and flexible designs.
6. Provide quick implementation of an incomplete, but functional, application.
7. Prototyping requires intensive involvement by the system users.
8. A very short time period is normally required to develop and implement it.
9. Since System user experiment with each version of the prototype through an interactive process, errors are hopefully detected and eliminated in the development process.

➤ Disadvantages/Weakness of Prototyping

1. Approval process and control are not strict.
2. Incomplete or inadequate problem may occur whereby only the most obvious and superficial needs will be addressed, resulting in current inefficient practices being easily built into the new system.
3. Requirements may frequently change significantly.
4. Identification of non-functional elements use is difficult to document.
5. Prototype may not have sufficient checks and balances incorporated.
6. Prototyping can only be successful if the users are willing to devote significant time in experimenting with the prototype and provide the system developers with change suggestion.
7. The interactive process of prototyping causes the prototype to be experimented with quite extensively. Because of this, the system developers are frequently tempted to minimize the testing and documentation process of the ultimately approved information system.
8. Prototyping may cause behavioral problems with system users. These problems include dissatisfaction by users if system developers are unable to meet all user demands for improvements as well as dissatisfaction and impatience by users when they have to go through too many interactions of the prototype.

3. The incremental Model

The incremental build model is a method of software development where the model is designed, implemented and tested incrementally. The product is defined as finished when it satisfies all of its requirements. This model combines the elements of the waterfall model with the iterative philosophy of prototyping.

4. Spiral Model

The spiral model is a software development process combining elements of both design and prototyping-in-stage. In an effort to combine advantages of top-down and bottom-up concepts. Also known as the spiral lifecycle, it is a systems development method which combines the features of the prototyping model and the waterfall model. The spiral model is intended for large, expensive and complicated projects.

5. Rapid Application Development (RAD)

RAD refers to a type of software development methodology which uses minimal planning in favor of rapid technology. The “Planning” of software developed using RAD is interrelated with writing the software itself. The lack of extensive pre-planning generally allows software to be written much faster, and makes it easier to change requirements.

6. Agile Methodologies

All the mythologies described before are based on the premise that May software development process should be predictable and reputable. One of the criticisms against these methodologies is that there is more emphasis on following procedures and preparing documentation. They are considered to be heavyweight or rigorous and are also criticized for their excessive emphasis on structure.

➤ Characteristics of Agile methodologies are as follows

1. Iterative with short cycles enabling fast verification and correctness
2. Time bound iterative cycles
3. Modularity at development process level
4. People oriented
5. Collaborative and communicative working style
6. Incremental and convergent approach that minimizes risks and facilities functional additions.

System Development life Cycle (SDLC)

The SDLC is document driven which means that at crucial stages during the process, documentation is produced. A phase of the SDLC is not complete until the appropriate documentation is produced. This feature of SDLC is critical to the successful management of an IS project.

➤ Advantages of SDLC are as Follows

1. Better planning and control by project managers
2. Compliance to prescribed standards ensuring better quality
3. Documentation that SDLC stresses on is an important measure of communication and control.
4. The phases are important millstones and help the project manager and the user for review and signoff.

➤ Phase/Process involved in the System Development life Cycle.

1. Preliminary Investigation:

When the user comes across a problem in the existing system or totally new requirement for computerization, a formal request has to be submitted for system development. It consists of three parts; request classification, feasibility study and request approval. Generally the request submitted is not stated clearly hence requires detailed study. On receipt of request and identification of needs, the feasibility study is conducted which includes the aspects related to technical, economic and operation feasibility and is normally conducted by a third party depending upon the quantum and size of the requirements. The approval is sought from top management to initiate the system development.

