

# Unit 1: Foundations of Systems Development

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## 1.1 The Systems Development Environment

### \* System:

A system is a set of components that interact to accomplish some purpose. Ex: College system, Economic system, a Business & its parts - Marketing, Sales, Research, Shipping, Accounting, etc. A system contains various subsystems.

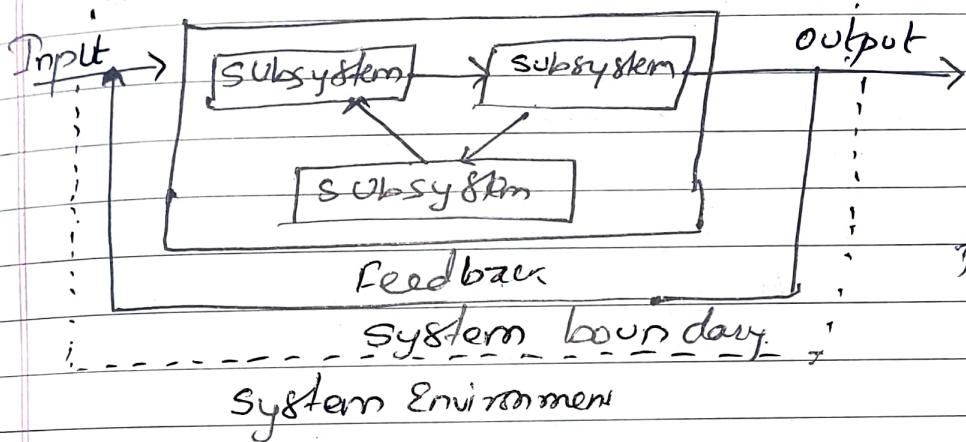
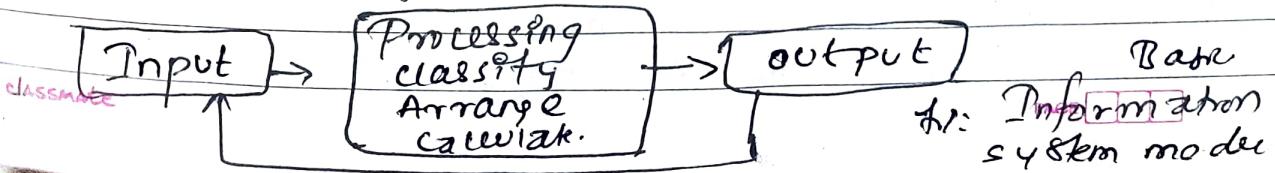


fig: Basic system model.

### \* Information system

- It is interrelated components working together to collect, process, store the information to support decision making, coordination control analysis & visualization in an organization.
- It is basically a system that provides information to people in an organization.
- It captures & manages data to produce useful information that supports an organization & its employees.

organizational information system



# Types of information processing system

## 1. Transaction Processing Systems (TPS<sub>s</sub>)

- A TPS is a type of information system that captures, stores, modifies and retrieves the data transactions of an organization.
- It is a computerized information system that captures and processes, that takes places within an organization every single transaction
- TPS play a vital role in an organization because managers look to the data generated by the TPS for up-to-the-minute information about what is happening in their company. It is essential to day-to-day operations of business that these systems function smoothly & without interruptions.

## 2. Management Information Systems (MIS)

- A MIS is an information system, used for decision-making and for the coordination, control, analysis, & visualization of information in an organization.
- The study of MIS involves people, processes & technology.
- MIS do not replace TPS; rather all MIS include TPS.
- It is also a computerized system. To access information, users of MIS share a common database. The database stores both data & models that help the user interact with, interpret & apply that.
- In corporates, the ultimate goal of the use of MIS is to increase the value & profits of the business.

