

Unit-2

Systems Development Life Cycle (SDLC)

The systems development life cycle (SDLC) is a conceptual model used in project management that describes the stages involved in an information system development project, from an initial feasibility study through maintenance of the completed application. SDLC can apply to technical and non-technical systems. In most use cases, a system is an IT technology such as hardware and software. Project and program managers typically take part in SDLC, along with system and software engineers, development teams and end-users. Every hardware or software system will go through a development process which can be thought as an iterative process with multiple steps. SDLC is used to give a rigid structure and framework to define the phases and steps involved in the development of a system. SDLC is also an abbreviation for Synchronous Data Link Control and software development life cycle. Software development life cycle is a very similar process to systems development life cycle, but it focuses exclusively on the development life cycle of software.

Steps in SDLC

In general, an SDLC methodology follows these following steps:

1. **Analysis:** The existing system is evaluated. Deficiencies are identified. This can be done by interviewing users of the system and consulting with support personnel.
2. **Plan and requirements:** The new system requirements are defined. In particular, the deficiencies in the existing system must be addressed with specific proposals for improvement. Other factors defined include needed features, functions and capabilities.
3. **Design:** The proposed system is designed. Plans are laid out concerning the physical construction, hardware, operating systems, programming, communications and security issues.
4. **Development:** The new system is developed. The new components and programs must be obtained and installed. Users of the system must be trained in its use.
5. **Testing:** All aspects of performance must be tested. If necessary, adjustments must be made at this stage. Tests performed by quality assurance (QA) teams may include systems integration and system testing.
6. **Deployment:** The system is incorporated in a production environment. This can be done in various ways. The new system can be phased in, according to application or location, and the old system gradually replaced. In some cases, it may be more cost-effective to shut down the old system and implement the new system all at once.
7. **Upkeep and maintenance:** This step involves changing and updating the system once it is in place. Hardware or software may need to be upgraded, replaced or changed in some way to better fit the needs of the end-users continuously. Users of the system should be kept up-to-date concerning the latest modifications and procedures.

Advantages of SDLC

Benefits of abiding by a clearly defined SDLC model include:

- Having a clear view of an entire project, workers involved, estimated costs and timelines.
- Gives project managers a projected base cost of the project.
- Goals and standards are clearly defined.
- Developers can move back a step if something does not go as expected.

Disadvantages of SDLC:

- Due to assumptions made at the beginning of a project, if an unexpected circumstance complicates the development of a system, then it may stockpile into more complications down the road. As an example, if newly installed hardware does not work correctly, then it may increase the time a system is in development, increasing the cost.
- Some methods are not flexible.
- It can be complicated to estimate the overall cost at the beginning of a project.
- Testing at the end of development may slow down some development teams.

Feasibility Study

In a feasibility study, a proposed plan or project is evaluated for its practicality. As part of a feasibility study, a project or venture is evaluated for its viability in order to determine whether it will be successful. As the name implies, a feasibility analysis is used to determine the viability of an idea, such as ensuring a project is legally and technically feasible as well as economically justifiable. It tells us whether a project is worth the investment—in some cases, a project may not be doable. There can be many reasons for this, including requiring too many resources, which not only prevents those resources from performing other tasks but also may cost more than an organization would earn back by taking on a project that isn't profitable. A well-designed study should offer a historical background of the business or project, such as a description of the product or service, accounting statements, details of operations and management, marketing research and policies, financial data, legal requirements, and tax obligations. Generally, such studies precede technical development and project implementation.

Understanding A Feasibility Study

Project management is the process of planning, organizing, and managing resources to bring about the successful completion of specific project goals and objectives. A feasibility study is a preliminary exploration of a proposed project or undertaking to determine its merits and viability. A feasibility study aims to provide an independent assessment that examines all aspects of a proposed project, including technical, economic, financial, legal, and environmental considerations. This information then helps decision-makers determine whether or not to proceed with the project. The feasibility study results can also be used to create a realistic project plan and budget. Without a feasibility study, it cannot be easy to know whether or not a proposed project is worth pursuing.

Types of Feasibility Study

A feasibility analysis evaluates the project's potential for success; therefore, perceived objectivity is an essential factor in the credibility of the study for potential investors and lending institutions. There are five types of feasibility study—separate areas that a feasibility study examines, described below.