2. Requirements analysis or system analysis.

Once the request of the system development is approved, the detailed requirement study is conducted in close interaction with the concerned employees and managers to understand the detailed functioning, short-comings, bottlenecks and to determine the features to be included in the system catering to the needs and requirements of the users. This process is termed as “System Requirements Study or System Analysis”

3. Design the System:

This activity evolves the methodology and steps to be included in the system to meet the identified needs and requirements of the system. The analyst designs the various procedures, report, inputs, files and database structures and prepares the comprehensive system design. These specifications are then passed on to the development team for program coding and testing.

4. Acquisition and Development of Software

Once the system designs details are resolved and SRS is accepted by user, the hardware and software details along with services requirements are determined and procured choosing the best-fit options. Subsequently, choices are made regarding which products to buy or lease from which vendors. The choice depends on many factors such as time, cost and availability of programmers. The analyst also works with users to develop documentation for software and various procedures manuals.

5. System Testing:

Once all the programs comprising the system have been developed and tested, the system needs to be tested as a whole. System testing is conducted with various probable option and conditions to ensure that it does not fail in any condition. The system is expected to run as per the specifications made in the SRS and users’ expectations. Live test data are input for processing, and results are examined. If it is found satisfactory, it is eventually tested with actual data from the current system.

6. Implementation and Maintenance

By the time of accomplishment of the above activities, it is ensured that the requisite hardware and software are installed and the users are trained on the new system to carry out operations independently. For sometime, hand-holding may be done by the system development team. The operations are monitored closely to ensure the users satisfaction. The system is maintained and modified to adopt to the changing needs of the users and business to ensure long-term acceptance of the system.

Short Note Topic

➤ **Delineation of Scope:** This is the third process of Preliminary investigation for system development. The scope of a Solution defines its boundaries. It should be clear and comprehensible to the user management stating what will be addressed by the solution and what will not, often the scope becomes a contentious issue between development and user organizations. Hence, outlining the scope in the beginning is essential. The two primary methods with the help of which the scope of the project can be analyzed are as follows:

1. Reviewing internal documents
2. Conducting Interviews

➤ **Feasibility Study:**

After Possible Solution options are identified, project feasibility – the likelihood that these systems will be useful for the organization – is determined. A Feasibility study is carried out by the system analyst who refers to a process of evaluation alternative systems through cost/benefit analysis so that the most feasible and desirable system can be selected for development. The Feasibility Study of a system is evaluated under following dimensions:

1. Technical: is the technology needed available?
2. Financial: is the solution viable financially?
3. Economic: Return on investments?
4. Schedule/Time: can the system be delivered on time?
5. Resources: are human resources reluctant for the solution?
6. Operational: how will the solution work?
7. Behavioral: is the solution going to bring any adverse effect on quality of work life?
8. Legal: is the solution valid in legal terms?

1. Technical Feasibility:

It is concerned with issues pertaining to hardware and software. Essentially, an analyst ascertains whether the proceeds system is feasible with existing or expected computer hardware and software technology. The technical issues usually raised during the feasibility stage of investigation include the following.

- I. Does the necessary technology exist to do what is suggested?
- II. Does the proposed equipment have the technical capacity to hold the data required to use the new system?
- III. Can the proposed application be implemented with existing technology?
- IV. Will the proposed system provide adequate responses to inquires, regardless of the number of location of users?
- V. Can the system be expanded if developed?
- VI. Are there technical guarantees of accuracy, reliability, ease of access, and data security?

Due to tremendous advancements in compute field these days, the technology is available for most business data processing systems but sometimes not within the constraints of the firm's resources or its implementation schedule. Therefore, trade offs are often necessary. A technically feasible system may no be economically feasible or may be so sophisticated that the firm's personnel cannot effectively operate it.

2. Financial Feasibility

The solution proposed may be prohibitively costly for the user organization. For example – Monitoring the stock through VSAT network connecting multiple locations may be acceptable for an organization with high turnover. But this may be not viable solution for smaller ones.