### 3. Decision Support systems (DSS)

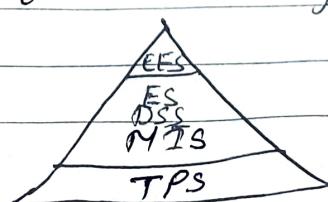
- It is an information system, used for improving the organization's decision-making capabilities.
- It analyzes large amounts of data & presents an organization with the best possible options available.
- DSS serve the management, operations & planning levels of an organization & help make decisions.
- DSS can be either fully computerized or human-powered, or a combination of both.

### 4. Executive Support system (ESS)

- ESS are the computerized information system that provide top managers with the ability to easily access to internal and external information such as new tax laws, summarized information from internal MIS & DSS & so on relevant to organizational goals for making strategic decisions.
- It is commonly considered to be a specialized form of DSS.

### 5. Expert systems (ES)

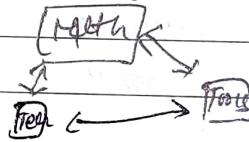
- Expert systems are a very special class of information systems that uses AI reasonings to solve problems in an organization.
- Expert systems effectively captures & uses the knowledge of a human expert or experts for solving a particular problem experienced in an organization.
- Unlike DSS, which leave the ultimate judgement to the decision maker, an ES selects the best sol'n to a problem.
- The basic components of ES are Knowledge base, Inference engine & the User interface.



# \* System analysis and design

- System analysis: process of gathering & interpreting facts, diagnosing problems, & using the facts to improve the system
- System design: process of planning a new system to replace or complement the old.

So, SAD is the systematic process to understand, analyze & design systems. In SAD, we use various methodologies, techniques & tools. Methodologies are the set of steps that will guide your work & influence your final product. Techniques are particular process that will help to ensure that the work is well thought-out & Tools are typically computer programs.



## \* Modern approach to SAD

- Computer based information system AD methodologies started growing during the year 1950 to 1960.
- Researchers argued that the software crisis was due to the lack of discipline of programmers.
- In 1986, No Silver Bullet article was published, that made people realize the need for developing software in structured manner.
- The new technologies & practices which were developed after 1970-1990 were primarily focused on solving the software crisis.
- The major elements used were software tools, formal methods, well defined processes that are methodologies like OOP, structured programming approaches.

# \* Developing Information Systems & The system development Life cycle (SDLC)

- When developing information systems, most organizations use a standard of steps called the SDLC as the common methodology for systems development. SDLC includes following phases

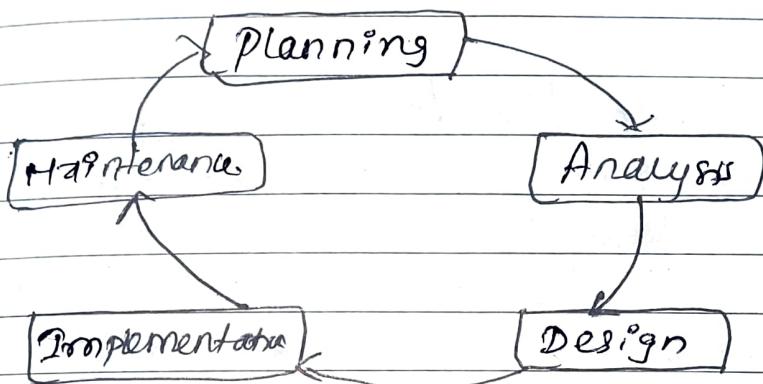


fig: SDLC.

Note: SDLC is a conceptual model.

The phases in SDLC are:-

## 1. Planning

- This phase is also known as feasibility study phase.
- We define a problem and scope of existing system.
- We overview the new system & determine its Objectives.
- We confirm feasibility of project & produce project schedule.
- A feasibility report for the entire project is created at the end of this phase.

## 2. Analysis

- Here we gather, analyze & validate the information.
- Define the requirements & prototypes of new system.
- Evaluate the alternatives & prioritize the requirement.
- Examine the information needs of end-user & enhances the system goal.