1. Technical Feasibility

This assessment focuses on the technical resources available to the organization. It helps organizations determine whether the technical resources meet capacity and whether the technical team is capable of converting the ideas into working systems. Technical feasibility also involves the evaluation of the hardware, software, and other technical requirements of the proposed system. As an exaggerated example, an organization wouldn't want to try to put Star Trek's transporters in their building—currently, this project is not technically feasible.

2. Economic Feasibility

This assessment typically involves a cost/ benefits analysis of the project, helping organizations determine the viability, cost, and benefits associated with a project before

financial resources are allocated. It also serves as an independent project assessment and enhances project credibility—helping decision-makers determine the positive economic benefits to the organization that the proposed project will provide.

3. Legal Feasibility

This assessment investigates whether any aspect of the proposed project conflicts with legal requirements like zoning laws, data protection acts or social media laws. Let's say an organization wants to construct a new office building in a specific location. A feasibility study might reveal the organization's ideal location isn't zoned for that type of business. That organization has just saved considerable time and effort by learning that their project was not feasible right from the beginning.

4. Operational Feasibility

This assessment involves undertaking a study to analyze and determine whether—and how well—the organization's needs can be met by completing the project. Operational feasibility studies also examine how a project plan satisfies the requirements identified in the requirements analysis phase of system development.

5. Scheduling Feasibility

This assessment is the most important for project success; after all, a project will fail if not completed on time. In scheduling feasibility, an organization estimates how much time the project will take to complete. When these areas have all been examined, the feasibility analysis helps identify any constraints the proposed project may face, including:

- Internal Project Constraints: Technical, Technology, Budget, Resource, etc.
- Internal Corporate Constraints: Financial, Marketing, Export, etc.
- External Constraints: Logistics, Environment, Laws, and Regulations, etc.

Importance of Feasibility Study

The importance of a feasibility study is based on organizational desire to “get it right” before committing resources, time, or budget. A feasibility study might uncover new ideas that could completely change a project's scope. It's best to make these determinations in advance, rather than to jump in and to learn that the project won't work. Conducting a feasibility study is always beneficial to the project as it gives you and other stakeholders a clear picture of the proposed project.

Below are some key benefits of conducting a feasibility study:

- Improves project teams' focus
- Identifies new opportunities
- Provides valuable information for a “go/no-go” decision
- Narrows the business alternatives
- Identifies a valid reason to undertake the project
- Enhances the success rate by evaluating multiple parameters
- Aids decision-making on the project
- Identifies reasons not to proceed

Apart from the approaches to feasibility study listed above, some projects also require other constraints to be analyzed -

- Internal Project Constraints: Technical, Technology, Budget, Resource, etc.
- Internal Corporate Constraints: Financial, Marketing, Export, etc.
- External Constraints: Logistics, Environment, Laws, and Regulations, etc.

Software design is a process to transform user requirements into some suitable form, which helps the programmer in software coding and implementation.

For assessing user requirements, an SRS (Software Requirement Specification) document is created whereas for coding and implementation, there is a need of more specific and detailed

requirements in software terms. The output of this process can directly be used into implementation in programming languages.

Software Design Levels

Software design yields three levels of results:

- **Architectural Design** - The architectural design is the highest abstract version of the system. It identifies the software as a system with many components interacting with each other. At this level, the designers get the idea of proposed solution domain.
- **High-level Design**- The high-level design breaks the ‘single entity-multiple component’ concept of architectural design into less-abstracted view of sub-systems and modules and depicts their interaction with each other. High-level design focuses on how the system along with all of its components can be implemented in forms of modules. It recognizes modular structure of each sub-system and their relation and interaction among each other.
- **Detailed Design**- Detailed design deals with the implementation part of what is seen as a system and its sub-systems in the previous two designs. It is more detailed towards modules and their implementations. It defines logical structure of each module and their interfaces to communicate with other modules.

Software Testing

Testing is the process of executing a program to find errors. To make our software perform well it should be error-free. If testing is done successfully it will remove all the errors from the software. Principles of Testing:-

- (i) All the tests should meet the customer requirements.
- (ii) To make our software testing should be performed by a third party.
- (iii) Exhaustive testing is not possible. As we need the optimal amount of testing based on the risk assessment of the application.
- (iv) All the tests to be conducted should be planned before implementing it
- (v) It follows the Pareto rule (80/20 rule) which states that 80% of errors come from 20% of program components.
- (vi) Start testing with small parts and extend it to large parts.