3. Economic feasibility

It includes the evaluation of all the incremental costs and benefits expected if the proposed system is implemented. This is the most difficult aspect of the study. The financial and economic questions raised by analysts during the preliminary investigation are for the purpose of estimating the following:

- I. The cost of conducting a full system's investigation.
- II. The cost of hardware and software for the class of applications being considered.
- III. The benefits in the form of reduced costs or fewer costly errors.
- IV. The cost if nothing changes (i.e proposed system is not developed)

The procedure employed is the traditional cost-benefit study.

4. Schedule/Time Feasibility

Schedule feasibility involves the design team's estimating how long it will take a new or revised system to become operational and communicating this information to the steering committee.

5. Resource Feasibility

This focuses on human resources. Implementing sophisticated software solutions becomes difficult in non-metro locations because of the reluctance of skilled personnel to move to such locations.

6. Operational Feasibility

It is concerned with ascertaining the views of workers, employees, customers and suppliers about the use of computer facility. The support or lack of support that the firm's employees are likely to give to the system is a crucial aspect of feasibility. A system can be highly feasible in all respects except the operational and fails miserably because of human problems. Some of the questions which may help in conducting the operational feasibility of a project are stated below:

- I. Is there sufficient support for the system from management and from users? If the current system is well liked and used to the extent that persons will not be able to see reasons for change, there may be resistance.
- II. Are current business methods acceptable to users? If they are not, users may welcome a change that will bring about a more operational and useful system.
- III. Have the users been involved in planning and development of the project? Early involvement reduces the chances of resistance to the system and changes in general and increases the likelihood successful projects.
- IV. Will the proposed system cause harm? Will it produce poorer results in any respect or area? Will loss of control result in any areas? Will accessibility of information be lost? Will individual performance be poorer after implementation than before? Will performance be affected in an undesirable way? Will the system slow performance in any areas?

7. Behavioral Feasibility

It refers to the system which will be designed to process data and produce the desired outputs. However, if the data input for the system is not nor readily available or collectable, then the system may not be successful.

8. Legal Feasibility

Legal feasibility is largely concerned with whether there will be any conflict between a newly proposed system and the organization's legal obligation.

System Requirement Analysis

This phase includes a thorough and detailed understanding of the current system, identifies the areas that need modification to solve the problem, the determination of user/managerial requirements and to have fair idea about various system development tools. There are many methods for analysis which are discussed below.

1. Fact Finding Techniques

Every system is built to meet some set of needs, to assess these needs; the analysts often interact extensively with the people, who will be benefited from the system, In order to determine what their actual requirements are. Various fact-finding techniques, which are used by the system analyst for determining these needs/requirements, are briefly discussed below:

- I. Documents
- II. Questionnaires
- III. Interviews
- IV. Observation

2. Analysis of the present system

Detailed investigation of the present system involves collecting, organizing and evaluation facts about the system and environment in which it operates. Enough information should be assembled so that a qualified person can understand the present system without visiting any of the operating departments. Review of existing methods, procedures, data flow, outputs, files, inputs and internal controls should be intensive in order to fully understand the present system and its related problems.

The following areas may be studied in depth for analyze the present system.

I. Review Historical Aspects:

- A brief history of the organization is a logical starting point for the analysis of the present system.
- The historical facts should identify the major turning points and milestones that have influenced its growth.
- A review of annual reports can provide an excellent historical perspective. A historical review of the organization chart can identify the growth of management levels as well as the development of various functional areas and departments.
- The system analyst should identify what system changes have occurred in the past. Theses should include operation that have been successful or unsuccessful with computer equipment and techniques

II. Analyze Inputs

- A detailed analysis of present inputs is important since they are basic to the manipulation of data. Source documents are used to capture the originating data for any type of system.
- The system analyst should be aware of the various sources from where data can be initially captured, keeping in view the fact that outputs for one area may serve as an input for another area.
- The system analyst must understand the nature of each form, what is contained in it, who prepared it, from where the form is initiated, where it is completed, the distribution of the form and other similar consideration
- If the analyst investigates these questions thoroughly, he will be able to determine how these input fit into the framework of the present system.