→ A Software Requirement Specification (SRS) document, which specifies the software, hardware, functional & network requirements of the system is prepared at the end of this phase.

### 3. Design.

- This phase includes the design of application, network, databases, user interfaces, and system interfaces.
- Here, we transform the SRS document into logical structure, which contains detailed & complete set of specifications that can be implemented in a program lang.
- Review the proposed design. Ensure that the final design must meet the requirements stated in SRS document.
- Finally, we prepare a design document which will be used during next phases.

### 4. Implementation

- Here, we implement the design into source code through coding.
- The information system is coded, tested, installed & supported in the organization.
- Programs & the entire system is tested to find & correct errors.
- A test report which contains errors is prepared through test plan information.
- We integrate the system into its environment & install the new system.

### 5. Maintenance / Support.

- Includes all the support such as phone support or physical on-site support for users.

- Information system is systematically repaired & improved
- It also includes handling the residual errors & resolve any issues that may exist in the system even after the testing phase.

## Products of SDLC phases.

Planning → Detailed steps, or work plan for project  
→ Assignment of team members & other resources  
→ Specification of system scope & planning on requirement & features.

Analysis → A size., explanation of alternate systems.

Design → Functional, detailed specs of all elements. (DB, UI...  
→ Technical Spec.

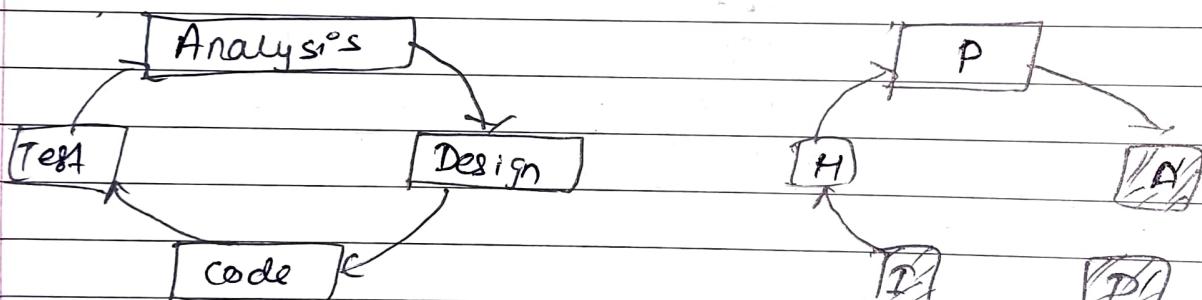
Implementation → Code, documentation, training procedures-

Maintenance → New versions or releases of software,  
with associated documentation of updates,  
training & support.

## \* The heart of the system Development Proc.

- The heart of system development process is analysis, design-implementation.
- After collecting the system requirements, they are thoroughly analyzed by the experts.
- After analyzing them properly, the design for implementation is done by keeping a stress on meeting the requirements.
- At next step, system design is implemented.

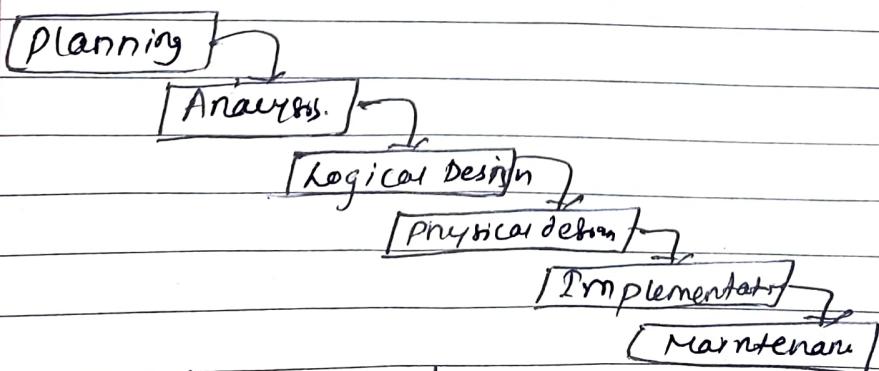
Current practice combines the analysis, design & implementation into a single process which is analysis-design-code-test process. These activities are the heart of system development as suggested in fig(2). This combination of activities is typical of current practices in Agile Methodologies.



fig(1) The analysis-design-code loop

fig(2) The heart of s-D.