Types of Testing:-

1. Unit Testing

It focuses on the smallest unit of software design. In this, we test an individual unit or group of interrelated units. It is often done by the programmer by using sample input and observing its corresponding outputs.

Example:

- a) In a program we are checking if the loop, method, or function is working fine
- b) Misunderstood or incorrect, arithmetic precedence.
- c) Incorrect initialization

2. Integration Testing

The objective is to take unit-tested components and build a program structure that has been dictated by design. Integration testing is testing in which a group of components is combined to produce output.

Integration testing is of four types: (i) Top-down (ii) Bottom-up (iii) Sandwich (iv) Big-Bang

Example:

- (a) **Black Box testing**:- It is used for validation. In this, we ignore internal working mechanisms and focus on what is the output?

(b) **White box testing**:- It is used for verification. In this, we focus on internal mechanisms i.e. how the output is achieved?

3. Regression Testing

Every time a new module is added leads to changes in the program. This type of testing makes sure that the whole component works properly even after adding components to the complete program.

Example : In school, record suppose we have module staff, students and finance combining these modules and checking if on integration of these modules works fine in regression testing

4. Smoke Testing

This test is done to make sure that the software under testing is ready or stable for further testing. It is called a smoke test as the testing of an initial pass is done to check if it did not catch the fire or smoke in the initial switch on.

Example: If the project has 2 modules so before going to the module make sure that module 1 works properly

5. Alpha Testing

This is a type of validation testing. It is a type of *acceptance testing* which is done before the product is released to customers. It is typically done by QA people.

Example: When software testing is performed internally within the organization

6. Beta Testing

The beta test is conducted at one or more customer sites by the end-user of the software. This version is released for a limited number of users for testing in a real-time environment.

Example: When software testing is performed for the limited number of people

7. System Testing

This software is tested such that it works fine for the different operating systems. It is covered under the black box testing technique. In this, we just focus on the required input and output without focusing on internal working. In this, we have security testing, recovery testing, stress testing, and performance testing

Example: This includes functional as well as nonfunctional testing

8. Stress Testing

In this, we give unfavorable conditions to the system and check how they perform in those conditions.

Example:

- (a) Test cases that require maximum memory or other resources are executed
- (b) Test cases that may cause thrashing in a virtual operating system
- (c) Test cases that may cause excessive disk requirement

9. Performance Testing

It is designed to test the run-time performance of software within the context of an integrated system. It is used to test the speed and effectiveness of the program. It is also called load testing. In it we check, what is the performance of the system in the given load.

Example: Checking several processor cycles.

10. Object-Oriented Testing

This testing is a combination of various testing techniques that help to verify and validate object-oriented software. This testing is done in the following manner:

- Testing of Requirements,
- Design and Analysis of Testing,
- Testing of Code,
- Integration testing,
- System testing,
- User Testing.

11. Acceptance Testing

Acceptance testing is done by the customers to check whether the delivered products perform the desired tasks or not, as stated in requirements.

System Implementation

Implementation is a process of ensuring that the information system is operational. It involves –

- Constructing a new system from scratch
- Constructing a new system from the existing one.

Implementation allows the users to take over its operation for use and evaluation. It involves training the users to handle the system and plan for a smooth conversion.

Training

The personnel in the system must know in detail what their roles will be, how they can use the system, and what the system will or will not do. The success or failure of well designed and technically elegant systems can depend on the way they are operated and used.

• Training Systems Operators

Systems operators must be trained properly such that they can handle all possible operations, both routine and extraordinary. The operators should be trained in what common malfunctions may occur, how to recognize them, and what steps to take when they come.

Training involves creating troubleshooting lists to identify possible problems and remedies for them, as well as the names and telephone numbers of individuals to contact when unexpected or unusual problems arise.

Training also involves familiarization with run procedures, which involves working through the sequence of activities needed to use a new system.