III. Review Data file maintained

- The analysis should investigate the data files maintained by each department, noting their number and size, where they are located, who uses them and the number of times per given time interval these are used.
- Information on common data files and their size will be an important factor, which will influence the new information system. This information may be contained in the systems and procedures manuals.
- The system analyst should also review all online and offline files which are maintained in the organization as these will retrieving and processing the data is another important factor should be considered by the system analyst.

IV. Review Methods, procedures and data Communication

- Methods and procedures transform input data into useful data. A method is defined as a way of doing something; a procedure is a series of logical steps by which a job is accomplished. A procedure's review is an intensive survey of the methods by which each job is accomplished, the equipment utilized and the actual location of the operations.
- Its basic objective s to eliminate unnecessary tasks or to perceive improvement in opportunities in the present information system.
- A system analyst also needs to review and understand the present data communications used by the organization.
- He must review the types of data communication equipment including data interface, data links, modems, dial-up and lease lines and multiplexers.
- The system analyst must understand how the data communication network is used in the system so as to identify the need to revamp the network when the new system is installed

V. Analyze Outputs

- The outputs r report should be scrutinized carefully by the system analyst in order to determine how well they will meet the organization's needs. The analyst must understand what information is needed and why, who needs it and when and where it is needed. Additional questions concerning the sequence of the data, how of then the form reporting is used, how long it is kept on file etc. must be investigated.
- Often many reports are a carryover from earlier days and have little relevance to current operations. Attempt should be made to eliminate all such reports in the new system

VI. Review Internal Controls

- A detailed investigation of the present information system is not complete until internal controls are reviewed.
- Locating the control points helps the analyst to visualize the essential parts and frameworks if a system. An examination of the present system of internal control may indicate weaknesses should be removed in the new system.
- The adoption of advanced methods, procedures and equipment might allow much greater control over the data.

VII. Model the existing physical system and logical system

- As the logic of inputs, methods, data files, data communications, reports, internal control and other important items are reviewed and analyzed in a top down manner; the process must be properly documented.

- The logical flow of the present information system may be depicted with the help of system flow charts. The physical flow of the existing system may be shown by employing data flow diagrams. During the process of developing the data flow diagram, work on data dictionary for the new information system should be begun.
- The data elements needed in the new system will be found in the present system only. Hence, it is wise to start the development of the data dictionary as early as possible.

VIII. Undertake Overall Analysis of present system

- Based upon the aforesaid investigation of the present information system, the final phase of the detailed investigation includes
 - a. The present work volume
 - b. The current personnel requirements
 - c. The present benefits and costs.

3. System development Tools

Tools and techniques have been developed to improve current information systems and to develop new ones. The major tools used for system development can be grouped into the following four categories based on the systems features each document has

1. System Components and Flows
 - These tools help the system analyst to document the data flow among the major resources and activities of an information system
2. User Interface
 - Designing the interface between end users and the computer system is a more consideration of system analyst while designing the new system.
3. Data attributes and Relationships
 - The data resources in information system are defined, catalogued and designed by this category of tools. A data dictionary catalogues the description of the attributes of all data elements and their relationships to each other as well as to external systems.
4. Detailed System process
 - These tools are used to help the program develop detailed procedures and processes required in the design of a computer program.

➤ CASE Tools

The data flow diagram and system flow charts that users review are commonly generated by system developers using the on-screen drawing modules found in CASE (Computer-aided-software Engineering) software packages.

➤ System Components Matrix

A System Components Matrix provides a matrix framework to document the resources used, the activities performed and the information produced by an information system.

➤ Data Dictionary

A Data dictionary is a computer file that contains descriptive information about the data items in the files of a business information system. Thus a data dictionary is a computer file about data.