## \* Traditional waterfall SDLC.



classmate fig: Traditional waterfall sde.

- Waterfall model is the linear sequential classic model of the SDLC. It is the oldest & most widely used approach for information systems development.
- Here, one phase begins when another completes.
- It emphasizes a logical progression of steps.

### • Application of waterfall model. (W.M is used when)

- Requirements are very well documented, clear & fixed.
- Product definition is stable.
- Technology is understood & isn't dynamic.
- There is no ambiguous requirement.
- Project is short.
- All resources are available & trained.

### • Advantages:

- Simple & easy to understand & use.
- Phases are processed & completed one at a time.
- Works well for smaller projects where requirements are very well understood.
- Clearly defined stages.
- Easy to arrange tasks & process & results are well documented.

### • Disadvantages:

- Doesn't allow for much reflection or revision.
- Once an application is in the testing phase, it is very difficult to go back & change something that was not well documented in the concept stage.
- High amounts of risk & uncertainty.
- Cannot work with changing requirements.
- Difficult to measure progress within stages.
- No working software is produced until late in the life cycle.

## \* CASE Tools

Computer-aided Systems engineering (CASE), also called Computer aided software engineering, is a technique that uses powerful software, called (CASE tool), to help system analysts develop & maintain information systems.

They support a wide variety of design methodologies, including structured analysis & object-oriented analysis. They boost IT productivity & support a wide variety of improving the quality of the finished product. They are basically the automated software packages that help to automate activities in SDLC.

### Types / Examples :-

- Diagram tools:- helps in diagrammatic & graphical representations of the data and system processes. Ex. Flow Chart maker tool.
- Computer display & report generator:- Helps in understanding the data requirements & the relationships involved.
- Analysis tools:- helps in collecting requirements; automatically check for any irregularity, imprecision in the diagram, data redundancies, etc.
- Documentation generators:- helps in generating user & technical documentation as per standards.
- Code generator:- helps in auto generation of code, with the help of designs, documents & diagrams.

Advantages

- servicing cost of product is reduced.
- quality of product is improved.

Disadvantages -

- Purchasing tools isn't easy.
- Learning to use isn't easy.

## 1.2 Other approaches / methodologies :

### 1. Prototyping

- Prototyping is a form of Rapid Application Development.
- Instead of spending a lot of time producing very detailed specifications, the developers find out generally what the users want.
- The developers do not want to develop the complete system all at once. Instead they quickly create a prototype, which either contains some portions of the system or is a small scale working model of the entire system.
- After reviewing the prototype with the users, the developer refine & extend it. This process is continued until final specification.

#### Phases:

- a) Requirements gathering:- The user is interviewed in order to know the requirements of the system.
- b) Quick design:- When requirements are known, a simple design of the system is created. However, it is not a complete design. It gives the brief idea of the system to user & helps in developing prototype.
- c) Build prototype:- Information gathered from quick design is used to design an actual prototype.
- d) Initial user evaluation:- The proposed system is presented to the client for an initial evaluation. It helps to find out strengths & weaknesses of the model. Comments & suggestions are collected from user.

## e) Refining prototype:-

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- If the user is not satisfied with the prototype, you need to refine the prototype according to the user's suggestions.

- f) Engineer product :- Once the requirements are completely met, the user accepts the final prototype. Once the final system is developed based on final prototype, it is thoroughly tested and deployed to production.