• User Training

- End-user training is an important part of the computer-based information system development, which must be provided to employees to enable them to do their own problem solving.
- User training involves how to operate the equipment, troubleshooting the system problem, determining whether a problem that arose is caused by the equipment or software.
- Most user training deals with the operation of the system itself. The training courses must be designed to help the user with fast mobilization for the organization.

Training Guidelines

- Establishing measurable objectives
- Using appropriate training methods

- Selecting suitable training sites
- Employing understandable training materials

Training Methods

Instructor-led training

It involves both trainers and trainees, who have to meet at the same time, but not necessarily at the same place. The training session could be one-on-one or collaborative. It is of two types –

Virtual Classroom

In this training, trainers must meet the trainees at the same time, but are not required to be at the same place. The primary tools used here are: video conferencing, text based Internet relay chat tools, or virtual reality packages, etc.

Normal Classroom

The trainers must meet the trainees at the same time and at the same place. Their primary tools used here are blackboard, overhead projectors, LCD projector, etc.

Self-Paced Training

It involves both trainers and trainees, who do not need to meet at the same place or at the same time. The trainees learn the skills themselves by accessing the courses at their own convenience. It is of two types –

Multimedia Training

In this training, courses are presented in multimedia format and stored on CD-ROM. It minimizes the cost in developing an in-house training course without assistance from external programmers.

Web-based Training

In this training, courses are often presented in hyper media format and developed to support internet and intranet. It provides just-in-time training for end users and allows organization to tailor training requirements.

Conversion

It is a process of migrating from the old system to the new one. It provides understandable and structured approach to improve the communication between management and project team.

Conversion Plan

It contains description of all the activities that must occur during implementation of the new system and put it into operation. It anticipates possible problems and solutions to deal with them.

It includes the following activities –

- Name all files for conversions.
- Identifying the data requirements to develop new files during conversion.
- Listing all the new documents and procedures that are required.
- Identifying the controls to be used in each activity.
- Identifying the responsibility of person for each activity.
- Verifying conversion schedules.

Conversion Methods

The four methods of conversion are –

- Parallel Conversion
- Direct Cutover Conversion
- Pilot Approach
- Phase-In Method

Method	Description	Advantages	Disadvantages
Parallel Conversion	Old and new systems are used simultaneously.	Provides fallback when new system fails. Offers greatest security and ultimately testing of new system.	Causes cost overruns. New system may not get fair trial.
Direct Cutover Conversion	New system is implemented and old system is replaced completely.	Forces users to make new system work.	No fall back if problems arise with new system.
Pilot Approach	Supports phased approach that gradually implement system across all users	Immediate benefit from new methods and control.	Requires most careful planning
Phase-In Method	Working version of system implemented in one part of organization based on feedback, it is installed throughout the organization all alone or stage by stage.	Allows training and installation without unnecessary use of resources. Avoid large contingencies from risk management.	A long term phase in causes a problem of whether conversion goes well or not.
		Provides experience and line test before implementation. When preferred new system involves new technology or drastic changes in performance.	Gives impression that old system is erroneous and it is not reliable.

File Conversion

It is a process of converting one file format into another. For example, file in WordPerfect format can be converted into Microsoft Word.

For successful conversion, a conversion plan is required, which includes –

- Knowledge of the target system and understanding of the present system
- Teamwork
- Automated methods, testing and parallel operations
- Continuous support for correcting problems
- Updating systems/user documentation, etc

System Maintenance / Enhancement

Maintenance means restoring something to its original conditions. Enhancement means adding, modifying the code to support the changes in the user specification. System maintenance conforms the system to its original requirements and enhancement adds to system capability by incorporating new requirements.

Thus, maintenance changes the existing system, enhancement adds features to the existing system, and development replaces the existing system. It is an important part of system development that includes the activities which corrects errors in system design and implementation, updates the documents, and tests the data.

Maintenance Types

System maintenance can be classified into three types –

- **Corrective Maintenance** – Enables user to carry out the repairing and correcting leftover problems.
- **Adaptive Maintenance** – Enables user to replace the functions of the programs.
- **Perfective Maintenance** – Enables user to modify or enhance the programs according to the users' requirements and changing needs.

Documentation Control

Documentation is a process of recording the information for any reference or operational purpose. It helps users, managers, and IT staff, who require it. It is important that prepared document must be updated on regular basis to trace the progress of the system easily.