➤ **System Requirements Specification (SRS)**

At the end of analysis phase, the system analyst prepares a document called SRS. A SRS Contain the Following

- i. The development team makes a presentation and then hands over the SRS document to be reviewed by tar user or customer
- ii. The review reflects the development team understands of the existing processes. Only after ensuring that the document represents existing process accurately, should the user sigh the document? This is a technical requirement of the contract between users and development team/organization.

➤ **Roles involved in System Development life Cycle**

1. Steering Committee
2. Project manager
3. Project leader
4. System Analyst/Business analyst
5. Module leader/Teal leader
6. Programmer/Coder/Developer
7. Database Administrator
8. Quality assurance
9. Tester
10. Domain Specialist
11. IS Auditor

System Design

After the detailed design phase is completed the following activities are covered under the design phase

- I. Architectural Design;** deals with the organization of applications in terms of hierarchy of modules and sub-modules. At this stage, we identify – major modules; functions and scope of each module; interface features of each module; modules that each module can call directly or indirectly and data received from/sent to/modified on other modules.
- II. Design of the Data/Information flow:** it is a major step in the conceptual design of the new system
- III. Design of the Database:** involves determining its scope ranging from local to global structure. Its involves four major activities
 1. Conceptual Modeling
 2. Data modeling
 3. Storage structure design
 4. Physical layout design
- IV. Design of the User-interface:** involves determine the ways in which users will interact with system. The point that need to be considered the user interface are as follows
 1. Source document to capture raw data
 2. Hard copy output reports
 3. Screen layouts for dedicated source document input
 4. Inquiry screens for database interrogation
 5. Graphic and color displays
 6. Requirements for special input/output device

V. Physical Design: the logical design is transformed into units, which in turn can be decomposed further into implementation units such as programs and modules.

VI. Design and acquisition of the hardware/system software platform

Development: Programming Techniques and Languages

In this phase application programs are written, tested and documented, conduct system testing. A good coded program should have the following characteristics

1. Reliability
2. Robustness : it refers to taking all possible inputs and outputs in any situation
3. Accuracy
4. Efficiency
5. Usability
6. Readability

System Implementation

The activities involved in system implementation are as follows

1. Equipment installation
 - a. Site preparation
 - b. Installation of new hardware/software
 - c. Equipment Check-out
2. Training Personnel
3. System implementation conversion

Conversion or changeover is the process of changing from the old system to the new system. The four types of implementation strategies are involved which are as follows

- a. Direct Implementation/Abrupt Change-over : Completely changeover in one time
- b. Phased implementation: Changeover taking place by degrees
- c. Pilot Implementation: operation in small scale unit
- d. Parallel running implementation

While we can also state the activities which involved in the conversion

- a. Procedure Conversion
- b. File Conversion
- c. System conversion
- d. Scheduling personnel and equipment

Post Implementation review and System Maintenance

Post implementation answer the question “did we achieve what we set out to do in business terms?” some of the purposes served a post implementation review ascertain the degree of success from the project. The dimension in which concerned with post implementation review is as follows

1. Development evaluation
2. Operation Evaluation
3. Information Evaluation

➤ **System Maintenance**

Maintenance the system is important aspects of SDLC. Maintenance can be categorized in the following ways

1. Schedule Maintenance
2. Rescue Maintenance
3. Corrective Maintenance
4. Adaptive Maintenance
5. Perfective Maintenance
6. Preventive Maintenance

Auditors' Role in SDLC

The audit of system under development can have three main objectives

1. To provide an opinion on the efficiency, effectiveness, and economy of project management.
 2. To assess the extent to which the system being developed provides for adequate audit trails and controls to ensure the integrity of data processed and stored.
 3. To assess the controls being provided for the management of the system's operation.
- For the first objective to achieve, an auditor will have to attend project and steering committee meetings and examine project control documentation and conduct interviews.
 - For the second objective, the auditor can examine system documentation, such as functional specifications, to arrive at an opinion on controls. And the same is true for the third objective.
 - An auditor may adopt a rating system such as a scale of 1 to 10 in order to give a rating to the various phases of SDLC.