4 types of prototyping models -

- Rapid Throw away Prototype
- Evolutionary prototype
- Incremental prototype
- Extreme prototype

### Advantages

- Customers get to see the partial product early in the life cycle. This ensures a greater level of user satisfaction.
- New Requirements can be easily accommodated.
- Errors can be detected much earlier.
- There will be hardly any chance of software rejection.
- Prototypes can be changed & even discarded. (there is flexibility in design)

### Disadvantages

- It is slow & time taking process.
- It may encourage excessive change requests.
- Poor documentation because the requirements of the customers are changing.
- Customers may get confused in prototypes & real systems.
- May become difficult for developer to accommodate all the changes demanded by the client.

## 2. Spiral Approach.

- It is one of the most important SDLC models, which provides support for risk handling.
- It is the combination of waterfall model & iterative model.
- Each phase of spiral model begins with a design goal and ends with the client reviewing the progress.

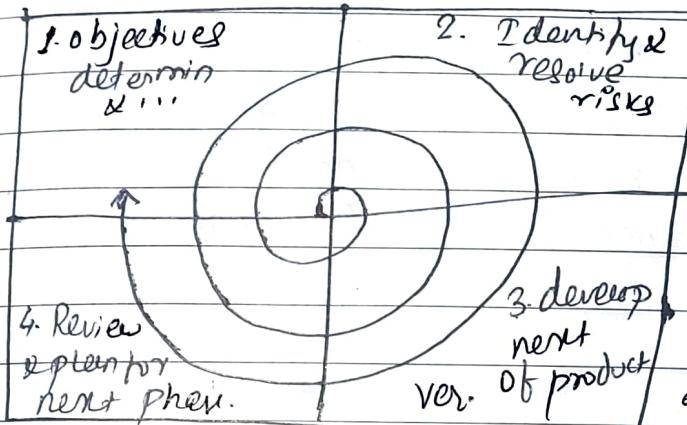


fig: Different phases in spiral model.

The exact no. of phases needed to develop the product depends upon the project manager. So, project manager has imp role to develop a product using spiral model. Each phase is divided into 4 quadrants:

- a) Objectives determination & identify alternative solutions  
→ Requirements are gathered from the customers & the objectives are identified & analyzed. Then alternative solutions possible for the phase are proposed.
- b) Identify & resolve risks ⇒ The risks associated with the software are identified & the risks are resolved using best possible strategy.
- c) Develop next version of product ⇒ The identified features are developed & verified through testing.
- d) Review & plan for the next phase ⇒ The customers evaluate the so far developed version of the software.

## Advantages

- Additional functionality or changes can be done at a later stage.
- Development is fast & features are added in systematic way.
  - Software is produced early in software life cycle
  - High amount of risk analysis.

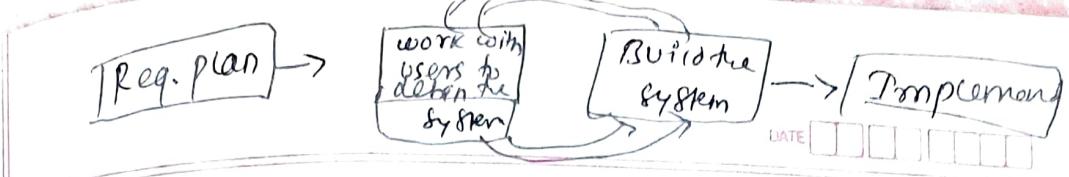
## Disadvantages

- Can be a costly model to use.
- Doesn't work well for smaller projects.
- Project's success is highly dependent on the risk analysis plan.
- Documentation is more as it has intermediate phases.

3.

## Rapid Application Development approach

- This model was proposed by IBM in the 1980s. It is an Object-oriented approach to systems development that includes a method of development as well as software tool.
- A software project can be implemented using this model if the project can be broken down into small modules where in each module can be assigned independently to separate teams. These modules can finally be combined to form a final product.
- Development of each module involves the various basic steps as in waterfall model i.e. analysing, designing, coding & then testing.