After the implementation of system if the system is working improperly, then documentation helps the administrator to understand the flow of data in the system to correct the flaws and get the system working.

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

Advantages

- It can reduce system downtime, cut costs, and speed up maintenance tasks.
- It provides the clear description of formal flow of present system and helps to understand the type of input data and how the output can be produced.
- It provides effective and efficient way of communication between technical and nontechnical users about system.
- It facilitates the training of new user so that he can easily understand the flow of system.
- It helps the user to solve the problems such as troubleshooting and helps the manager to take better final decisions of the organization system.
- It provides better control to the internal or external working of the system.

Types of Documentations

When it comes to System Design, there are following four main documentations –

- Program documentation
- System documentation
- Operations documentation
- User documentation

Program Documentation

- It describes inputs, outputs, and processing logic for all the program modules.
- The program documentation process starts in the system analysis phase and continues during implementation.

- This documentation guides programmers, who construct modules that are well supported by internal and external comments and descriptions that can be understood and maintained easily.

Operations Documentation

Operations documentation contains all the information needed for processing and distributing online and printed output. Operations documentation should be clear, concise, and available online if possible.

It includes the following information –

- Program, systems analyst, programmer, and system identification.
- Scheduling information for printed output, such as report, execution frequency, and deadlines.
- Input files, their source, output files, and their destinations.
- E-mail and report distribution lists.
- Special forms required, including online forms.
- Error and informational messages to operators and restart procedures.
- Special instructions, such as security requirements.

User Documentation

It includes instructions and information to the users who will interact with the system. For example, user manuals, help guides, and tutorials. User documentation is valuable in training users and for reference purpose. It must be clear, understandable, and readily accessible to users at all levels.

The users, system owners, analysts, and programmers, all put combined efforts to develop a user's guide.

A user documentation should include –

- A system overview that clearly describes all major system features, capabilities, and limitations.
- Description of source document content, preparation, processing, and, samples.
- Overview of menu and data entry screen options, contents, and processing instructions.
- Examples of reports that are produced regularly or available at the user's request, including samples.
- Security and audit trail information.
- Explanation of responsibility for specific input, output, or processing requirements.
- Procedures for requesting changes and reporting problems.
- Examples of exceptions and error situations.
- Frequently asked questions (FAQs).
- Explanation of how to get help and procedures for updating the user manual.

System Documentation

System documentation serves as the technical specifications for the IS and how the objectives of the IS are accomplished. Users, managers and IS owners need never reference system documentation. System documentation provides the basis for understanding the technical aspects of the IS when modifications are made.

- It describes each program within the IS and the entire IS itself.
- It describes the system's functions, the way they are implemented, each program's purpose within the entire IS with respect to the order of execution, information passed to and from programs, and overall system flow.
- It includes data dictionary entries, data flow diagrams, object models, screen layouts, source documents, and the systems request that initiated the project.

- Most of the system documentation is prepared during the system analysis and system design phases.
- During systems implementation, an analyst must review system documentation to verify that it is complete, accurate, and up-to-date, and including any changes made during the implementation process.

Importance of documentation to system analysis

1. Introduction Documentation is one of the system's which are used to communicate, instruct and record the information for any reference or operational purpose. With the help of documentation it is very easy to track the flow of the system's progress and the workings of the system can be explained very easily.
2. It facilitates effective communication regarding the system between the technical and the non technical users.
3. It is very useful in training new users.
4. Documentation also helps the users to solve problems like trouble shooting
5. It plays a significant role in evaluation process.
6. It not only helps to exercise better control over the internal and external workings of the firm.
7. Documentations can help the manager to better quantify the financial ramifications/footprint of the system.
8. The basic importance of documentation is to help learn from the design, development, implementation and re-evaluation experience which is used to create a record as well as help in future evaluation or modification.
9. Documentation of processes helps in creating systematic information to articulate the intervention strategies and develop the flow chart of a system
10. Benefit is not only enjoyed by the system evaluated but also other similar projects and can use the outcome as a model in their formulation and implementation methods.
11. Documentation is also used by agencies undertaking new and complex forms as part of expansion of systems
12. Documentation is a much ignored but absolutely important part of every stage in the System Development Life Cycle of any system. A well written and organized documentation makes the work of future system user in any stage easier.