## Phases.

Requirements planning phase.

- a) Requirements Gathering  
→ Here, users and analysts meet to identify objectives of the application or system. It requires intense involvement from both groups. It may involve users from different levels of the organization. We may be working with CEO as well as strategic planners.

### b) RAD design Workshop.

- It is a design & refine phase that can be best categorized as a workshop. Here, the users respond to actual working prototypes & analysts refined the prototypes based on the [users response] [on repetition]

### c) Implementation Phase

- c) Implementation Phase  
→ Analysts work with users to design the business & non technical aspects of the system. As soon as these aspects are agreed on, the systems are built & refined & implemented.

## Advantages

- Advantages:

  - Changing requirements can be easily accommodated.
  - Progress can be measured.
  - Productivity with fewer people in short time.
  - Reduced development time
  - Increases reusability of components

## Disadvantages

- Disadvantages
  - Dependency on technically strong team member for identifying business requirements.
  - Requires highly skilled developers
  - Inapplicable to cheaper projects.

Agile → able to move quickly & easily.

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## 4. AGILE Development Approach

- The Agile software development model was mainly intended for helping developers build a project which can adapt into transforming requests quickly. So, it helps in easy and rapid project achievement.
- This helps to develop a system that need an agile adaptation to any sort of changes. Instead of focusing on detailed development process, agile development sets its focus on developer, existing software, customer, changing requirements.

### Phases | development process

- a) Exploration → Here, you explore the environment, assemble the team & evaluate the team members' skills. Here, we practice estimating the time needed for variety of tasks. This is all to be prepared for agile attitude towards environment, its problems, technologies & people. It may take few weeks to months.
- b) Planning → In contrast to the 1st phase, planning may only take a few days to accomplish. Here, you & your customers agree on a date anywhere from 2 months to half a year from a current date to deliver solutions to their business problem.
- c) Iterating to the 1st release → In this stage, typically the iterations (cycles of testing, feedback & change) take about 3 weeks. Here, we will sketch out the entire architecture of the system, even though it is outline or skeleton form.
- d) Productionizing → The product is released in this phase but may be improved by adding other features.

e) Maintenance : Once the system has been released, it needs to be kept running smoothly. New features may be added, riskier customer suggestions may be considered.

### Advantages

- Fewer errors
- Reduces total development time of whole project.
- Easy to change or add requirement if needed.

### Disadvantages

- Due to the lack of formal documents, it creates confusion.
- Due to the lack of proper documentation, maintenance of the developed project can become a problem.

# 1.3 Managing the Information System Project

i.e. Project management

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## \* Project Management

- Project management is the process of planning and controlling the development of a system within a specified timeframe at minimum cost with the required functionality.
- It is a continued process of initiating, planning, executing, monitoring and controlling & closing project. It is an important aspect of the development of information systems.
- A project manager has the primary responsibility for managing the hundreds of tasks & roles that need to be carefully coordinated.

### Phases of project management :-

- Initiating : During this phase, the project is conceptualized and feasibility is determined. Activities like defining the project scope, identifying the project manager, identifying potential risks are performed.
- Planning : Next, the project manager will create a blueprint to guide the entire project. The blueprint will map out the project's scope, resources required to create deliverables, estimated time, execution plan etc.
- Executing : The project manager will oversee the work on the project while maintaining good relationships with all team members & keeping the entire project on time & on ~~page~~ budget.

- Monitoring & Control: In this phase, the project manager will closely monitor the progress of the project to ensure it's developing properly. It's closely related to project planning. While planning determines what is to be done, monitoring & controlling establish how well it is done.
- Closing: Here, the project manager will close contracts with suppliers, external vendors, consultants & other third-party providers. All documentation will be archived and a final project report will be produced.

## X Managing the Information System project.

### 1) Shaping a Project

- A successful project must be completed on time with budget & deliver a quality product that satisfies users & meet requirements.
- Project management techniques can be used throughout the SDLC & maintain balance between constraints, & interactive elements such as project cost, scope, & time.

### 2) Project Triangle.

- Fig represents the 3 legs of project management, Cost, scope & time. The challenge is to find the optimal balance among these factors. Any change in one of the factors will affect other 2 factors.



fig: project triangle.

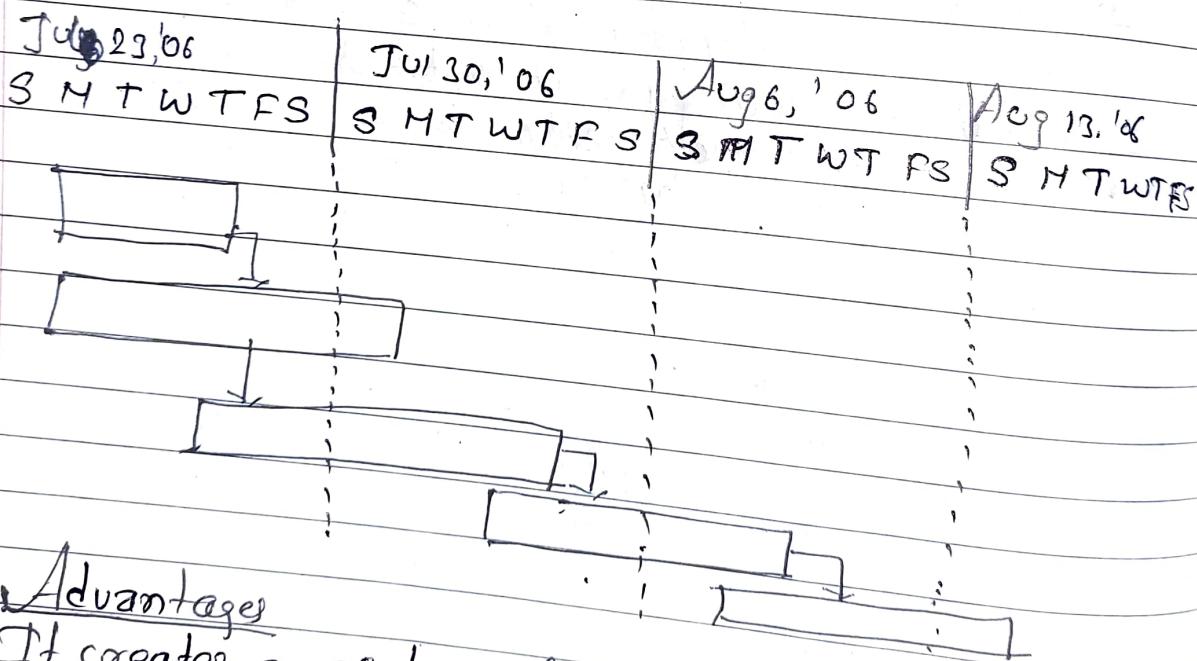
### 3) Project manager.

- A project manager has the primary responsibility for managing the hundreds of tasks & roles that need to be carefully coordinated. Creating a successful project requires managing the resources, activities, & tasks needed to complete the information system project.

# X Representing and scheduling project plans.

## I. Gantt charts:

- Gantt Chart is a graphical representation of a project that shows each task activity as a horizontal bar which is proportion to its time for completion.
- It is the most commonly used method for graphical reports and it is useful for simple projects or subparts of a larger project.
- It is also used for monitoring the progress of activities. They do not show how tasks must be ordered but simply show when it should end.



### Advantages

- It creates a picture of complexity.
- It helps you to set realistic time frames.
- It can be highly visible.
- Deadlines are depicted in the chart.

### Disadvantages

- classmate  
need to be constantly updated.
- It can become very complex
  - Size of bar doesn't indicate amount of work

## 2. Network Diagrams:

- It is a graphical representation of a project that shows how each activity relates to others in the project.
- The project manager can track each element of project & report progress to stakeholders with the help of N.D
- It shows the ordering of activities by connecting a task to its predecessor & successor tasks.

### Grant Charts vs. Network diagrams:

#### Grantt charts

**Definition:** It is a graphical representation that shows each task activity with their corresponding start & finish date.

**Tasks:** Visual representation of duration of tasks

**Depict:** Time overlap between tasks

**Slack time:** Visually shows slack time.

**Category:**

Bar chart

N.D =>



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#### Network Diagrams

It is a schematic display of logical relationships among project activities.

Visual representation of dependencies between tasks

Tasks can be done in parallel.

Shows slack time by using rectangles filled by data.

Flow chart



### 3. Representing Project Plans:

- Project scheduling and management requires time, costs & resources to be controlled.
- Resources are any person, group of people, piece of equipment or material used in accomplishing an activity.
- Network diagram is a critical path scheduling technique used for controlling resources.
- A critical path refers to a sequence of task activities whose order & durations directly affect the completion date of a project.
- A network diagram is most often used than Gantt Charts due to its ability to represent how completion time vary for activities.
- Network diagrams are composed of circles & rectangles representing activities and connecting arrows showing req'd work as flow.

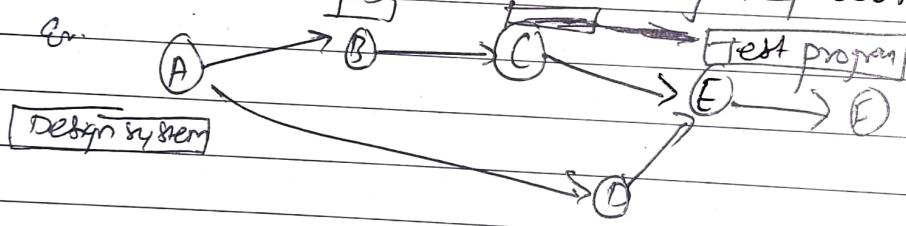


Fig: Network Diagram

4.

- Calculating Expected Time duration Using PERT
- PERT (Program Evaluation Review Technique) is a technique that uses optimistic, pessimistic, & realistic time estimates to calculate the expected time for a particular task. This technique helps us to obtain a better time estimate when we are uncertain as to how much time a task will require to be completed.

$$ET = \frac{O + 4R + P}{6}$$

where, ET = Expected time computation for an activity

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P=pessimistic // // //

O= optimistic time // // PAGE

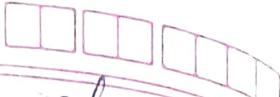
R=realistic time // //

## X Using Project Management Software.

- A wide variety of project management tools is available to help to manage a development project.
- Most of the available tools have a set of common features that include the ability to define & order tasks, assign resources to tasks, & easily modify tasks & resources.
- These tools are available to run on Windows, MAC, etc.
- Some of the popular project management software sites are:- MeisterTask, Basecamp, Teamwork Projects, Zoho projects, Trello, etc.
- Most programs offer features such as Gantt Charts, resource scheduling, project calendars, cost tracking, PERT/CPM, etc.

## Questions-asked

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- Q. What is SDLC? Explain each phase of SDLC in detail. (2078-10 marks)
- Q. What is System analysis & design? Why is it imp. for developing information systems? (2078-5 marks)
- Q. Why do we need CASE tool during system development? What are different components of CASE tool? (2078-5 marks)
- Q. Short note on: Agile development (2.5)
- Q. What is waterfall model? Explain Prototyping model for developing information systems along with merits & demerits (2076(new)- 10 marks)
- Q. What is rapid application development? Explain (2076(new)- 5 marks)
- Q. Explain modern approaches to SAD. (2076(new)-5 marks)
- Q. Short note on: Spiral model. (2.5 marks) (2076(new))
- Q. What is project management? Explain some activities & skills of project manager: (2078 - 5 marks)